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DEVELOPING COUNTRY BORROWING AND DOMESTIC WEALTH

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ABSTRACT

We show that across developing countries, external debt to private creditors rises more than proportionately with income. We then develop a simple theoretical model consistent with this phenomenon and also consistent with the well-documented relationship between capital market development and growth. Our framework stresses information asymmetries at the level of individual borrowers as the source of frictions in world capital markets. Because of moral hazard problems, marginal products of capital and borrowing-lending spreads are higher in poorer countries. In a two-country version of the model, we demonstrate the possibility of a "siphoning effect" which exacerbates the costs of transfers. Also because of the siphoning effect, increased wealth in the rich country can stunt investment in the poor country.

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I. Introduction

The standard neoclassical model of trade and growth predicts that rich-country savers will lend to investors in high-marginal-product-of-capital poor countries. After the deregulation of international capital markets in the 1960s, the 1970s indeed witnessed a broad expansion of lending from industrialized countries to the developing world. However, for certain features of the data, the standard model does not seem to provide the simplest explanation. For example, during the 1970s "middle income" developing countries were able to borrow more per capita than poorer countries. Using data from 1980 for a cross-section of seventy countries, we show that for each percentage point increase in per capita income, per capita external debt to private creditors tends to rise significantly more than one percent. Moreover, this relation between external debt and national income tends to hold across countries within the same region (Africa, Asia, and Latin America).

Our aim is to provide a natural explanation of this evidence which is also consistent with the well-documented positive relationship between capital market development and growth [Goldsmith (1969) and Mckinnon (1973)]. The framework here stresses asymmetric information at the level of individual borrowers as a source of (endogenously-derived) frictions in world capital markets.[1] A positive relation between external borrowing and the state of development can emerge because in wealthier countries firms are better capitalized. Informational problems consequently have less impact, resulting

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[1]Our analysis draws on recent developments in the closed-economy literature on interactions between the real and financial sectors; see Gertler (1988) for a survey. To abstract from sovereign risk, we assume that there is a supranational legal authority, capable of enforcing contracts across borders. Hence our analysis is really as much a model of capital flows between Manhattan and the Bronx as between Japan and India.

in a lower cost difference between internal (to a firm) finance and external finance.

Thus even in a world of perfectly integrated capital markets, in which riskless rates are equalized, marginal products of capital can differ across nations. An important empirical implication is that the spread between borrowing and lending rates should be larger in poorer countries, which most development economists take as a stylized fact.

Section II of the paper presents some simple correlations between national income and borrowing. A small-country model is presented in section III and a two-country general equilibrium version is given in section IV. The two-country model yields an interesting new perspective on the classic transfer problem: The cost to a country of repaying a debt may exceed the face value of the debt, since the decline in wealth exacerbates the information-induced loan market inefficiencies. Also, a rise in capital market efficiency in the rich country can lead to a "siphoning" of investment funds from the poor country. In the conclusions, we discuss some possible alternative explanations for the positive relation between capital inflows and domestic wealth.

II. External Debt and GNP for Developing Countries

In Table 1, we present 1980 data on income and external borrowing for seventy developing countries, listed in order of GNP per capita. The second column lists external debts owed to private lenders; the third column also includes debts owed to other governments and to multilateral credit agencies (e.g., the International Monetary Fund and the World Bank). A casual comparison of column one with either column two or three indicates a strong correlation between GNP and external borrowing. Table 2 contains two sets of

TABLE 1

Measures of External Borrowing Versus GNP: 1980

DOLLARS PER CAPITA

	GNP	*External Debt to Private Lenders*	*Total External Debt*
Ethiopia	107	3	21
Uganda	131	16	56
Nepal	142	0	15
Bangladesh	144	3	45
Chad	162	14	49
Burma	171	9	45
Malawi	190	51	136
Burundi	222	5	40
Rwanda	226	6	37
Mali	231	8	101
Burkina Faso	234	9	54
India	256	3	29
Sri Lanka	271	25	125
Tanzania	276	46	138
Pakistan	283	16	120
Haiti	289	7	60
Sierra Leone	321	51	131
Benin	331	69	120
Cen. Afr. Rep.	343	30	82
Sudan	358	78	268
Somalia	361	13	191
Madagascar	370	68	144
Zaire	380	71	183
Ghana	384	24	114
Kenya	412	117	210
Mauritania	412	122	511
Togo	435	208	408
Niger	471	111	163
Lesotho	481	14	53
Senegal	504	106	225
Yemen A.R.	508	17	165
Indonesia	511	78	143
Egypt	514	149	470
Bolivia	516	263	482
Liberia	591	131	383
Zambia	617	226	558
Honduras	648	201	400
Thailand	686	124	178
Philippines	729	284	360
El Salvador	780	87	202
Cameroon	803	150	296
Papua New Gui.	831	169	243
Morocco	859	240	483
Botswana	1028	11	190
Congo	1036	663	1096

TABLE 1 (Continued)

Dominican Rep.	1096	212	368
Jordan	1122	259	601
Guatemala	1128	91	168
Peru	1139	373	578
Jamaica	1157	318	885
Cote D'Ivoire	1206	557	703
Nigeria	1236	98	110
Turkey	1256	190	428
Columbia	1285	176	268
Tunisia	1332	243	554
Ecuador	1373	577	739
Paraguay	1467	174	304
Syria	1518	111	315
Korea	1584	414	773
Panama	1754	1235	1565
Brazil	1912	525	582
Argentina	1987	894	962
Costa Rica	2044	846	1216
Algeria	2203	851	1001
Chile	2391	951	1084
Portugal	2431	750	982
Mexico	2726	763	828
Uruguay	3448	235	570
Gabon	3584	1108	1462
Venezuala	3961	1929	1963

Sources: *World Bank, World Debt Tables: External Debt of Developing Countries, Vol. II, 1988-89 ed., and International Monetary Fund, International Financial Statistics.*

