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North-South R&D Spillovers

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Abstract

We examine the extent to which developing countries that do little, if any, research and development themselves benefit from R&D that is performed in the industrial countries. By trading with an industrial country that has a large "stock of knowledge" from its cumulative R&D activities, a developing country can boost its productivity by importing a larger variety of intermediate products and capital equipment embodying foreign knowledge, and by acquiring useful information that would otherwise be costly to obtain. Our empirical results, which are based on observations over the 1971-90 period for 77 developing countries, suggest that R&D spillovers from the industrial countries in the North to the developing countries in the South are substantial.

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Summary

This paper examines the extent to which less developed countries that hardly invest in research and development themselves benefit from the R&D that is performed in the industrial countries. Recent theoretical arguments suggest that international trade plays an important role as a transmission channel for R&D spillovers to the less developed countries. This study provides quantitative estimates of these effects for a group of 77 developing countries based on equations that relate a developing country's overall productivity to the foreign R&D capital stock, the share of imports from industrial countries in the developing country's GDP, and the secondary school enrollment rate. The foreign R&D capital stock consists of a weighted average of the domestic R&D capital stocks of 22 industrial countries with which the developing country trades, using bilateral import shares with the industrial countries as weights.

The results imply that a developing country's total factor productivity is larger the greater is its foreign R&D capital stock, the more open it is to trade with the industrial countries, and the more educated is its labor force. In addition, a developing country has higher productivity when its trade is more biased towards industrial countries that have large cumulative experiences in R&D. A developing country with a larger import share in GDP or a higher secondary school enrollment rate is also more productive. In the preferred specification, the foreign R&D capital stock only affects productivity when interacted with the import share. This implies that a country that is more open to trade derives a larger marginal benefit from foreign R&D, and a country that has a larger foreign R&D capital stock gains more productivity from a marginal percentage increase in imports.

The estimated elasticities suggest that the R&D spillovers from the North to the South are significant and substantial. The implied rates of return--the rise in real GDP of the developing countries resulting from a 100 U.S. dollar increase in the domestic R&D capital stock of an industrial country--are large. They suggest, for example, that an addition of 100 dollars to either the U.S. or Japanese domestic R&D capital stock raises total GDP in the 77 developing countries as a group by almost 25 dollars. The paper concludes that R&D spillovers from the industrial countries in the North to the less developed countries in the South are substantial.

I. Introduction

Almost the entire R&D activity in the world economy is concentrated in the industrial countries.[1] Moreover, within the OECD the seven largest economies (the G-7) accounted for 92 percent of R&D in 1991. This high concentration of an activity that leads to the development of new technologies, products, and materials, to the improvement of existing manufacturing techniques, and to the development of new manufacturing techniques, raises the question of whether the benefits of R&D are limited to the countries that do it. Much of the current debate about technology policy is based on the supposition that a country's productivity level depends importantly on its investment in research and development. Indeed, many studies have found that the rate of return on R&D is high, and that it is much higher than the rate of return on investment in structures, machines, and equipment (see Griliches (1994) for a recent review).

Coe and Helpman (1993) have shown that the rate of return on R&D is not only high in the performing countries, but that significant benefits are also derived by their industrial country trade partners. Using a sample of 21 OECD countries plus Israel, they estimated that the average rate of return on R&D investment in the G-7 economies was about 120 percent, and that an additional 30 percent accrued to the other 15 countries in the sample. These estimates suggest that countries enjoy substantial benefits from R&D done by their trade partners.

In this paper we examine the extent to which less developed countries that hardly invest in research and development themselves benefit from R&D that is performed in the industrial countries.[2] Recent theoretical arguments suggest that international spillovers of R&D are not confined to the group of industrial countries but are also important for less developed countries. We provide quantitative estimates of these effects for a group of 77 developing countries from Africa, Asia, Latin America, and the Middle East. We conclude from these estimates that R&D spillovers from the industrial countries in the North to the less developed countries in the South are substantial.

The following section describes the transmission channels of R&D spillovers to the less developed countries that have been identified by recent theories of economic growth. International trade plays an important role in these theoretical arguments. Based on that reasoning we derive an *estimation equation that relates a developing country's* overall productivity level to the foreign R&D capital stock, the import share in GDP, and the

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[1]In 1990, the industrial countries accounted for 96 percent of total world R&D expenditures (UNESCO (1993)).

[2]As used here, "less developed" or "developing" countries refer to the 77 countries shown in Table 1, and "industrial" countries refer to 21 OECD countries plus Israel studied in Coe and Helpman (1993). These labels are somewhat misleading as some developing countries have clearly caught up to, or surpassed, some industrial countries in terms of levels of per capita incomes or other indicators of development.

secondary school enrollment rate. The foreign R&D capital stock consists of a weighted average of the domestic R&D capital stocks of the industrial countries with which the developing country trades, using bilateral import shares with the industrial countries as weights. The domestic R&D capital stock of an industrial country consists of its cumulative real investment in R&D, allowing for depreciation (see the appendix for details). The construction of the foreign R&D capital stock variables follows Coe and Helpman (1993), using the 22 countries in their sample as representative of the industrial North. For each of the 77 developing countries we construct this variable from 1971 to 1990. And we compute for each of the developing countries a measure of total factor productivity as the ratio of real GDP to a Cobb-Douglas index of labor and capital inputs. The import share is the ratio of imports from the 22 industrial countries to GDP in each developing country, and the secondary school enrollment rate is relative to the population of secondary school age. Our data are described in Section III.

The heart of the paper is Section IV, in which we report the estimated elasticities of total factor productivity with respect to the foreign R&D capital stocks, with respect to import shares, and with respect to secondary school enrollment rates. All of them are found to be positive and significant, implying that a developing country's total factor productivity is larger the larger is its foreign R&D capital stock, the more open it is to foreign trade with the industrial countries, and the more educated is its labor force. Given the way the foreign R&D capital stocks have been constructed, however, an additional implication is that a developing country whose trade is more biased towards industrial countries that have large cumulative experiences in R&D has higher productivity. A developing country with a larger import share in GDP or a higher secondary school enrollment rate is also more productive. In our preferred specification, the foreign R&D capital stock only affects developing country productivity when interacted with the import share. This implies that a country that is more open to foreign trade derives a larger marginal benefit from foreign R&D, and a country that has a larger foreign R&D capital stock (which means that its trade is biased towards industrial countries that have heavily invested in R&D) gains more productivity from a marginal percentage increase in imports. Contrary to our expectations, however, we cannot reject the hypothesis that a higher secondary school enrollment rate has no effect on the marginal benefit of foreign R&D.

Using these estimates we compute the elasticity of total factor productivity of each developing country with respect to the domestic R&D capital stock of each industrial country. These elasticities provide a good measure of the extent of R&D spillovers from the North to the South. The result is that the United States, which has by far the largest domestic R&D capital stock, has the largest impact on productivity in the developing countries (in elasticity terms), about five times as high as Japan, which is the country with the second largest effect. There are, however, substantial differences across countries. For example, Hong Kong's elasticity of total factor productivity with respect to the U.S.'s domestic R&D capital stock is about twice as high as with respect to Japan's domestic R&D capital stock,

while Brazil's elasticity of total factor productivity with respect to the U.S.'s domestic R&D capital stock is more than ten times as high as with respect to Japan's domestic R&D capital stock. These differences partly reflect the differences in the trade composition of Hong Kong and Brazil.

Finally, we use the estimated elasticities together with supplementary data to calculate by how much real GDP of the developing countries rises when the domestic R&D capital stock of an industrial country increases by 100 U.S. dollars. The estimated rates of return are substantial. For example, an addition of 100 dollars to the U.S. domestic R&D capital stock raises China's GDP by 4 dollars, Singapore's by 1, Brazil's by 0.77, and Zimbabwe's by only 4 cents. The aggregate real GDP of the 77 developing countries rises in this case by 22 dollars. On the other hand, an addition of 100 dollars to Japan's domestic R&D capital stock raises China's GDP by 7 dollars, Singapore's by 1.5, Brazil's by 0.23, and Zimbabwe's by only 3 cents. The aggregate real GDP of the 77 developing countries rises in this case by about 24 dollars. Increases in Japan's R&D capital thus have a larger impact on developing countries GDP than do increases in the United States' R&D capital.

II. Theoretical Considerations

Recent developments in the theory of international trade and economic growth have identified a number of channels through which productivity levels of countries are interrelated. Four channels stand out in particular (see Grossman and Helpman (1991)). First, international trade enables a country to employ a larger variety of intermediate products and capital equipment, which enhances the productivity of its own resources. These inputs can be complementary to each other, or they can differ in quality and be vertically differentiated. In either case their use raises the economy's productivity. Second, international trade provides channels of communication that stimulate cross-border learning of production methods, product design, organizational methods, and market conditions. Each one of these helps either to employ domestic resources more efficiently or to adjust the mix of products so as to obtain more value added per unit input. Third, international contacts enable a country to copy foreign technologies and adjust them to domestic use. Imitation is widespread and it has played a major role in the growth of high performing economies such as Japan and the newly industrializing economies of East Asia. Finally, international trade can raise a country's productivity in the development of new technologies or the imitation of foreign technologies, thereby indirectly affecting the productivity level of its entire economy.