Notes: *Total external debt includes public and publicly guaranteed long-term debt, private non-guaranteed long-term debt, IMF credit, and short-term debt. External debt to private lenders includes long-term public and publicly guaranteed debt to private creditors, long-term private non-guaranteed debt, and short-term debt. All of the World Bank's list of developing countries are included above, except those with 1986 populations under one million and/or GNP per capita over $3,000. Communist countries are also excluded; Bhutan, Lebanon, Guinea, Zimbawe Malaysia are excluded due to insufficient data.*

TABLE 2

OLS Regressions of Debt/Capita on GNP/Capita for Developing Countries: 1980

log Total External Debt per Capita	*Constant*	*log GNP per Capita*	*# Observations*	R^2
All countries	-1.29	1.05 (.08)	68	.73
Sub-Saharan Africa	-1.40	1.08 (.16)	30	.60
Latin America and Caribbean	-.78	.97 (.21)	19	.56
Asia	-2.36	1.20 (.19)	10	.83

log External Debt to Private Lenders per Capita	*Constant*	*log GNP per Capita*	*# Observations*	R^2
All Countries	-5.84	1.60 (.12)	68	.73
Sub-Saharan Africa	-5.20	1.51 (.25)	30	.55
Latin America and Caribbean	-5.16	1.51 (.29)	19	.62
Asia	-9.77	2.22 (.30)	10	.87

Africa: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote D'Ivoire, Ethiopia, Ghana, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Tanzania, Togo, Uganda, Zaire, Zambia.

Latin America and the Caribbean: Argentina, Bolivia, Brazil, Chile, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Uruguay, Venezuela.

Asia: Bangladesh, Burma, India, Indonesia, Korea, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand.

Other: Algeria, Egypt, Jordan, Morocco, Portugal, Syria, Tunisia, Turkey, Yemen Arab Republic.

regressions, both using the log of GNP per capita as the explanatory variable. In the first, the dependent variable is the log of total external debt per capita. Over the entire sample [2], the coefficient on GNP was 1.05, with a standard error of .08. Separate regressions for Asia, Africa, and Latin America yield similar results.

One problem with using total external debt to measure country borrowing is that the component consisting of official (public) debt is probably best viewed as foreign aid. Whereas most official debt is senior in principle, it is junior to private debt in practice. Though technically, developing-country debtors have promptly repaid official debt, in most cases official creditors have made new loans in excess of any principal and interest repayments due. [See Bulow and Rogoff (1988)].

In the second set of regressions reported in Table 2, the dependent variable includes only external debt owed to private creditors. Note that the coefficients are always larger than one and the difference is significant over the full sample.[3] Again, this simple relation explains a very large share of the variation in external borrowing across countries, and the coefficients are relatively stable across regimes.[4]

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[2] Nepal, which had zero private debt per capita, had to be excluded when the regressions were run in logs. Because it is poor, Nepal's exclusion biases the estimated coefficients downwards.

[3] The results are quite robust to excluding trade credits and/or short term debt from the regressions. However, when "Micronesian" countries with populations under one million are included, the coefficients become smaller and the standard errors larger.

[4] We also ran a regression that included the growth rate of per capita GNP from 1980 to 1986 as a proxy for expected productivity change. The variable, however, was unimportant. One can also interpret the regional regressions as a crude attempt to control for differences in expected productivity across countries - the idea being that, while technology may differ between Brazil and Nigeria, it is less likely to significantly differ between Brazil and Argentina. Obviously, it would be desirable to explore the dynamics of the

We chose the year 1980 because after the debt crisis began in 1982, the correspondence between book value and the market value of loans becomes much weaker.[5] There did not exist a secondary market for bank loans as of 1980, but most of the private loans were indexed to short-term interest rates. Thus any capital gains or losses would mainly have to involve sovereign risk. The fact that most debtor nations were still receiving new funds in 1980 suggests that expectations of default were still quite low. Almost all sovereign debt to private creditors is of equal priority (for a rationale see Bulow and Rogoff (1988)), so countries can generally only get new loans only if their old loans are valued near par.[6]

III. A Small-Country Model with Agency Costs of Investment

Our goal throughout is to provide the simplest possible model capable of illustrating our main points. Before turning to the two-country case, we first develop and analyze a small country framework. We consider an open economy inhabited by a large number of identical individuals; the economy is small in the sense that it cannot affect the world interest rate. There are two periods and one good. The representative individual is risk neutral and cares only about consuming in period two:

$$U(c) = c, \qquad (1)$$

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external debt-GNP relation more fully, but unfortunately short-term debt data for years prior to 1980 is suspect.

[5]However, the appendix presents similar regressions for the 1986 data, with similar results.

[6]Our results do not include direct investment, since including this would not be in the spirit of the asymmetric information model of section III. However, we note that for within Africa and Asia, direct investment was small relative to debt. For South America, it was somewhat larger, though still small relative to debt.

where c is her second-period consumption.

Entering period one, each person is endowed with W units of the consumption good.[7] There exist two ways to convert this endowment into final period consumption. The first option is to lend abroad at the (gross) world riskless interest rate r; the alternative is to invest in a risky technology. In particular, each person in the country has a project. All projects are identical ex ante, and yield ex post returns as follows: k units invested in period one yield θ units of second-period output with probability $\pi(k)$, and zero units with probability $1 - \pi(k)$. That is,

$$y = \begin{cases} \theta \text{ with probability } \pi(k) \\ 0 \quad \text{"} \qquad \text{"} \qquad 1 - \pi(k) \end{cases} \tag{2}$$

where y is second-period output. The function $\pi(\cdot)$ is increasing, strictly concave and twice continuously differentiable, with $\pi(0) = 0$, $\pi(\infty) = 1$, and $r/\theta < \pi'(0) < \infty$.[8] Thus, investment raises the probability that the individual's project will yield a high level of output, and the marginal expected return to investment is diminishing.[9] We assume that output realizations are independent across the projects of different individuals.

If an individual wants to invest more than her endowment in her project,

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[7]W can include any future income which is collateralizable. The distinction between current and future endowment is not important here. It is important in the two-country case since the world equilibrium will depend on the total supply of current endowment; see below.

[8]$\pi'(0) > r/\theta$ is needed to guarantee that it is optimal to invest under perfect information. It is not essential that $\pi'(0)$ be finite, but introducing this restriction makes the exposition a bit simpler.