We have singled out international trade as the main carrier of productivity gains. But except for the first channel described above all others may operate with equal force via direct foreign investment. In fact, DFI that involves technology transfer can be a very potent source of learning, the benefits of which can spread within an industry and across sectors as a result of labor mobility. However, the lack of suitable data

on direct foreign investment for all the countries in our sample has led us in our empirical work to focus on foreign trade as the carrier of knowledge.

The theory thus describes two broad ways in which foreign trade boosts domestic productivity: by making available products that embody foreign knowledge and by making available useful information that would otherwise be costly to acquire. Both are particularly important for less developed countries that lag far behind the technology frontier. Testimony to the importance of direct learning channels is provided by case studies. Lockwood (1954, chapter 6), for example, describes the importance of this channel in Japan when it opened up to the rest of the world in the post-Meijii era. And Rhee, Ross-Larson, and Purcell (1984) describe the importance of this channel in South Korea during its industrialization process.

For a country to benefit from foreign trade in these ways, it needs to have trade partners that are capable of providing it with products and information in which the country is in short supply. Both depend on the trade partners' accumulated knowledge that is embodied in products, technologies, and organizations. Thus by trading with an industrial country that has a larger "stock of knowledge" a developing country stands to gain more in terms of both the products it can import and the direct knowledge it can acquire than it would by trading with another developing country. For this reason we construct for each developing country in our sample a measure of the openness to trade with the industrial countries defined as the ratio of imports from industrial countries to GDP in each developing country. We also construct a measure of the "foreign R&D capital stock" of each developing country, which we treat as a proxy for the stock of knowledge embodied in the country's trade *composition*. This variable is calculated as a weighted average of the R&D capital stocks of its industrial country trade partners, with bilateral import shares serving as weights. The R&D capital stock of the industrial country trade partner is computed as cumulative real R&D spending, with an allowance made for depreciation (see Coe and Helpman (1993) and the data appendix for details). The theory suggests that a developing country's total factor productivity is larger the larger is its foreign R&D capital stock. In addition, productivity is larger the more open is the economy to foreign trade.

The theory also suggests that productivity depends on the domestic R&D capital stock. In the sample of developing countries that we study, however, R&D expenditures are negligible in all but a few countries, and in any case, cross-country data are not available. Therefore we cannot construct meaningful domestic R&D capital stocks for the developing countries. Other types of data, such as expenditures on reverse engineering, that could, in principle, be used to construct stocks of knowledge are also not available.

Productivity, of course, also depends on the quality of a country's labor force, i.e., on its human capital. Suitable measures of human capital are scarce, however, especially for developing countries. Fortunately,

there are data on school enrollment rates, which we use as proxies for human capital. A better educated work force will increase aggregate productivity directly through more productive workers, and indirectly by attracting foreign direct investment and by allowing a country to take better advantage of technological advances in its trade partners.

With these considerations in mind, our empirical work is based on a log-linear specification that links total factor productivity to measures of the foreign R&D capital stock, the degree of openness to trade with industrial countries, and educational attainment. We also allow for a time trend to capture the impact of other ongoing secular changes. Our simplest specification in level terms is:

$$\log F_{it} = \alpha_i^0 + \alpha_i^S \log S_{it} + \alpha_i^M M_{it} + \alpha_i^E E_{it} + \alpha_{it}^T T_t + \mu_{it} \qquad (1)$$

where i and t index countries and time periods, F is total factor productivity, the α_is are country-specific parameters, S is the foreign R&D capital stock, M is the share of imports from industrial countries in developing country GDP, E is the secondary school enrollment rate, T is a time trend, and μ is a white noise error term.

We also expect that there might be important interactions between the foreign R&D capital stocks and both import shares and secondary school enrollment rates. Indeed, it could be argued that foreign R&D capital affects developing countries primarily, and perhaps exclusively, indirectly through trade. To this end, we estimate equations based on the following specification:

$$\log F_{it} = \alpha_i^0 + \alpha_i^S \log S_{it} + \alpha_i^M M_{it} + \alpha_i^E E_{it} + \alpha_i^{SM} M_{it} \log S_{it} + \alpha_i^{SE} E_{it} \log S_{it} + \alpha_{it}^T T_t + \mu_{it} \qquad (2)$$

If the estimated coefficient on the interaction of trade with the foreign R&D capital stock is positive ($\alpha_i^{SM} > 0$), then the effect of foreign R&D on domestic productivity is larger the more open the economy is to foreign trade, and the effect of foreign trade on productivity is larger the larger is the foreign R&D capital stock. Similarly for the interaction of education with foreign R&D: if $\alpha_i^{SE} > 0$, then the effect of the foreign R&D capital stock on productivity is larger the more educated is the domestic labor force, and the effect of education on productivity is larger the larger is the foreign R&D capital stock. We allow the constants and the coefficients to differ across countries in the equations specified above, although in our empirical work we test whether the estimated coefficients

are equal across countries. The above specifications also allow for "fixed-effects" (α_i^0) and "time effects," including country-specific trends ($\alpha_{it}^T T_t$).[1]

The specification of (1) and (2) differs from that used in Coe and Helpman (1993) to study R&D spillovers among industrial countries. There are two main differences. The first is that here we include a proxy for human capital. Increases in human capital over the past two decades are likely to have been much more important for developing than for industrial countries. The second is that domestic as well as foreign R&D capital stocks were included as a determinant of total factor productivity for the industrial countries, whereas here we only include foreign R&D capital.

III. Data

Our empirical results are based on data for 77 developing countries over the 1971-90 period. The data for all countries are summarized in Table 1, and graphs for a subset of seven countries are shown in Figures 1-4.[2] Definitions, sources, and the data used in estimation are reported in an appendix.

There are strikingly divergent developments in total factor productivity, which is defined as an index of real GDP relative to a Cobb-Douglas weighted average of indices of the labor force and the private and public physical capital stocks. For about half of the 77 countries, and on average for all countries, total factor productivity was not too different in 1990--within a range of plus or minus 10 percent--than in 1971. In a dozen countries, however, total factor productivity increased more than 50 percent over the two decades to 1990, including in Malta and Mauritius where it doubled. In marked contrast to these countries, total factor productivity in another dozen countries fell sharply during these two decades, and by 1990 it was less than 75 percent of its 1971 value. Developments in total factor productivity have also varied considerably over time. Only Mauritius and eight Asian economies--China, Hong Kong, India, Korea, Pakistan, Singapore, Sri Lanka, and Taiwan Province of China--did not experience a decline in total factor productivity in at least one of the four 5-year periods to 1990. And during the first half of the 1980s, the

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[1]In the levels specification, it is necessary to allow the constants to differ for two reasons. First, there may exist country-specific effects that are not related to foreign R&D capital stocks, trade openness, or education. Second, total factor productivity and the foreign R&D capital stocks are indices, they obtain the value 1 for each country in 1985. The difference of the absolute levels of these indices will therefore show up in the constant of each country.

[2]The group of dynamic east Asian economies in Table 1 is defined here to include China, Hong Kong, Indonesia, Korea, Malaysia, Singapore, Taiwan Province of China, and Thailand.

Figure 1. Total Factor Productivity
(Logarithms of indices with 1985=1)

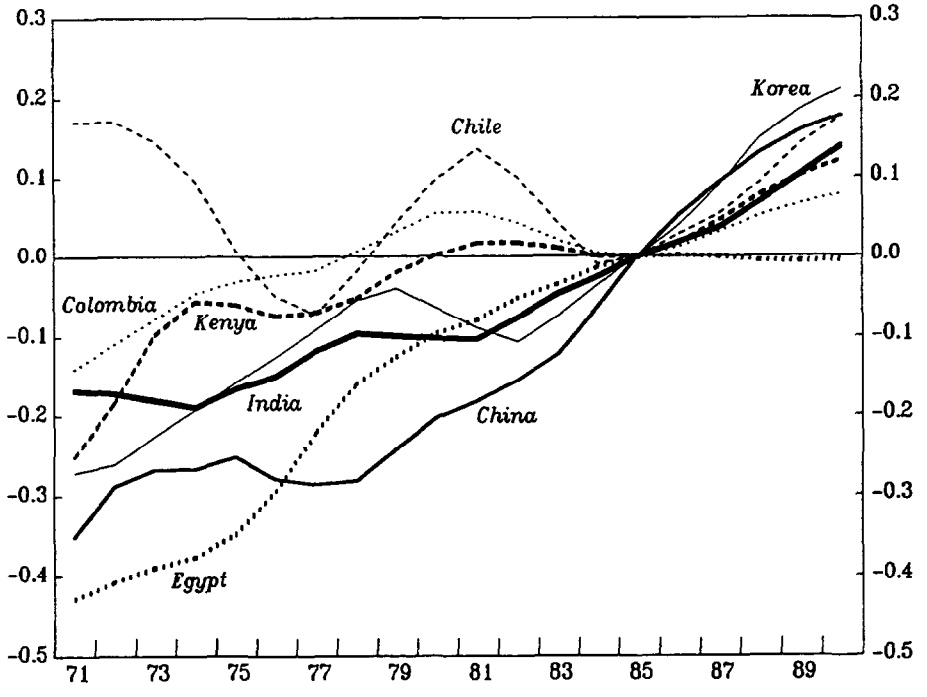

Figure 2. Foreign R&D Capital Stock
(Logarithms of indices with 1985=1)