[9]It is easy to generalize the results to a technology with a large set of possible output realizations. We choose the two-point distribution for ease of exposition.

then she must raise funds from the world capital market; that is,

$$W + b \geq k \tag{3}$$

where b is the amount she borrows. In return for this amount, she issues a state-contingent security which pays Z^g in the event the project yields the good outcome, and Z^b in the event of the bad outcome. The security must offer lenders the market rate of return r, so that[10]

$$\pi(k)Z^g + [1 - \pi(k)]Z^b = rb \tag{4}$$

The left-hand side of (4) is the expected payment to lenders.

The individual's expected second period consumption is given by

$$E\{c\} = \pi(k)[\theta - Z^g] - [1 - \pi(k)]Z^b + r[W + b - k] \tag{5}$$

where the last term is the individual's return from risk-free investments abroad, and the first two terms represent the expected net return on her project.

The information structure is as follows: Lenders may observe a borrower's initial wealth and the total amount she borrows. What the borrower does with the funds, however, is her private knowledge. In particular, she may secretly lend abroad rather than invest in her project. Whereas investment is unobservable, lenders can freely observe realized output. The production function $\pi(\cdot)$ is common knowledge.

If there were no information asymmetries, the individual would invest to the point where the expected marginal project return equals the world interest rate. Let k^* denote this first-best level of investment; thus

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[10]It is not necessary to assume that lenders are risk neutral, but only that idiosyncratic project risk be diversifiable in world capital markets.

$$\pi'(k^*)\theta = r \tag{6}$$

Under asymmetric information, however, it is not generally possible to implement the first best allocation because the borrower's choice of investment k is not verifiable.[11] Contracts can be conditioned only on realized output y, and not on k. Given any output-contingent payoffs (Z^g, Z^b) specified by the contract, the borrower will pick k to maximize her expected consumption, given by (5). Thus she will equate her expected marginal gain from investing with her opportunity cost of (secretly) holding assets abroad[12]

$$\pi'(k)[\theta - (Z^g - Z^b)] = r \tag{7}$$

So long as Z^g differs from Z^b, k will differ from its first-best optimum value k^*, given by (6). The problem is that the borrower's marginal benefit from investing depends not only on the marginal gain in expected output, but on the change in her expected obligation to lenders, as well. We will subsequently refer to (7) as the "incentive constraint."

If the borrower could promise lenders a fixed payment $Z^g = Z^b = r(k^* - W)$ then [by (7)] she would invest the first best amount k^*. This is not feasible, however, since the project yields nothing in the bad state. Since the borrower's consumption must be non-negative, an important constraint on the form of the contract is

$$Z^b \leq 0 \tag{8}$$

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[11]The incentive problem emerging here is classified as moral hazard because the informational asymmetry arises after contracting. See Dixit (1987) for an application to international trade.

[12]The analysis would be qualitatively similar if the borrower had the option of secretly consuming in period one instead of secretly lending abroad.

For the case where $W < k^*$ the optimal incentive compatible contract is found by choosing Z^g, Z^b, *b*, and k to maximize (5) subject to (3), (4), (7) and (8). The solution is as follows[13]: The contract pays lenders zero in the bad state, so that (8) is binding. (More generally, the contract always pays lenders the maximum feasible amount in the bad state.) This serves to minimize the spread between Z^g and Z^b, thereby minimizing the difference between the borrower's decision rule for k [eq. (7)] and the socially efficient rule [eq. (6)].[14] Similarly, equation (3) is binding; $W + b = k$. Thus, *in equilibrium*, the borrower does not secretly lend abroad. Borrowing more than is essential to finance k would raise the gap between Z^g and Z^b.

Since (3) and (5) hold with equality for the information-constrained case, one can use these equations to eliminate *b* and Z^b from (4) and (7). The result is the following two equations, which determine k and Z^g:

$$\pi'(k)[\theta - Z^g] = r, \qquad \text{IC curve} \tag{9}$$

$$Z^g = r(k - W)/\pi(k) \qquad \text{MR curve} \tag{10}$$

Equation (9) is the incentive constraint, and is drawn as the curve IC in Figure 1. It is downward sloping. A rise in Z^g lowers the borrower's expected marginal gain from investing and therefore must be offset by a decline in k. The curve intersects the vertical axis at a value of Z^g which lies between zero and θ (recall that $r/\theta < \pi'(0) < \infty$). It intersects the horizontal axis at k^* since eq. (9) resembles eq. (6) when Z^g equals zero. Equation (10) is the constraint that lenders must receive the market rate of

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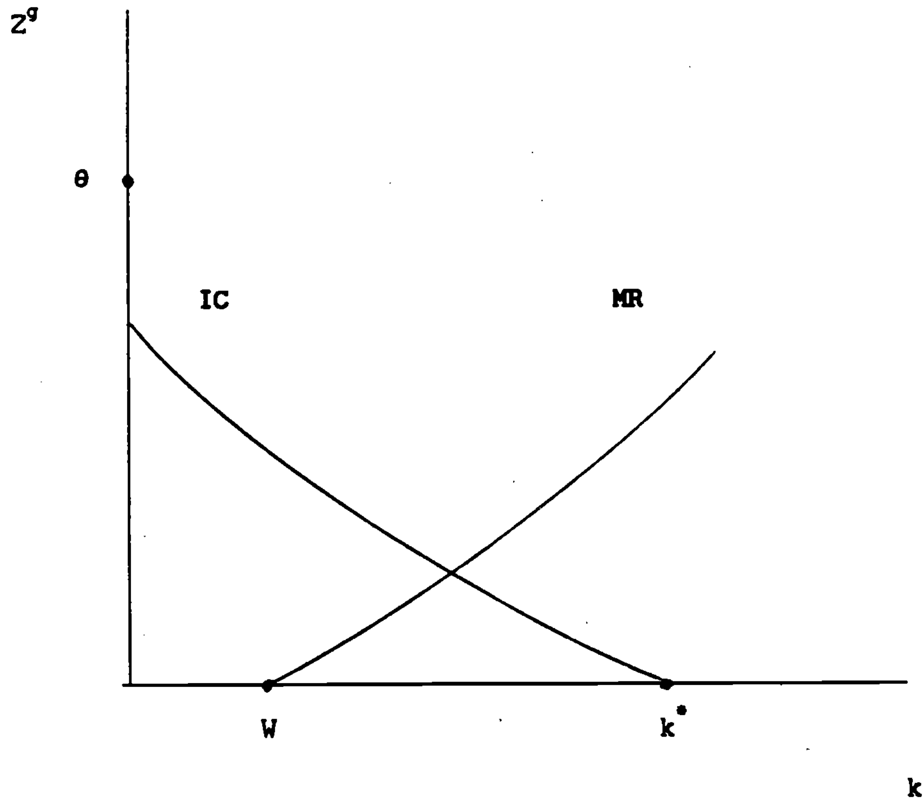
[13]See the Appendix for details.

[14]The idea that informational asymmetries can affect an individual firm's investment strategies and financial structure originated with Jensen and Meckling (1976).

Figure 1

EQUILIBRIUM IN THE SMALL COUNTRY CASE



return, and is labeled as the MR curve. It is upward sloping.[15] When k rises, borrowing goes up; this means Z^g must rise since Z^b cannot adjust. The curve intersects the horizontal axis at k equal to W. It lies above the horizontal axis at k^* since $k^* > W$.

Investment in the information-constrained case must be below its first best value k^*. The result that $k < k^*$ follows immediately from a comparison of (6) and (9), as well as from inspection of Figure 1. If k is below k^*, then ex post per capita output, $\theta\pi(k)$, must lie below its first best value, $\theta\pi(k^*)$.[16] An implication is that both per capita investment and per capita output will depend on per capita wealth. A rise in W shifts the MR curve downward in Figure 1 and leaves the IC curve unchanged, thereby raising k and lowering Z^g.[17] Additional wealth increases the amount of internal funds available to the borrower; so for a given level of investment, Z^g declines, mitigating the incentive problem. Investment rises, in accordance with eq. (9), thus raising output as well.[18]

Now consider the link between external borrowing and country wealth.

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[15]The slope of the MR curve equals $[r/\pi(k)][1 - \phi(k)(1 - W/k)]$; where $\phi(k)$ is the ratio of the marginal product of capital to the average product, given by $\pi'(k)/(\pi(k)/k)$. Since $0 < \phi(k) < 1$ and since $W < k$ along the MR curve, the slope must be positive.

[16]Because the productivity risks are independent across investment projects, and because the number of projects is large, there is no aggregate risk.

[17]The result that increases in borrower net worth stimulate investment when informational problems are present is quite general; see Bernanke and Gertler (1989). For some empirical support, see Fazzari, Hubbard and Petersen (1988).

[18]The effect of a change in W on k is given by

$$\frac{\partial k}{\partial W} = \pi'(k)Z_3^g/[(\pi''(k)/\pi'(k))r - \pi'(k)Z_2^g] > 0$$

where $Z^g(r,k,W) = r(k - W)/\pi(k)$, so that $Z_2^g > 0$ and $Z_3^g < 0$.

Let x denote per capita borrowing from abroad, equal in this case to k - W. Then, from differentiating eqs. (9) and (10), one obtains

$$\frac{dx}{dW} = \left[1 - \phi(k)(1-W/k) - \frac{\pi''(k)\pi(k)}{\pi'(k)^2}\right]^{-1} - 1 \qquad (11)$$

where,

$$0 < \phi(k) = \pi'(k)/[\pi(k)/k] < 1$$

External borrowing will rise with W if a dollar increase in wealth induces more than a dollar increase in investment. This will be the case if diminishing returns set in slowly, i.e., $\pi''(k)$ is small relative to $\pi'(k)$. (Inspection of eq. (11) indicates that the magnitude of $\frac{\partial x}{\partial W}$ varies inversely with the absolute value of $\pi''(k)/\pi'(k)$.) Thus, to the extent that per capita GNP can be considered a proxy for per-capita wealth, the framework is capable of explaining the positive relation between external borrowing and output for developing countries, documented in section II. The informational problem is of course key to the result; when the incentive constraint is not binding, external borrowing simply <u>declines</u> a dollar for each dollar increase in wealth; this occurs since investment is no longer influenced by changes in W.

A corresponding result is that the spread between the marginal product of capital and the world riskless interest rate will vary across countries, and will in particular be larger the poorer the country. Note that cross-country differences in marginal products of capital may arise here even though the world capital market is perfectly integrated (the riskless rate is the same everywhere).[19]

Finally, consider how changes in the world interest rate influence

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[19] Thus our model is completely consistent with Frankel and MacArthur's (1988) finding that covered interest differentials are relatively small for many LDCs.

investment. As r goes up, the IC curve shifts to the left. The borrower's opportunity cost of investing rises, so for any given value of Z^g, k must decline. The MR curve moves inward as well. Some combination of a rise in Z^g and a fall in k is necessary for lenders to continue to receive a competitive return. The interest-elasticity of investment in the information-constrained case may or may not be greater than in the full information case. It is greater if $dZ^g/dr > 0$. This will likely be the case if the initial amount borrowed, k - W, is large or if the production function is sufficiently concave so that the decline in k is not enough to offset the higher rate of interest.[20]

None of the countries listed in Table 1 represents more than a tiny fraction of the world's GNP. However, taken together, they are economically larger than Japan. Therefore, for some issues involving multi-lateral transfers of wealth (e.g., due to a global restructuring of Third World debt), it is of interest to analyze the general equilibrium implications of these nations' capital market activities.

IV. The Two-Country General Equilibrium Case

Suppose there are two countries of equal population size, country R ("rich") and country P ("poor"). In each country, α percent of the individuals are "entrepreneurs" and $1-\alpha$ percent are "lenders." All individuals have the same utility function, given by equation (1). That is,

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[20]The adjustment of k in response to a change in r is given by

$$\frac{dk}{dr} = [1 + \pi'(k)Z_1^g]/[(\pi''(k)/\pi'(k))r - \pi'(k)Z_2^g] < 0$$

where $Z^g(r,k) = r(k - W)/\pi(k)$, so that $Z_1^g > 0$ and $Z_2^g < 0$.

they are risk neutral and care only about second period consumption. Entering the first period, all entrepreneurs in the poor country are endowed with W^P units of the good, and all lenders are endowed with W^{PL} units. Similarly, entrepreneurs and lenders in the rich country are endowed with W^R and W^{RL} units, respectively. For the time being, the only restriction we need impose is that $W^P < W^R$.