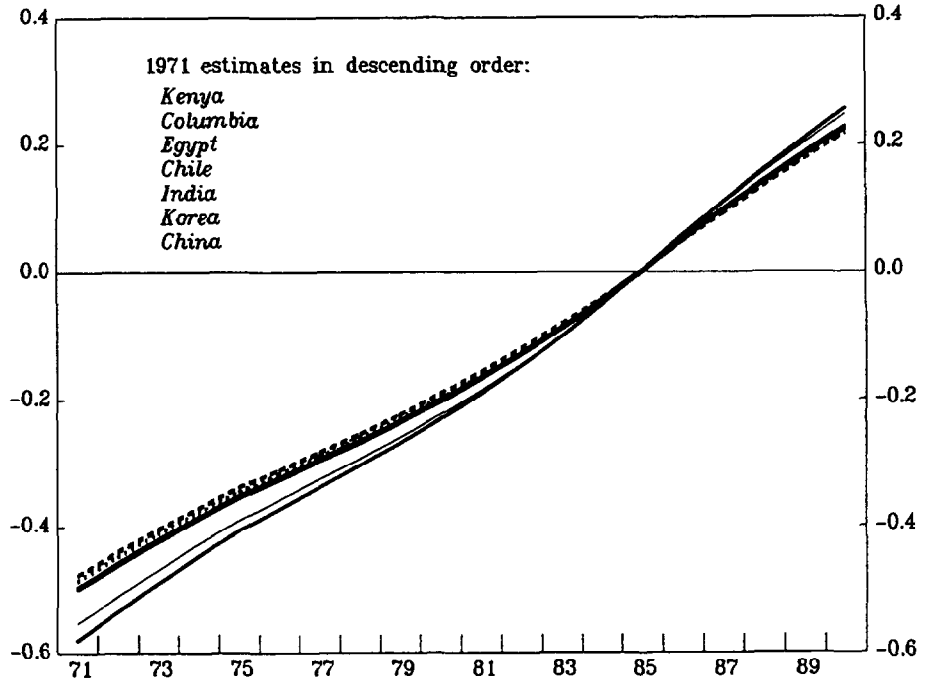

Figure 3. Import Shares
(Ratio of imports from industrial countries to GDP)

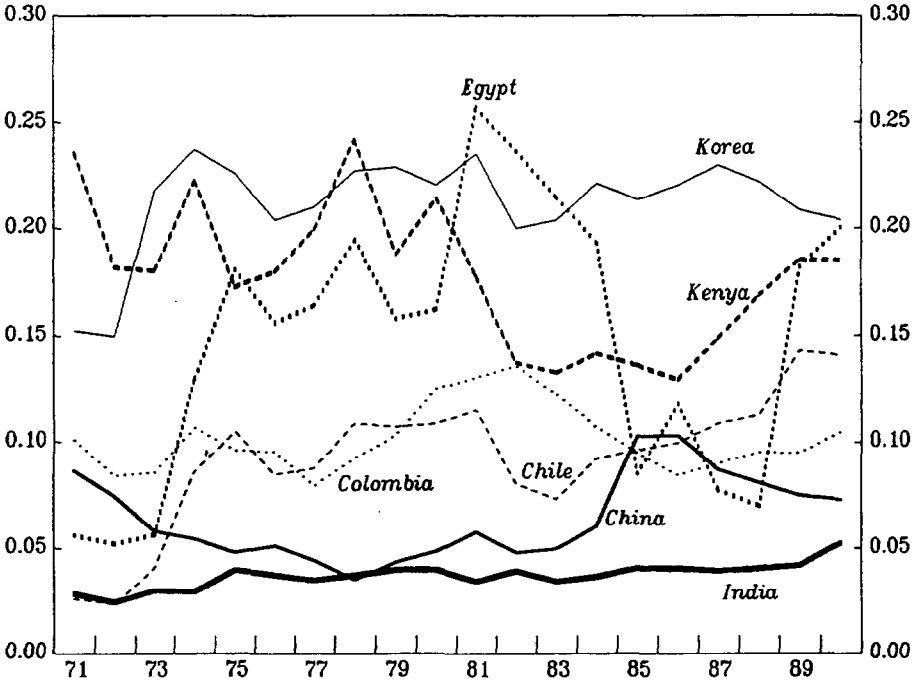

Figure 4. Secondary School Enrollment Ratio
(Enrollment as a ratio to secondary school age population)