Each entrepreneur owns and manages a risky investment project. The project technology is the same across entrepreneurs and across countries, and is given by equation (2) above. As before, if an entrepreneur wants to invest more than her endowment she has to borrow, so that equation (3) still applies. Lenders do not have projects; their only option is to lend to entrepreneurs.[21]

The information structure is the same as in the small country case. Lenders observe a project's realized output, but cannot observe the capital input. They cannot directly see whether the entrepreneur is secretly lending to other entrepreneurs.[22]

If there were no information asymmetries, the following three equations would characterize the world equilibrium:

$$\pi'(k^{P*})\theta = r^* \tag{12}$$

$$\pi'(k^{R*})\theta = r^* \tag{13}$$

$$\alpha(k^{R*} + k^{P*}) = \alpha(W^P + W^R) + (1-\alpha)(W^{PL} + W^{RL}) \tag{14}$$

where the P and R superscripts denote the countries, and the *'s denote the

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[21]Without lenders, entrepreneurs would not be borrowers in the world general equilibrium.

[22]Note that entrepreneurs may secretly rechannel their investment funds either directly, or through a (zero-profit) intermediary.

full information equilibrium. The main difference from the small country case is of course that the world interest rate r is endogenous. It depends on technology and the total world endowment. Since the technologies are the same, k^{P*} equals k^{R*}. Under perfect information, the pattern of investments is independent of the pattern of endowments.

Under asymmetric information, the following five equations characterize the world equilibrium:

$$\pi'(k^P)[\theta - Z^{gP}] = r \qquad (15$$

$$\pi'(k^R)[\theta - Z^{gR}] = r \qquad (16$$

$$Z^{gP} = r[k^P - W^P]/\pi(k^P) \qquad (17$$

$$Z^{gR} = r[k^R - W^R]/\pi(k^R) \qquad (18$$

$$\alpha(k^P + k^R) = \alpha(W^P + W^R) + (1-\alpha)(W^{PL} + W^{RL}) \qquad \textbf{WW curve} \qquad (19$$

Equations (15) and (16) correspond to equation (9) for the small country case, and equations (17) and (18) correspond to equation (10). Equation (19) is the condition that the total demand for investment capital must equal the world supply, and is drawn as the negatively-sloped WW curve in Figure 2.

Investment in the poor country is now less than in the rich country. Combining equations (15) through (18) yields

$$r = \rho(\underset{-}{k^P}, \underset{+}{W^P})\theta = \rho(\underset{-}{k^R}, \underset{+}{W^R})\theta \qquad \rho\rho \textbf{ curve} \qquad (20$$

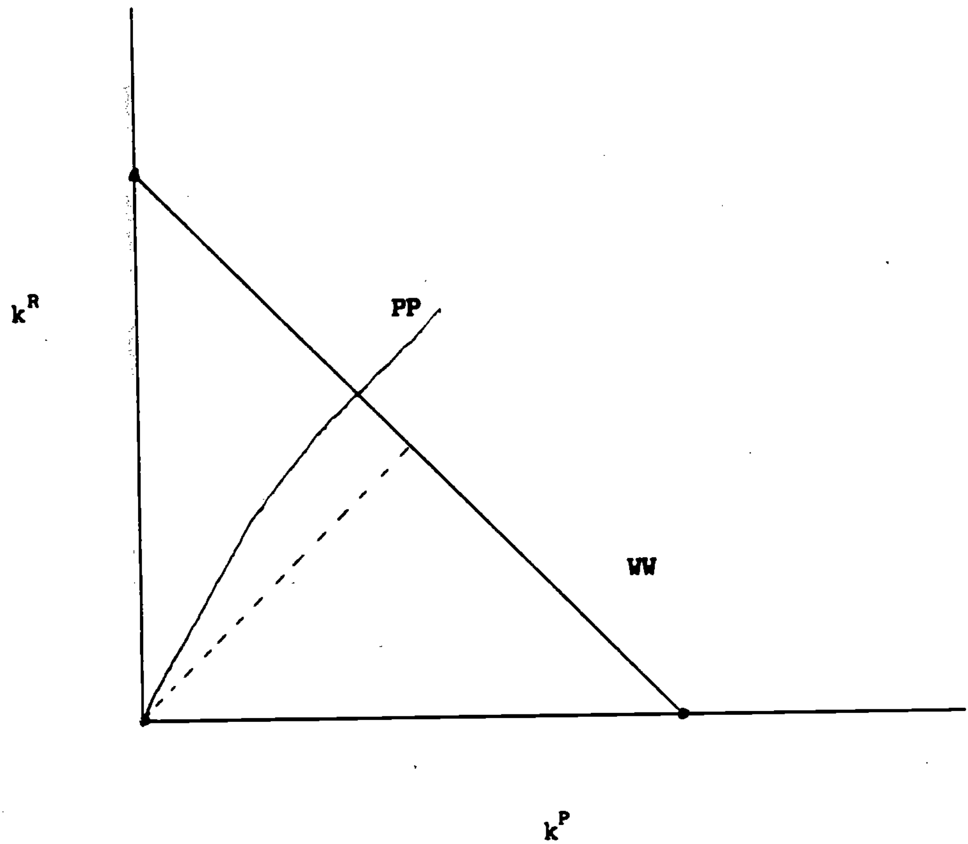
where the function $\rho(\cdot,\cdot)$ is given by

$$\rho(k^J, W^J) = \frac{\pi'(k^J)}{1 + \pi'(k^J)[k^J - W^J]/\pi(k^J)}, \qquad J = P,R \qquad (21$$

As indicated in equation (20), $\rho_1 < 0$ and $\rho_2 > 0$. It follows immediately tha

Figure 2

EQUILIBRIUM IN THE TWO COUNTRY CASE



$k^P < k^R$, since $W^P < W^R$. Because investment is distorted, world output is lower than in the perfect information case. The world interest rate must al be lower; this is easily demonstrated by comparing conditions (16) and (13), and noting that $k^R > k^{R*}$, and that $Z^g > 0$. Thus lenders must be worse off under asymmetric information. Equation (20) is drawn as the positively-slop $\rho\rho$ curve in Figure 2.

In general, the pattern of world investment depends on the agency costs of lending in one country relative to the other, which in turn depends on th net asset positions of entrepreneurs across countries.[23] To illustrate this point, suppose that the wealth of rich country entrepreneurs improves, but that both total world endowment and the endowments of poor country entrepreneurs remain unchanged. Consider, for example, a redistribution of wealth in the rich country from lenders to entrepreneurs. This corresponds an upward rotation in the $\rho\rho$ curve in Figure 2; the WW curve remains unchanged. k^R rises and k^P falls. The decline in the agency costs of finan in the rich country induces a "siphoning" of investment funds from the poor country.[24] The increased demand for funds by rich country entrepreneurs driv up the world interest rate, drawing capital out of the poor country. [Inspection of eq. (20) indicates that $\partial r/\partial W^R > 0$ since k^P declines and W^P unchanged.] Entrepreneurs in the poor country lose rents as a result of the

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[23]An important difference between our model and earlier frameworks emphasizin capital market frictions (e.g., Persson and Svenson (1987)) is that the imperfections and the forms of the financial contracts are derived endogenously. An important exception is Greenwood and Williamson (forthcoming) who develop a monetary model of international business fluctuations under incomplete information. Another related paper is Samolyk (1988), who studies the transmission of regional disturbances in financial markets.

[24]See the appendix for an analytical derivation.

capital flight. This loss of rents is aggravated by the rise in the world interest rate. Lenders in the poor country benefit from the rise in interest rates but as long as the poor country is a net borrower, its national income must fall.

A fall in the wealth of poor country entrepreneurs similarly induces siphoning of capital from the poor to the rich country. The reduced efficiency of lending in the poor country causes funds to flow out to the world capital market. In contrast to the previous case, the world interest rate declines. [Inspection of eq. (20) indicates that $\partial r/\partial W^P < 0$ since k^R increases while W^R remains unchanged.] The shift of investment funds from the high marginal product of capital poor country to the low marginal product of capital rich country depresses the equilibrium interest rate.

Now consider a transfer of wealth from the poor country to the rich. In particular, suppose that τ units of wealth are taken from each citizen of the poor country and are distributed evenly among the citizens of the rich country. This transfer can also be graphed as an upward rotation of the $\rho\rho$ curve in Figure 2. However, for a given change in W^R the $\rho\rho$ curve shifts by more than for our earlier example in which the transfer came from rich country lenders. Both the increase in W^R and the decline in W^P induce k^R to rise and k^P to fall. The net effect on the world interest rate is ambiguous; greater W^R tends to move the interest rate up while less W^P moves it down, as discussed earlier. Note that under perfect information a similar transfer of wealth would affect neither investment nor the interest rate (see eqs. (12) - (14)).

The wealth transfer naturally imposes a direct cost on the poor country. But there may be indirect costs as well. Holding constant the world interest rate, entrepreneurs in the poor country lose additionally because their project rents decline due to the reduction in investment. Thus, to the exten that the movement in the world interest rate is not large, the indirect effects always magnify the costs of the transfer. If the change in the interest rate is large (owing to highly concave production functions) then th exact effect on the poor country's national income depends on whether it is a net debtor or creditor in the world capital market. However, if the poor country is small, the movement in r is negligible so that the capital market problems always magnify the costs of wealth transfers.

This model accordingly produces a "transfer" problem in the sense that the cost to a country of paying a foreign debt may exceed the face value of the payments. Here the transfer problem relates to intertemporal trade rathe than contemporaneous trade, as in the classic debate between Keynes and Ohlin It arises because the distribution of wealth affects the allocation of investment, due to information asymmetries.

As another variation on this theme, consider a shock which increases the initial endowment of all individuals in the rich country, thus increasing the total supply of investment funds available to the world capital market. Under perfect information, capital investment would rise the same in each country. But under asymmetric information, there will be a siphoning effect since the wealth of rich country entrepreneurs rises as well. Thus the increase in investment will be greater in the rich country, and it is even conceivable that investment may decline in the poor country.

Note that in a dynamic context, the relevant measure of a borrower's wealth, W, includes not only liquid assets, but any collateralizable expected future profits as well.[25] Thus good news about future business conditions in

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[25] See Gertler (1988), who studies a closed economy with repeated production and asymmetric information where entrepreneurs enter long-term financial

the rich country can also induce the "siphoning" effect described above.

Finally, we consider a shock to world productivity, θ. By inspection of of equation (20), we see that a world productivity shock has no effect on the distribution of investment capital, since θ factors out of both sides. As in the full information case, the rise in θ increases per capita world output and the world interest rate r .

V. Conclusions

Across developing countries, external debt to private creditors rises more than proportionately with income. Our simple model of international finance under asymmetric information provides one natural explanation of this phenomenon. There are, however, other plausible theories. Sovereign risk is clearly an important feature of developing-country borrowing, and modern bargaining-theoretic analyses of sovereign lending suggest a strong relation between income and external debt. In the standard models, the relationship is generally proportional.[26] It would be interesting to extend the present model to include both sovereign risk and asymmetrically-informed borrowers and lenders.[27] The Marshall-Romer model of growth under increasing returns to scale yields a very different rationale for why the income elasticity of external borrowing might exceed unity [Romer (1989)]. One testable difference between the Marshall-Romer model and the one developed here is that our

contracts with lenders.

[26] See Bulow and Rogoff (1989), or Fernandez and Rosenthal (1988).

[27] The model of Atkeson (1988) does incorporate both sovereign risk and moral hazard, though the private information in his model is at the level of the government and not the individual.

framework would predict that marginal products of capital are higher in poor countries. Our framework yields a similar prediction for borrowing and lending spreads.