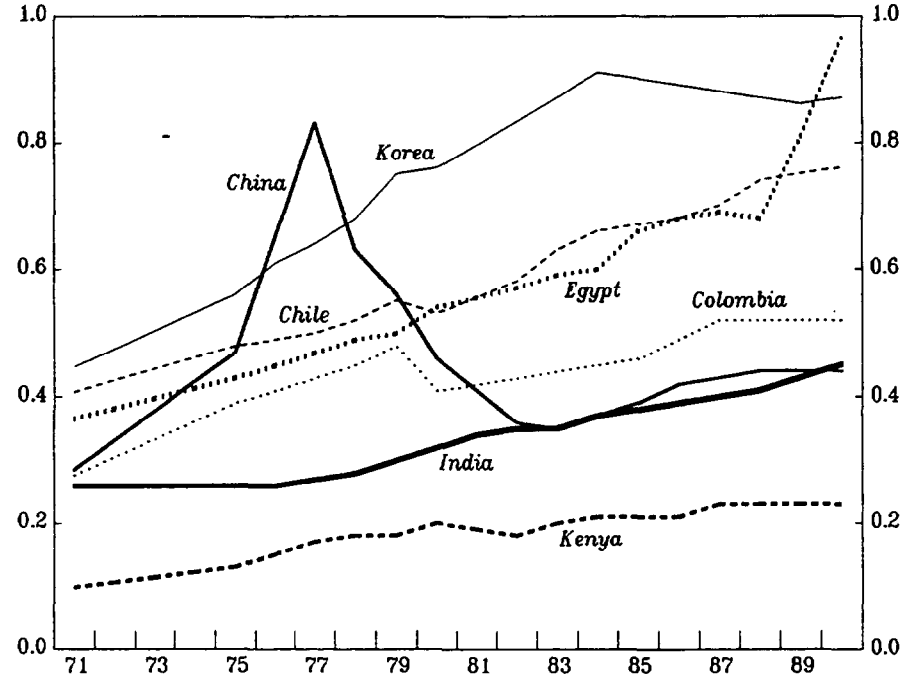

Table 1. Summary Statisics

	Ratio 1990 to 1971		Average 1971-90	
	Total Factor Productivity	Foreign R&D Capital Stock	Import Share	Secondary Enrollment
Algeria	1.03	2.08	0.19	0.37
Argentina	0.91	2.06	0.03	0.61
Bangladesh	1.11	2.16	0.08	0.19
Benin	0.91	1.95	0.20	0.14
Bolivia	0.93	2.07	0.10	0.33
Brazil	1.19	2.04	0.04	0.32
Burkina Faso	1.00	2.00	0.13	0.04
Burundi	1.30	2.24	0.10	0.03
Cameroon	1.11	2.03	0.16	0.19
Central African Rep.	1.08	2.01	0.10	0.11
Chad	0.92	1.95	0.09	0.05
Chile	1.01	2.05	0.09	0.58
China	1.70	2.31	0.06	0.45
Colombia	1.25	2.02	0.10	0.43
Comoros	0.72	1.92	0.57	0.17
Congo	1.78	1.97	0.21	0.32
Costa Rica	0.98	2.02	0.20	0.42
Cotes d Ivoire	1.75	2.02	0.18	0.17
Dominican Republic	0.91	2.01	0.20	0.48
Ecuador	1.46	2.05	0.13	0.47
Egypt	1.53	2.02	0.15	0.56
El Salvador	0.71	2.00	0.15	0.24
Equatorial Guinea	0.34	1.92	0.65	0.13
Fiji	0.94	2.29	0.33	0.56
Gabon	1.12	1.97	0.15	0.16
Gambia, The	0.84	1.85	0.38	0.13
Ghana	0.94	1.90	0.09	0.36
Guatemala	1.03	2.01	0.11	0.16
Guinea	0.90	1.96	0.21	0.13
Guinea-Bissau	1.26	2.15	0.33	0.07
Guyana	0.60	1.91	0.38	0.60
Haiti	0.80	1.98	0.19	0.14
Honduras	1.08	2.00	0.18	0.26
Hong Kong	1.85	2.33	0.43	0.66
India	1.36	2.06	0.04	0.33
Indonesia	1.17	2.33	0.10	0.31
Jordan	1.45	2.04	0.31	0.71
Kenya	1.45	2.00	0.18	0.18
Korea	1.62	2.23	0.21	0.73
Malawi	1.11	1.92	0.15	0.04
Malaysia	1.23	2.25	0.26	0.49
Mali	1.13	1.97	0.12	0.07
Malta	2.19	1.93	0.70	0.73
Mauritania	0.61	1.97	0.34	0.10
Mauritius	2.00	2.02	0.29	0.46
Mexico	0.91	1.98	0.09	0.44
Morocco	0.96	1.98	0.17	0.25
Myanmar	1.03	2.61	0.04	0.22
Nepal	0.86	2.51	0.06	0.20
Niger	0.66	1.97	0.11	0.04
Nigeria	0.67	1.97	0.13	0.17
Oman	1.08	2.17	0.18	0.19
Pakistan	1.52	2.14	0.09	0.16
Panama	0.89	2.00	0.18	0.57
Papua New Guinea	0.89	2.32	0.32	0.11
Paraguay	1.13	2.10	0.06	0.26
Peru	0.82	2.02	0.08	0.55
Philippines	0.98	2.16	0.14	0.63
Rwanda	0.76	2.36	0.10	0.04
Senegal	1.10	1.95	0.22	0.12
Seychelles	0.99	1.87	0.33	0.26
Sierra Leone	0.99	1.93	0.14	0.14
Singapore	1.41	2.22	0.82	0.58
Sri Lanka	1.09	2.22	0.12	0.57
Sudan	0.88	1.96	0.09	0.16
Syrian Arab Rep.	1.21	2.14	0.12	0.49
Taiwan Province of China	1.87	2.24	0.27	0.47
Thailand	1.57	2.39	0.17	0.27
Togo	0.87	1.96	0.30	0.22
Trinidad and Tobago	0.66	1.97	0.23	0.67
Turkey	1.29	2.06	0.09	0.37
Uganda	0.87	1.94	0.11	0.07
Uruguay	1.10	2.03	0.05	0.67
Venezuela	0.64	2.00	0.14	0.44
Zaire	0.64	2.00	0.13	0.24
Zambia	0.88	1.93	0.26	0.17
Zimbabwe	1.13	1.96	0.18	0.24
Maximum	**2.19**	**2.61**	**0.82**	**0.73**
Minimum	**0.34**	**1.85**	**0.03**	**0.03**
Average	**1.10**	**2.07**	**0.19**	**0.31**
Regional averages				
Africa	1.02	1.99	0.21	0.16
Asia	1.31	2.28	0.21	0.41
Dynamic east Asia economies	1.58	2.25	0.28	0.50
Middle East and Europe	1.46	2.06	0.26	0.51
Western Hempsphere	0.95	2.02	0.14	0.43

most severe period of the debt crisis, total factor productivity was either stagnant or declined in all but a handful of countries (Table A1).

In contrast to the divergent developments in total factor productivity, the estimates of the foreign R&D capital stocks have increased steadily over time and at very similar rates across countries. Differences here reflect different trading patterns of each developing country *vis-à-vis* the industrial countries. This is because the foreign R&D capital stocks for each of the developing countries is constructed as the weighted average of the domestic R&D capital stocks of its industrial country trading partners, with the weights based on average bilateral import shares over the 1971-90 period. Many of the developing countries whose foreign R&D capital stocks increased the most are countries in southeast and east Asia whose imports are predominantly from Japan and Australia where the domestic R&D capital stocks are estimated to have grown relatively rapidly from 1971 to 1990 (see Table 1 in Coe and Helpman (1993)).

There is considerable variation in imports from the industrial countries as a share of GDP in the developing countries. Only 18 countries' imports from industrial countries are larger than 25 percent of GDP; and these are mostly small, and with the exception of Hong Kong, Malaysia, Singapore, and Taiwan Province of China, low-income economies. The majority of countries' imports from industrial countries is less than 15 percent of GDP. The import share fluctuates from year to year for most countries, but does not appear to have a trend.

As noted, we use average secondary school enrollment relative to the population of secondary school age as a proxy for human capital. Over the full sample period, the secondary school enrollment ratio ranges from as low as 3 percent in a number of African countries to more than 70 percent in Jordan, Korea, and Malta.[1] The secondary school enrollment ratio generally increased in each of the five-year periods to 1990. In Bangladesh, Equatorial Guinea, Fiji, and Guinea, however, the secondary school enrollment ratio was lower in 1990 than it was twenty years earlier (Table A5).

IV. Empirical Results

The theoretical model presented above is more relevant to medium-term, rather than to year-to-year, developments in total factor productivity. For this reason, and because the estimates for the secondary school enrollment ratio are interpolated for some years, our empirical work is mainly based on a panel made up of data for four 5-year time periods for the two decades to 1990 for the 77 countries, although we report some results based on cross-sectional data.

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[1]These data are only available for every five years starting in 1970; the annual data for the intervening years shown in Figure 4 are interpolated.

We base the choice of a level or a change specification for our empirical work on the time series properties of the data. Pooled unit root tests on the panel data are presented in Table 2.[1] The unit root tests indicate that the log level of total factor productivity, the log level of foreign R&D capital stocks, and the import share interacted with the foreign R&D capital stocks are nonstationary; whereas the import share, the secondary school enrollment rate, and the enrollment rate interacted with the log level of the foreign R&D capital stocks are stationary. These results suggest that a long-term relationship between the levels of these six variables does not exist.[2] However, the pooled unit root tests indicate that changes in all six of the variables are stationary, suggesting that there may exist a relationship between the changes in the variables. For this reason, we specify the equations presented in the theory section in their first difference form for purposes of estimation.[3] In Coe and Helpman *all of the variables--domestic and foreign R&D capital stocks and total* factor productivity--were nonstationary so the equations were specified in level form as pooled cointegrating equations.

We report in Table 3 estimation results based on the first difference of the equations presented in the theory section. Hypothesis tests on equations specified as in Table 3 indicated that the variances are not equal across countries and that there are important time effects but not significant fixed effects. Accordingly, all the equations are estimated by weighted least squares to correct for unequal variances across countries and, except for equation (iv), include time effects.[4] The time effects correspond to different trends for each time period in the levels equation specified in Section II. The null hypothesis that the estimated coefficients, including the constants, are the same across all countries

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[1]The unit root tests are based on the full data set of 20 annual observations for each country and allow for country-specific constants and dynamics. The distribution for the pooled unit root tests and the adjustment to the augmented Dickey-Fuller test statistic are derived in Levin and Lin (1993).

[2]The levels of total factor productivity, the foreign R&D capital stocks, and the import share interacted with foreign R&D capital do not cointegrate (based on the unit root tests on panel data in Levin and Lin (1993)), so there is not a long-run relationship between these three variables. See Cuthbertson, Hall, and Taylor (1992) for a survey of cointegration.

[3]Because one annual observation is lost by taking first differences, the first of the four time periods used in estimation refers to the four-year change 1971-75 whereas the remaining three time periods refer to five-year changes.

[4]See Hsiao (1986) for a discussion of estimation issues for panel data. There is little difference in the sizes or significance of the estimated coefficients reported in Table 3 compared with the OLS estimates, although the adjusted R^2 is about twice as large with the weighted least squares estimates.

Table 2. Pooled Unit-Root Tests

(Annual data for 77 countries; levels are 1971-90, 1540 observations; changes are 1972-90, 1463 observations)

logF	-0.308
ΔlogF	-13.070*
logS	42.033
ΔlogS	-2.789*
M	-4.389*
ΔM	-29.347*
M•logS	27.736
Δ(M•logS)	-16.096*
E	-7.449*
ΔE	-14.633*
E•logS	-4.271*
Δ(E•logS)	-14.633*

The adjusted augmented Dickey-Fuller t-statistics from the pooled data (see Levin and Lin (1993)). A * indicates that the null hypothesis of a unit root is rejected. The last four unit root tests exclude Congo, Gabon, Seychelles, and Taiwan Province of China because it was not possible to estimate the long-run variance of the secondary school enrollment ratio time series for these countries.

F = total factor productivity.
S = foreign R&D capital stock.
M = ratio of imports of goods and services from 22 industrial countries to GDP.
E = ratio of secondary-school enrollment to secondary-school-age population.