It is important to stress that although there are capital market imperfections in the model, government intervention cannot be Pareto improving. To achieve Pareto improving interventions the public agency would have to be more efficient than private lenders in overcoming the informational problems.

Finally, we note that the present analysis suggests an alternative explanation for the Feldstein-Horioka (1980) puzzle that savings and investment tend to be highly correlated across countries.[28] In a world of perfect information, if a small country's endowment increases without any corresponding increase in its productive opportunities, it will invest any increased savings abroad. In a model where borrowing is subject to informational problems, however, a large part of the increase in savings may be invested domestically.

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[28] Feldstein and Horioka appeal to imperfectly integrated world capital markets to explain their puzzle. Obstfeld (1986), Stulz (1986) and Tesar (1988) show how the saving-investment correlation could arise in a frictionless setting if technology shocks are dominant.

APPENDIX

The formal problem which jointly determines how much the entrepreneur invests and her contractual arrangement with lenders is as follows: Choose k, b, Z^g and Z^b to solve

$$\max \quad \pi(k)(\theta - Z^g) - [1 - \pi(k)]Z^b + r(W + b - k) \tag{A1}$$

subject to

$$\pi(k)Z^g + [1 - \pi(k)]Z^b = rb \tag{A2}$$

$$\pi'(k)[\theta - (Z^g - Z^b)] = r \tag{A3}$$

$$0 \geq Z^b \tag{A4}$$

$$W + b - k \geq 0 \tag{A5}$$

Let μ, γ, ν, and ψ be the (non-negative) multipliers associated with (A2) - (A5), respectively. Then the first-order necessary conditions with respect to k, b, Z^g and Z^b are given by

$$\mu\pi'(k)(Z^g - Z^b) + \gamma r\pi''(k)/\pi'(k) - \psi = 0 \tag{A6}$$

$$\psi = r(\mu - 1) \tag{A7}$$

$$\pi(k)(\mu - 1) - \gamma\pi'(k) = 0 \tag{A8}$$

$$[1 - \pi(k)](\mu - 1) + \gamma\pi'(k) - \nu = 0 \tag{A9}$$

Recall that k^* is the first best level of capital investment, given by

$$\pi'(k^*)\theta - r = 0 \tag{A10}$$

(which corresponds to eq. (6) in the text). Then we have:

Proposition 1: (i) If $W \geq k^*$, $k = k^*$; (ii) if $W < k^*$, $k < k^*$.

Proof: Part (i) is obvious; since $W \geq k^*$ the entrepreneur has sufficient wealth to undertake the unconstrained optimal investment without borrowing; she will lend any residual wealth. Part (ii) can be proven by contradiction. Suppose $W < k^*$ and $k \geq k^*$. Then (A5) implies $b > 0$. If $b > 0$, then (A2) and (A4) imply $Z^g > Z^b$. If $Z^g > Z^b$ then (A3) and (A10) imply $k < k^*$, which leads to a contradiction. *Q.E.D.*

Proposition 2: If $W < k^*$, k is given jointly with Z^g by

$$\pi'(k)(\bar{\theta} - Z^g) = r \tag{A11}$$

$$Z^g = r(k - W)/\pi(k) \tag{A12}$$

where (A11) and (A12) correspond to eqs. (9) and (10) in the text.

Proof: If $W < k^*$ then $k < k^*$, from Proposition 1. If $k < k^*$ then $Z^g > Z^b$, from (A3) and (A10). It follows from (A6) - (A8) that $\mu > 1$. This in turn implies that γ, ν, and ψ are positive. Thus (A4) and (A5) hold with equality. Using (A4) and (A5) to eliminate Z^b and b from (A2) and (A3) yields (A11) and (A12). *Q.E.D.*

Corollary: If $W < k^*$, $W < k < k^*$.

Proof: $W < k^*$ implies $k < k^*$, from Proposition 1. Proposition 2 then implies $Z^b = 0$. If $k < k^*$ and $Z^b = 0$, then $Z^g > 0$ from (A3). It follows from

(A12) that $k > W$. *Q.E.D.*

COMPARATIVE STATICS OF THE TWO-COUNTRY CASE

From eqs. (19) and (20) in the text, k^R and k^P are determined jointly by the following two conditions:

$$\rho(k^R,W^R) = \rho(k^P,W^P) \tag{B1}$$

$$\alpha(k^R + k^P) = \alpha(W^R + W^P) + (1-\alpha)(W^{RL} + W^{PL}) \tag{B2}$$

where

$$\rho(k^J,W^J) \equiv \rho^J = \frac{\pi'(k^J)}{1 + \pi'(k^J)[k^J - W^J]/\pi(k^J)} \qquad J = P,R \tag{B3}$$

so that $\rho_1^J < 0$ and $\rho_2^J > 0$.

Initially we assume that world wealth is held constant at $\bar{W}$ (think of the experiments as being wealth redistributions) so that (B4) temporarily replaces (B2):

$$\alpha(k^R + k^P) = \bar{W} , \tag{B4}$$

where $\bar{W}$ is a fixed number. Then,

$$\frac{\partial k^R}{\partial W^R} = - \frac{\partial k^P}{\partial W^R} = - \rho_2^R/(\rho_1^R + \rho_1^P) > 0 \tag{B5}$$

$$\frac{\partial k^R}{\partial W^P} = - \frac{\partial k^P}{\partial W^P} = \rho_2^P/(\rho_1^R + \rho_1^P) < 0 \tag{B6}$$

Inspection of eq. (20) indicates that $\frac{\partial r}{\partial W^R} > 0$ (since k^P declines and W^P is unchanged), while $\frac{\partial r}{\partial W^P} > 0$ (since k^R declines and W^R is unchanged).

Next note that national income per capita for country J, y^J, is given by

$$y^J = \alpha[\pi(k)\theta - r(k^J - W^J)] + (1-\alpha)rW^{JL},$$

$$= \alpha\pi(k)\theta + r[(\alpha W^J + (1-\alpha))W^{JL}) - \alpha k^J] \quad (B7)$$

Using the previous results in conjunction with (B7), one can readily determine the impact of changes in W^R and W^P on the national income of each country. For example, it is straightforward to show that a rise in W^R may lower the national income of the poor country, and definitely does so if the poor country is a net debtor in the world capital market (i.e., if $\{[\alpha W^J + (1-\alpha))W^{JL}] - \alpha k^J\} < 0$).