Table 3. Total Factor Productivity Estimation Results

(Pooled data, four observations for 77 countries, 308 observations, standard errors in parentheses)

Variable	Coefficient	(i)	(ii)	(iii)	(iv)	(v)
ΔlogS	α^S	1.034	0.868	0.853	0.006	
		(0.255)	(0.302)	(0.271	(0.137)	
ΔM	α^M	0.229	0.288	0.286	0.412	0.360
		(0.094)	(0.088)	(0.087	(0.087)	(0.085)
Δ(M•logS)	α^{SM}		0.296	0.294	0.458	0.431
			(0.150)	(0.147)	(0.151)	(0.143)
ΔE	α^E	0.125	0.268	0.267	0.310	0.322
		(0.052)	(0.095)	(0.095)	(0.097)	(0.095)
Δ(E•logS)	α^{SE}		-0.017			
			(0.135)			
Time effects		yes	yes	yes	no	yes
Standard error		1.280	1.291	1.289	1.345	1.308
R^2		0.196	0.202	0.203	0.145	0.176
R^2 adjusted		0.180	0.180	0.184	0.111	0.160
Hypotheses tests:						
no fixed effects F(228,76)		1.590	1.570	1.568	1.657	1.690
no time effects F(228,3)		...	...	...	0.217	...
equal coefficients on:						
ΔlogS, ΔM, ΔE		0.730	0.683	0.694	0.938	0.767
interaction terms		...	0.799	1.054	0.989	0.987

The dependent variable is ΔlogF. Δ indicates the 4-year change to 1975, and 5 year changes to 1980, 1985, and 1990. The equations are estimated using weighted least squares, because preliminary unreported regressions indicate that the null hypothesis of equal variances is rejected in all cases. Fixed effects are not included in the regressions because no significant evidence of their importance was found at the 5 percent level except in equation (v) where there was no significant evidence at the 1 percent level. The degrees of freedom for the tests for equal coefficients on ΔlogS, ΔM, ΔE are F(228,73), F(228,71), F(228,72), F(230,73), and F(230,74); and on the interaction terms are F(152,147), F(76,224), F(78,225), and F(79,226).

F = total factor productivity.
S = foreign R&D capital stock.
M = ratio of imports of goods and services from 22 industrial countries to GDP.
E = ratio of secondary-school enrollment to secondary-school-age population.

cannot be rejected.[1] The estimated equations explain about 15 to 20 percent of the variance in the dependent variable (the change of log total factor productivity for 77 developing countries over the 1971-90 period). All of the estimated coefficients are significantly greater than zero with the exception of those on the change in the secondary school enrollment ratio interacted with the foreign R&D capital stocks in equation (ii) and the change in the foreign R&D stock in equation (iv).

Equation (i) is the basic specification corresponding to equation (1) in the theory section. Equation (ii) corresponds to equation (2) and includes the interaction of the foreign R&D capital stocks with both the import share and the secondary school enrollment ratio. Because the interaction of secondary school enrollment and the foreign R&D capital stocks is insignificantly different than zero, this term is omitted in equation (iii). A variety of specifications with the primary school enrollment ratio were tried--in addition to, and instead of, the secondary school enrollment ratio as well for groups of countries at different income levels--but in no case was the estimated coefficient positive.

On econometric grounds, equation (iii) is quite good. The size of the estimated elasticity on the change in foreign R&D capital, however, is implausibly large.[2] This very large estimated elasticity turns out to reflect the offsetting interaction of the change in foreign R&D capital and the time effects. Based on equation (iii), for example, the net effect on the predicted change in total factor productivity from the positive contribution of changes in foreign R&D capital and the negative contribution from the time effects, both of which are very large relative to changes in the dependent variable, is essentially zero. That the foreign R&D capital and the time trends--which are represented by constants in the first difference specification--interact in this way is not surprising since, as is apparent from Figure 2, there is a strong trend in our estimates of the foreign R&D capital stock.

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[1]Because there are not enough degrees of freedom to test for the cross-country equality of all parameters in equations (ii) and (iii) simultaneously, the tests that the estimated coefficients on $\Delta logS$, ΔM, and ΔE are equal were done conditional on the estimated coefficients of the interaction terms being equal across countries; and the tests that the estimated coefficients on the interaction terms are equal were done conditional on the other estimated coefficients being equal across countries.

[2]Studies for industrial countries typically find elasticities of TFP with respect to domestic R&D capital stocks to be in the range of 0.06 to 0.1 (Griliches (1988), p. 15). Coe and Helpman (1993) find elasticities of TFP with respect to foreign R&D capital stocks to be in the range of 0.02 to 0.08 for the major industrial countries and in the range of 0.04 to 0.26 for the smaller industrial countries.

When the time effects are dropped, as is done in equation (iv), the estimated coefficient on the change in foreign R&D capital becomes very small and insignificantly different than zero while the other estimated coefficients increase somewhat in size and significance. Our preferred specification is equation (v), which includes time effects but excludes a direct impact from changes in foreign R&D capital, i.e., changes in foreign R&D capital only affects developing country total factor productivity through its interaction with import shares.[1] Given an average import share of 0.2, the average elasticity of total factor productivity with respect to foreign R&D capital is about 0.08 in equation (v). An average elasticity of this size is plausible on *a priori* grounds and is consistent with other results from the literature. For individual countries or specific time periods, the elasticity of foreign R&D capital will vary according to the level of import shares ($\alpha^{SM}M_{t-5}$), as shown in Table 4.

In equation (v) the estimated time trends/constants are 0.012 (standard error of 0.011) for 1971-75, -0.010 (0.011) for 1975-80, -0.044 (0.011) for 1980-85, and 0.003 (0.012) for 1985-90. These estimates imply a significant negative trend during the most severe period of the debt crisis in the first half of the 1980s.

Estimates of the R&D spillovers from the industrial countries to the developing countries are presented in Table 5 based on equation (v) in Table 3. The estimates suggest that the North-South R&D spillovers are important. The spillovers from the United States are largest because it is the most important industrial country trade partner to many developing countries and because the size of its R&D stock is by far the largest among the industrial countries. This means that the U.S. R&D capital stock accounts for the largest share in the foreign R&D capital stock of most developing countries. A 1 percent increase of the R&D capital stock in the United States, for example, raises total factor productivity on average for all 77 countries by about 0.04 percent, whereas a comparable increase in the R&D capital stocks in Japan, Germany, France, and the United Kingdom raises total factor productivity in the developing countries by 0.005 to 0.01 percent. There are important regional differences in the R&D spillovers. In general, countries in Latin America trade more with the United States so their productivity is most influenced by R&D in the U.S. While countries in Africa trade more with Europe, so their productivity is more influenced by R&D in Europe. For any single country, the impact on total factor productivity of a 1 percent increase in R&D capital stocks in all the industrial countries is as given in Table 4. On average for

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[1]In equation (v) the null hypothesis that there are no fixed effects is not rejected at the 1 percent significance level but is rejected at the 5 percent level. If fixed effects are added to equation (v), the size and significance of all of the estimated coefficients is reduced somewhat, particularly the estimated coefficient on the change in R&D capital interacted with the import share where the estimated coefficient (standard error) is 0.325 (0.226).

Table 4. Country- and Time-Specific Estimates of the Elasticity of Total Factor Productivity with Respect to Foreign R&D Capital

	1971-75	1985-90
Brazil	0.292	0.284
Cameroon	0.025	0.052
Chile	0.015	0.011
China	0.046	0.039
Colombia	0.019	0.012
Egypt	0.011	0.041
Hong Kong	0.043	0.041
India	0.075	0.076
Kenya	0.187	0.076
Korea	0.076	0.036
Mexico	0.059	0.053
Singapore	0.045	0.029
Turkey	0.052	0.117
Uganda	0.078	0.061
Zimbabwe	0.020	0.031
Average for all 77 countries	0.102	0.071

Calculated as $\alpha^{SM}M_{t-5}$, based on equation (v) in Table 3.

Table 5. North-South R&D Spillovers: Elasticities of Total Factor Productivity in Developing Countries with Respect to R&D Capital Stocks in Industrial Countries, 1985-90

	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Other Industrial Countries	Europe
Brazil	0.0106	0.0008	0.0007	0.0002	0.0001	0.0002	0.0000	0.0001	0.0012
Cameroon	0.0207	0.0049	0.0050	0.0158	0.0007	0.0017	0.0001	0.0007	0.0240
Chile	0.0347	0.0032	0.0018	0.0005	0.0002	0.0006	0.0001	0.0002	0.0033
China	0.0283	0.0120	0.0022	0.0005	0.0002	0.0006	0.0002	0.0002	0.0037
Colombia	0.0363	0.0023	0.0011	0.0004	0.0001	0.0004	0.0001	0.0002	0.0021
Egypt	0.0282	0.0019	0.0029	0.0015	0.0006	0.0011	0.0000	0.0005	0.0065
Hong Kong	0.1133	0.0601	0.0054	0.0019	0.0009	0.0055	0.0002	0.0015	0.0149
India	0.0122	0.0021	0.0014	0.0003	0.0001	0.0011	0.0001	0.0002	0.0031
Kenya	0.0257	0.0111	0.0067	0.0022	0.0007	0.0112	0.0001	0.0010	0.0217
Korea	0.0674	0.0206	0.0019	0.0005	0.0002	0.0009	0.0002	0.0003	0.0036
Mexico	0.0297	0.0006	0.0004	0.0001	0.0000	0.0001	0.0000	0.0000	0.0007
Singapore	0.2213	0.0722	0.0082	0.0032	0.0009	0.0067	0.0002	0.0015	0.0201
Turkey	0.0334	0.0036	0.0084	0.0019	0.0011	0.0025	0.0001	0.0009	0.0146
Uganda	0.0072	0.0035	0.0034	0.0007	0.0006	0.0053	0.0000	0.0004	0.0102
Zimbabwe	0.0277	0.0043	0.0050	0.0014	0.0004	0.0062	0.0001	0.0007	0.0136
Average for all 77 countries	0.0428	0.0095	0.0047	0.0076	0.0011	0.0048	0.0001	0.0010	0.0191

Estimated elasticity of total factor productivity in the row countries with respect to the R&D capital stock in the column country. Based on equation (v) in Table 3. The elasticities are defined as $\Delta\log F_i/\Delta\log S_k^d \equiv \Delta\log F_i/\Delta\log S_i \cdot \Delta\log S_i/\Delta\log S_k^d$ where S_k^d is the R&D capital stock in the column country, $\Delta\log F_i/\Delta\log S_i = \alpha^{SM} M_{i,t-5}$ (see note to Table 4), and $\Delta\log S_i/\Delta\log S_k^d = \psi_{ik} S_k^d/S_i$ where ψ_{ik} is the bilateral import share of row-country i *vis-à-vis* column-country k. The last two columns are calculated as the sum of the elasticities for the other 15 industrial countries and for the 16 European countries.

1985-90, a 1 percent increase in R&D capital stocks in the industrial countries is estimated to raise total factor productivity and output in the developing countries as a group by 0.071 percent.

The estimated rates of return, which are reported in Table 6, differ considerably across countries. The sources of these differences is apparent from the formula used to calculate the rates of return, which are defined as the increase in output in the developing countries that results from R&D investment in the industrial countries (see notes to Tables 5 and 6):

$$\Delta \mathbf{Y}_i / \Delta \mathbf{S}_k^d = (\alpha^{SM} \mathbf{M}_{i,t-5})\ \psi_{ik}\ \mathbf{Y}_i / \mathbf{S}_i$$

where $\mathbf{Y}_i$ is GDP in developing country i, $\mathbf{S}_i$ is its foreign R&D capital stock, $\mathbf{M}_{i,t-5}$ is its five year lagged imports from all the industrial countries *relative to GDP*, ψ_{ik} *is its imports from industrial country k relative to* total imports from the industrial countries, and $\mathbf{S}_k^d$ is the domestic R&D capital stock of industrial country k. Bold symbols indicate that the variables are measured in U.S. dollars at purchasing power parities. Because the effect of the industrial country k that is the source of the R&D spillover appears only through the relative import share ψ_{ik}, the rows in Table 6 are proportional to the rows in Table A3 in the appendix. It follows that, all else equal, a developing country derives larger benefits from an increase in R&D in the industrial countries with which it trades relatively more. The formula also indicates that a developing country derives larger benefits from an increase in R&D in the industrial countries the larger is its total trade with industrial countries (which enlarges its elasticity of total factor productivity with respect to foreign R&D), the larger is its economy as measured by GDP, and the smaller is its foreign R&D capital stock (i.e., the more its trade is biased towards industrial countries that have little cumulative experience in R&D). And the developing country's benefit from a particular industrial country is proportional to its relative trade with that industrial country. Thus, for example, the relatively large benefits in Table 6 for Brazil, China, India, and Mexico reflect predominantly the fact that these are large economies. On the other hand, the relative benefits that Brazil and China derive from additional R&D in the U.S. are of the order 1/5, while their relative benefits from additional R&D in Japan are of the order of 1/30, which reflects the fact that China's trade is biased towards Japan while Brazil's trade *is biased towards the United States*.

An important conclusion from the estimates reported in Tables 5 and 6 is that the R&D spillovers from North to South are substantial. Expansion of R&D in Japan produces the largest benefits for less developed countries: an additional 100 dollars of the domestic R&D capital stock in Japan raise aggregate GDP of the 77 less developed countries by 24 dollars. This compares with an aggregate increase in developing country GDP of 22 dollars from an additional 100 dollars in the U.S. R&D capital. The larger estimated rate of return to Japanese R&D mainly reflects the fact that a large share of the imports of China and Indonesia--two of the largest developing countries--are from Japan. An additional 100 dollars of the

Table 6. Rates of Return in the South from R&D Investment in the North, 1990

(*In percent*)

	United States	Japan	Germany	France	Italy	United Kingdom	Canada	Other Industrial Countries	Europe
Brazil	0.77	0.23	0.30	0.11	0.10	0.08	0.10	0.04	0.14
Cameroon	0.04	0.04	0.06	0.30	0.04	0.03	0.01	0.01	0.09
Chile	0.24	0.09	0.08	0.04	0.02	0.03	0.02	0.01	0.04
China	4.16	7.05	1.95	0.68	0.73	0.61	1.04	0.25	0.92
Colombia	0.48	0.12	0.09	0.04	0.03	0.03	0.04	0.02	0.05
Egypt	0.37	0.10	0.23	0.18	0.16	0.10	0.02	0.04	0.14
Hong Kong	1.03	2.20	0.29	0.15	0.18	0.35	0.06	0.10	0.23
India	0.96	0.67	0.64	0.24	0.17	0.62	0.18	0.12	0.41
Kenya	0.07	0.11	0.10	0.05	0.04	0.20	0.01	0.02	0.10
Korea	1.85	2.28	0.31	0.13	0.09	0.17	0.17	0.06	0.17
Mexico	1.49	0.12	0.12	0.06	0.04	0.04	0.04	0.02	0.06
Singapore	1.15	1.51	0.25	0.15	0.11	0.25	0.04	0.06	0.18
Turkey	0.77	0.33	1.14	0.39	0.55	0.40	0.08	0.14	0.57
Uganda	0.01	0.02	0.02	0.01	0.02	0.04	0.00	0.00	0.02
Zimbabwe	0.04	0.03	0.05	0.02	0.02	0.07	0.01	0.01	0.04
Total for all 77 countries	22.02	24.50	10.13	8.40	4.72	6.22	2.76	1.82	6.68

The rates of return $\Delta \mathbf{Y}_i/\Delta \mathbf{S}_k^d = (\Delta \log \mathbf{Y}_i/\Delta \log \mathbf{S}_k^d)(\mathbf{Y}_i/\mathbf{S}_k^d)$, where bold symbols indicate that the variables are measured in U.S. dollars (valued at purchasing power parities), Y is real value added, and $\Delta \log X \simeq \Delta X/X$; note that the first term is the elasticities reported in Table 5 since $\Delta \log Y_i = \Delta \log F_i$ (for unchanged labor and physical capital). The rates of return are the increase of the row country's output from a 100 dollar increase of the R&D capital stock of the column country, where both output and the R&D capital stocks are measured in U.S. dollars valued at purchasing power parities. The last two columns are calculated as the average rate of return for the 15 other industrial countries, and for the 16 European countries.

domestic R&D capital stock in Canada raise aggregate GDP of the 77 less developed countries by 3 dollars, which is the lowest rate of return among the G-7 economies.

The theoretical and empirical specifications discussed above focus on technology spillovers and do not include a variable to represent the scope for developing countries to catchup to the productivity levels prevailing in the industrial countries. When a catchup variable--defined as the logarithm of the ratio of percapita GDP in each developing country to average percapita GDP in the industrial countries ($\log(Y_i/Y_k)$ in the first year of each time period)--is added to the estimated equations in Table 3 that include time effects, the estimated coefficients have the expected negative sign but are not significantly different than zero. When the equations include fixed effects, however, the catchup variable is correctly signed and significant. For example, the equation comparable to (v) in Table 3 including unreported time and fixed effects is (standard errors in parentheses):

$$\Delta\log F = \underset{(0.096)}{0.260\Delta M} + \underset{(0.202)}{0.469\Delta(M\cdot\log S)} + \underset{(0.099)}{0.267\Delta E} - \underset{(0.032)}{0.106\log(Y_i/Y_k)_{t-5}}$$

Standard error = 1.107, observations = 308
R^2 = 0.276, R^2 adjusted = 0.253

The estimated coefficient on the change in R&D capital interacted with the import share is essentially identical to our preferred specification reported in Table 3, implying that our basic results are robust to the inclusion of a catch-up variable.

The catchup variable is also correctly signed and significant in a cross-section regression over the full sample period. The cross-section equation is (standard errors in parentheses):

$$\Delta\log F = \underset{(0.354)}{1.195\Delta M} + \underset{(0.292)}{0.590\Delta(M\cdot\log S)} + \underset{(0.261)}{0.681\Delta E} - \underset{(0.051)}{0.118\log(Y_i/Y_k)_{1971}} - \underset{(0.178)}{0.440}$$

Standard error = 0.280, observations = 77
R^2 = 0.288, R^2 adjusted = 0.234

In a cross-section equation analogous to equation (v) in Table 3, i.e. one without the catchup variable, the estimated coefficient (standard error) on the change in R&D capital interacted with the import share is 0.427 (0.292).

V. Concluding Remarks

Recent theoretical models of economic growth highlight the importance of trade as a vehicle for technological spillovers that allow less developed countries to close the technological gap *vis-à-vis* the industrial countries. There has also been a large number of recent empirical, cross-country

studies of economic growth, growth convergence, and catch up. For the most part, however, these studies do not assign an important role to innovative activity in, or trade with, the industrial countries in explaining productivity in the less developed countries.[1] This paper, by contrast, has presented empirical evidence that the growth of total factor productivity in developing countries is positively and significantly related to R&D in their industrial country trade partners and to their openness to trade with industrial countries.