Now suppose the total stock of world endowment is permitted to change. For simplicity, let $W^R = W^{RL}$ and $W^P = W^{PL}$, so that (B2) becomes

$$\alpha k^R + \alpha k^P = W^R + W^P \quad (B8)$$

Then,

$$\frac{\partial k^R}{\partial W^R} = (-\alpha\rho_2^R + \rho_1^P)/\alpha(\rho_1^R + \rho_1^P) > 0 \quad ; \quad \frac{\partial k^P}{\partial W^R} = (\alpha\rho_2^R + \rho_1^R)/\alpha(\rho_1^R + \rho_1^P) \quad ? \quad (B9)$$

Under perfect information, (B8) together with eqs. (12) and (13) imply that $\frac{\partial k^R}{\partial W^R} = \frac{\partial k^P}{\partial W^R} = 1/2\alpha$. Equation (B9) indicates that under asymmetric information $\frac{\partial k^R}{\partial W^R} > 1/2\alpha$ if ρ_1^P is not too much smaller than ρ_1^R or if ρ_2^R is sufficiently large.[29] The term $-\alpha\rho_2^R$ in the numerator of (B9) reflects the influence of the siphoning effect. If the siphoning effect is very strong (ρ_2^R is large), $\frac{\partial k^P}{\partial W^R}$ may be negative.

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[29]Note that $\rho_1^R = \rho_1^P$ when $W^R = W^P$.

TABLE A1

Measures of External Borrowing Versus GNP: 1986

DOLLARS PER CAPITA

	GNP	*External Debt to Private Lenders*	*Total External Debt*
Ethiopia	116	9	49
Bhutan	132	0	16
Bangladesh	152	3	78
Chad	157	13	46
Nepal	158	3	44
Malawi	162	20	155
Zaire	164	38	220
Mali	183	16	206
Tanzania	199	35	181
Zambia	204	232	815
Burma	206	3	96
Burkina Faso	235	7	99
Madagascar	236	46	285
Burundi	257	10	114
Uganda	275	9	79
Guinea	282	31	249
Niger	285	87	230
India	297	13	54
Rwanda	304	6	70
Sudan	308	142	431
Togo	313	56	349
Kenya	327	69	233
Benin	332	122	226
Pakistan	336	27	149
Lesotho	343	8	119
Cen. Afr. Rep.	344	19	166
Sierra Leone	345	40	165
Sri Lanka	389	61	252
Somalia	395	54	485
Ghana	398	32	189
Mauritania	400	70	934
Zimbabwe	415	190	669
Haiti	415	21	130
Indonesia	429	145	258
Liberia	456	143	633
Nigeria	468	179	248
Senegal	531	88	456
Philippines	543	344	515
Bolivia	590	401	844
Yemen A.R.	619	46	328
Morocco	619	274	830
Egypt	660	233	763
Papua New Gui.	706	525	705
Dominican Rep.	774	194	548
El Salvador	779	58	349
Thailand	786	200	356
Honduras	792	223	662

TABLE A1 (Continued)

Cote D'Ivoire	852	715	1097
Guatemala	857	142	337
Botswana	874	38	345
Congo	907	1382	2079
Jamaica	918	315	1709
Paraguay	937	204	535
Cameroon	989	168	351
Ecuador	1050	641	956
Turkey	1123	331	652
Tunisia	1129	282	788
Columbia	1155	293	526
Chile	1211	1286	1641
Jordan	1214	596	1179
Peru	1314	480	790
Mexico	1540	1072	1270
Costa Rica	1540	958	1696
Syria	1756	178	416
Brazil	1940	634	814
Uruguay	2000	986	1277
Panama	2159	1462	2213
Portugal	2248	1314	1604
Korea	2288	822	1124
Argentina	2397	1353	1602
Gabon	2569	1009	1374
Venezuala	2723	1903	1951
Algeria	2752	723	857

Sources: World Bank, *World Debt Tables: External Debt of Developing Countries*, Vol. II, 1988-89 ed., and International Monetary Fund, *International Financial Statistics*.

Notes: Total external debt includes public and publicly guaranteed long-term debt, private nonguaranteed long-term debt, IMF credit, and short-term debt. External debt to private lenders includes long-term public and publicly-guaranteed debt to private creditors, private non-guaranteed long-term debt, and short-term debt. All of the World Bank's list of developing countries are included above, except those with 1986 populations under one million and 1986 GNPs over $3,000. Communist countries are excluded; Lebanon and Malaysia are excluded due to insufficient data.

TABLE A2

OLS Regressions of Debt/Capita on GNP/Capita for Developing Countries: 1986

log Total External Debt per Capita	*Constant*	*log GNP per Capita*	*# Observations*	R^2
All countries	-.68	1.04 (.09)	73	.67
Sub-Saharan Africa	-.21	.99 (.19)	33	.69
Latin America and Caribbean	-1.10	1.11 (.23)	19	.58
Asia	-3.09	1.38 (.20)	12	.82

log External Debt to Private Lenders per Capita	*Constant*	*log GNP per Capita*	*# Observations*	R^2
All Countries	-6.35	1.74 (.13)	72	.72
Sub-Saharan Africa	-5.05	1.54 (.29)	33	.47
Latin America and Caribbean	-8.08	2.00 (.29)	19	.73
Asia	-10.90	2.45 (.36)	11	.83

Africa: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote D'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe.

Latin America and the Caribbean: Argentina, Bolivia, Brazil, Chile, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Uruguay, Venezuela.

Asia: Bangladesh, Burma, India, Indonesia, Korea, Nepal, Pakistan, Papua New Guinea, Philippines, Sri Lanka, Thailand.

Other: Algeria, Egypt, Jordan, Morocco, Portugal, Syria, Tunisia, Turkey, Yemen Arab Republic.

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