Our estimates suggest that the R&D spillovers from North to South are substantial, implying that developing countries derive substantial benefits from research and development in the industrial North. Our estimates suggest, for example, that the spillover effects from R&D in the industrial countries in 1990 may have boosted output in the developing countries by about 21 billion U.S. dollars, which compares with total official development aid of about 50 billion U.S. dollars.[2]

There are a number of ways in which the research presented here could be extended. It would be useful, for example, to expand the sample to include the industrial countries together with developing countries as recipients of R&D spillovers, and to include estimates of domestic R&D capital for those developing countries for which data are available. This would allow a test of whether the effects of foreign R&D are significantly different between countries at similar stages of development compared with countries at different stages of development. Another extension would be to incorporate measures of direct foreign investment to test its importance as a conduit for R&D spillovers, to investigate the interaction of DFI with R&D and human capital, and to examine the extent to which DFI and trade are complementary vehicles for R&D spillovers.

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[1]This literature is summarized in Fagerberg (1994).

[2]The largest recipients of official development aid were not, in general, the countries that benefited the most from the R&D spillovers. The 21 billion dollars is the percent increase in the foreign R&D capital stock (4) times the elasticity of developing country TFP with respect to total foreign R&D capital divided by 100 (0.00071, from Table 4) times the level of developing country output in 1990 (7393 billion U.S. dollars).

Data Sources and Definitions

For each developing country, total factor productivity (F) is defined as

$$F = Y/[K^{\beta}L^{(1-\beta)}],$$

where Y is GDP, K is the total (private plus public) stock of capital, and L is total labor force. All variables are constructed as indices with 1985 = 1. The coefficient β, which is the share of capital income in GDP, is set to 0.4. Y and L are from the World Economic Outlook data base; K is from the World Bank's DEC Analytical Database. The estimates of total factor productivity are summarized in Table A1.

The foreign R&D capital stock for each developing country (S_i) is a weighted average of the R&D capital stocks of its 22 industrial country trading partners (S_k^d), with bilateral import shares (ψ_{ik}) of each developing country i *vis-à-vis* industrial country k serving as weights

$$S_i = \Sigma_{k=1}^{22}\psi_{ik}S_k^d$$

The bilateral import shares, which are averages for 1971-90, are from the IMF's *Direction of Trade*. The R&D capital stocks for the industrial countries, which are taken from Coe and Helpman (1993), are defined as cumulative real business sector R&D expenditures added to a calculated benchmark and depreciated at the rate of 15 percent a year. The R&D expenditure data are from the OECD's *Main Science and Technology Indicators*. The data appendix in Coe and Helpman (1993) describes the construction of the R&D capital stocks in detail and reports the data. The estimates of foreign R&D capital stocks are summarized in Table A2 and a matrix of the bilateral import shares is reported in Table A3.

The import share is defined as total imports of each developing country from the 22 industrial countries as a percent of GDP in each developing country. The bilateral import data are from the *Direction of Trade* data base. The import shares are summarized in Table A4.

The secondary school enrollment ratio is defined as total secondary school enrollment divided by total population of secondary school age. The data are from UNESCO, "Trends and Projections of Enrollment by Level of Education and by Age," (March 1983) for 1970, 1975, and 1980; and UNESCO *Statistical Yearbooks* thereafter. The estimates of the secondary school enrollment ratio are summarized in Table A5.

The data used the estimated regressions discussed in the text are reported in the first four columns of Tables A1, A2, A4, and A5. Note that although these four columns are all labelled as five-year changes, the first column is the four-year change from 1971-75.

Table A1. Total Factor Productivity
(Logarithms of indices with 1985=1)

	Five-year changes to:				1971-90			
	1975	1980	1985	1990	Maximum	Minimum	Average	Standard Deviation
Algeria	0.10	0.06	0.00	-0.13	0.00	-0.15	-0.05	0.05
Argentina	0.04	-0.01	-0.11	-0.02	0.12	-0.02	0.06	0.05
Bangladesh	-0.12	0.09	0.08	0.05	0.05	-0.19	-0.06	0.07
Benin	-0.01	-0.06	-0.01	-0.01	0.10	-0.01	0.03	0.04
Bolivia	0.06	0.02	-0.17	0.02	0.20	-0.03	0.09	0.08
Brazil	0.19	0.03	-0.10	0.06	0.10	-0.11	0.04	0.06
Burkina Faso	-0.05	0.05	0.02	-0.03	0.02	-0.08	-0.03	0.03
Burundi	0.21	0.01	-0.00	0.05	0.05	-0.21	0.01	0.06
Cameroon	0.02	0.19	0.13	-0.24	0.01	-0.35	-0.18	0.14
Central African Rep.	0.04	0.06	-0.04	0.01	0.06	-0.06	-0.00	0.03
Chad	-0.11	-0.21	0.13	0.11	0.19	-0.25	0.02	0.13
Chile	-0.16	0.09	-0.10	0.18	0.18	-0.07	0.07	0.07
China	0.10	0.05	0.20	0.18	0.18	-0.35	-0.13	0.17
Colombia	0.11	0.09	-0.06	0.08	0.08	-0.14	0.00	0.06
Comoros	-0.11	-0.26	0.06	-0.03	0.31	-0.10	0.05	0.13
Congo	0.20	0.07	0.41	-0.10	0.00	-0.68	-0.31	0.23
Costa Rica	0.06	-0.02	-0.14	0.07	0.16	-0.01	0.09	0.06
Cotes d'Ivoire	0.19	0.07	0.41	-0.10	0.00	-0.66	-0.31	0.23
Dominican Republic	0.12	-0.05	-0.06	-0.10	0.11	-0.10	0.03	0.06
Ecuador	0.37	0.09	-0.06	-0.02	0.06	-0.40	-0.04	0.12
Egypt	0.08	0.25	0.10	-0.00	0.00	-0.43	-0.15	0.16
El Salvador	0.04	-0.06	-0.29	-0.03	0.36	-0.03	0.18	0.16
Equatorial Guinea	-0.29	-0.84	-0.03	0.07	1.16	-0.01	0.34	0.43
Fiji	0.08	-0.02	-0.14	0.03	0.16	-0.02	0.08	0.06
Gabon	0.42	-0.18	-0.03	-0.11	0.40	-0.22	0.03	0.17
Gambia, The	0.14	-0.23	-0.08	0.01	0.34	-0.01	0.12	0.12
Ghana	0.01	-0.09	-0.13	0.16	0.25	-0.02	0.12	0.08
Guatemala	0.11	0.08	-0.15	0.00	0.15	-0.03	0.05	0.06
Guinea	-0.00	0.09	-0.14	-0.07	0.14	-0.13	0.03	0.09
Guinea-Bissau	0.11	-0.05	0.02	0.16	0.16	-0.07	0.02	0.06
Guyana	0.00	-0.10	-0.28	-0.13	0.40	-0.13	0.19	0.18
Haiti	0.03	0.04	-0.15	-0.13	0.15	-0.13	0.06	0.09
Honduras	0.04	0.12	-0.12	0.03	0.12	-0.05	0.03	0.05
Hong Kong	0.12	0.20	0.09	0.21	0.21	-0.41	-0.10	0.18
India	0.00	0.06	0.10	0.14	0.14	-0.19	-0.07	0.10
Indonesia	0.10	0.08	-0.05	0.03	0.06	-0.12	-0.01	0.05
Jordan	-0.00	0.37	-0.05	0.06	0.11	-0.32	-0.06	0.16
Kenya	0.19	0.06	-0.00	0.12	0.12	-0.25	-0.02	0.09
Korea	0.11	0.09	0.06	0.21	0.21	-0.27	-0.06	0.13
Malawi	0.05	0.05	-0.04	0.05	0.05	-0.06	-0.00	0.03
Malaysia	0.07	0.07	-0.00	0.06	0.06	-0.15	-0.03	0.05
Mali	0.01	0.19	-0.12	0.03	0.12	-0.09	0.02	0.07
Malta	0.22	0.46	-0.02	0.12	0.12	-0.66	-0.15	0.26
Mauritania	-0.12	-0.22	-0.16	0.00	0.52	-0.03	0.19	0.19
Mauritius	0.24	0.15	0.01	0.30	0.30	-0.40	-0.04	0.18
Mexico	0.04	0.01	-0.07	-0.08	0.09	-0.08	0.02	0.05
Morocco	-0.01	-0.04	-0.04	0.05	0.10	0.00	0.05	0.03
Myanmar	0.03	0.13	0.08	-0.20	0.00	-0.24	-0.12	0.08
Nepal	-0.06	-0.06	-0.09	0.06	0.21	0.00	0.09	0.07
Niger	-0.27	0.12	-0.23	-0.05	0.37	-0.05	0.12	0.13
Nigeria	-0.03	-0.22	-0.30	0.15	0.56	0.00	0.27	0.21
Oman	-0.15	-0.03	0.24	0.02	0.02	-0.24	-0.10	0.09
Pakistan	0.03	0.10	0.16	0.13	0.13	-0.29	-0.12	0.14
Panama	-0.02	0.04	0.05	-0.18	0.03	-0.18	-0.06	0.06
Papua New Guinea	0.00	-0.04	-0.10	0.02	0.14	-0.00	0.07	0.05
Paraguay	0.09	0.15	-0.12	0.01	0.14	-0.12	0.01	0.07
Peru	0.07	-0.04	-0.14	-0.09	0.19	-0.09	0.10	0.07
Philippines	0.07	0.06	-0.15	-0.01	0.15	-0.08	0.06	0.08
Rwanda	-0.09	0.08	-0.01	-0.26	0.08	-0.26	-0.04	0.09
Senegal	-0.03	-0.02	0.07	0.08	0.08	-0.08	-0.01	0.04
Seychelles	-0.02	0.06	-0.20	0.15	0.20	-0.03	0.11	0.07
Sierra Leone	0.03	-0.05	-0.00	0.01	0.06	-0.05	0.01	0.03
Singapore	0.07	0.04	0.08	0.15	0.15	-0.20	-0.06	0.09
Sri Lanka	0.03	0.02	0.01	0.02	0.03	-0.08	-0.01	0.03
Sudan	-0.05	0.14	-0.10	-0.12	0.19	-0.12	0.02	0.09
Syrian Arab Rep.	0.21	0.09	-0.06	-0.04	0.10	-0.23	-0.02	0.10
Taiwan Province of China	0.12	0.17	0.10	0.24	0.24	-0.38	-0.09	0.18
Thailand	0.04	0.13	0.06	0.22	0.22	-0.23	-0.06	0.12
Togo	0.01	-0.06	-0.14	0.05	0.20	0.00	0.11	0.07
Trinidad and Tobago	0.04	0.16	-0.32	-0.30	0.34	-0.30	0.10	0.20
Turkey	0.09	0.02	0.02	0.13	0.13	-0.13	-0.01	0.07
Uganda	-0.07	-0.22	0.07	0.08	0.22	-0.13	0.05	0.11
Uruguay	0.01	0.11	-0.20	0.17	0.22	0.00	0.12	0.06
Venezuela	-0.06	-0.13	-0.25	0.00	0.44	0.00	0.21	0.17
Zaire	-0.01	-0.28	-0.09	-0.06	0.39	-0.06	0.15	0.16
Zambia	-0.03	-0.10	-0.05	0.04	0.17	-0.01	0.08	0.06
Zimbabwe	0.11	-0.18	0.11	0.08	0.09	-0.13	0.00	0.06
Maximum	0.42	0.46	0.41	0.30	1.16	0.00	0.34	0.43
Minimum	-0.29	-0.84	-0.32	-0.30	0.00	-0.68	-0.31	0.03
Average	0.04	0.01	-0.03	0.02	0.18	-0.16	0.02	0.10

Table A2. Foreign R&D Capital Stock
(Logarithms of indices with 1985=1)

	Five-year changes to:				1971-90			
	1975	1980	1985	1990	Maximum	Minimum	Average	Standard Deviation
Algeria	0.15	0.16	0.20	0.22	0.22	-0.51	-0.16	0.22
Argentina	0.14	0.15	0.20	0.22	0.22	-0.50	-0.16	0.22
Bangladesh	0.15	0.16	0.22	0.24	0.24	-0.53	-0.17	0.23
Benin	0.13	0.14	0.18	0.21	0.21	-0.46	-0.15	0.20
Bolivia	0.14	0.15	0.20	0.23	0.23	-0.50	-0.16	0.22
Brazil	0.14	0.15	0.20	0.22	0.22	-0.49	-0.16	0.21
Burkina Faso	0.14	0.15	0.19	0.21	0.21	-0.48	-0.15	0.21
Burundi	0.17	0.18	0.22	0.24	0.24	-0.57	-0.18	0.24
Cameroon	0.15	0.16	0.19	0.21	0.21	-0.49	-0.16	0.21
Central African Rep.	0.15	0.15	0.19	0.21	0.21	-0.49	-0.15	0.21
Chad	0.13	0.14	0.18	0.21	0.21	-0.46	-0.15	0.20
Chile	0.14	0.15	0.20	0.22	0.22	-0.49	-0.16	0.22
China	0.17	0.18	0.23	0.26	0.26	-0.58	-0.18	0.25
Colombia	0.14	0.15	0.20	0.22	0.22	-0.48	-0.15	0.21
Comoros	0.14	0.15	0.17	0.20	0.20	-0.46	-0.14	0.19
Congo	0.14	0.15	0.18	0.21	0.21	-0.47	-0.15	0.20
Costa Rica	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Cotes d'Ivoire	0.15	0.15	0.19	0.21	0.21	-0.49	-0.15	0.21
Dominican Republic	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Ecuador	0.14	0.15	0.20	0.22	0.22	-0.49	-0.16	0.22
Egypt	0.14	0.15	0.20	0.22	0.22	-0.48	-0.15	0.21
El Salvador	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Equatorial Guinea	0.13	0.14	0.18	0.21	0.21	-0.45	-0.14	0.19
Fiji	0.17	0.17	0.23	0.26	0.26	-0.57	-0.18	0.25
Gabon	0.14	0.15	0.18	0.21	0.21	-0.47	-0.15	0.20
Gambia, The	0.12	0.13	0.17	0.20	0.20	-0.42	-0.13	0.19
Ghana	0.12	0.14	0.18	0.20	0.20	-0.44	-0.14	0.19
Guatemala	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Guinea	0.14	0.14	0.19	0.21	0.21	-0.46	-0.15	0.20
Guinea-Bissau	0.16	0.16	0.21	0.24	0.24	-0.53	-0.17	0.23
Guyana	0.12	0.13	0.18	0.21	0.21	-0.44	-0.14	0.19
Haiti	0.13	0.14	0.19	0.22	0.22	-0.47	-0.15	0.21
Honduras	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Hong Kong	0.18	0.18	0.23	0.26	0.26	-0.59	-0.19	0.25
India	0.14	0.15	0.20	0.22	0.22	-0.50	-0.16	0.22
Indonesia	0.18	0.18	0.23	0.26	0.26	-0.59	-0.19	0.25
Jordan	0.14	0.15	0.20	0.22	0.22	-0.49	-0.16	0.21
Kenya	0.14	0.15	0.19	0.22	0.22	-0.48	-0.15	0.21
Korea	0.16	0.17	0.22	0.25	0.25	-0.55	-0.18	0.24
Malawi	0.13	0.14	0.18	0.21	0.21	-0.45	-0.14	0.20
Malaysia	0.17	0.17	0.23	0.25	0.25	-0.56	-0.18	0.24
Mali	0.14	0.15	0.18	0.20	0.20	-0.48	-0.15	0.20
Malta	0.13	0.14	0.18	0.20	0.20	-0.45	-0.14	0.20
Mauritania	0.14	0.15	0.18	0.21	0.21	-0.47	-0.15	0.20
Mauritius	0.14	0.15	0.19	0.22	0.22	-0.48	-0.15	0.21
Mexico	0.13	0.14	0.19	0.22	0.22	-0.47	-0.15	0.21
Morocco	0.14	0.15	0.19	0.21	0.21	-0.47	-0.15	0.20
Myanmar	0.21	0.20	0.26	0.29	0.29	-0.68	-0.21	0.28
Nepal	0.20	0.20	0.25	0.27	0.27	-0.65	-0.20	0.27
Niger	0.14	0.15	0.18	0.21	0.21	-0.47	-0.15	0.20
Nigeria	0.13	0.14	0.19	0.21	0.21	-0.47	-0.15	0.20
Oman	0.16	0.16	0.21	0.24	0.24	-0.53	-0.17	0.23
Pakistan	0.15	0.16	0.21	0.24	0.24	-0.52	-0.17	0.23
Panama	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Papua New Guinea	0.17	0.18	0.23	0.26	0.26	-0.58	-0.18	0.25
Paraguay	0.15	0.15	0.21	0.23	0.23	-0.51	-0.16	0.22
Peru	0.14	0.15	0.20	0.22	0.22	-0.48	-0.16	0.21
Philippines	0.16	0.16	0.22	0.24	0.24	-0.53	-0.17	0.23
Rwanda	0.18	0.19	0.23	0.25	0.25	-0.60	-0.19	0.25
Senegal	0.14	0.15	0.18	0.20	0.20	-0.46	-0.15	0.20
Seychelles	0.12	0.13	0.17	0.20	0.20	-0.43	-0.14	0.19
Sierra Leone	0.13	0.14	0.18	0.21	0.21	-0.45	-0.14	0.20
Singapore	0.16	0.17	0.22	0.25	0.25	-0.55	-0.17	0.24
Sri Lanka	0.16	0.17	0.22	0.25	0.25	-0.55	-0.17	0.24
Sudan	0.13	0.14	0.19	0.21	0.21	-0.46	-0.15	0.20
Syrian Arab Rep.	0.16	0.16	0.21	0.23	0.23	-0.53	-0.17	0.23
Taiwan Province of China	0.17	0.17	0.23	0.25	0.25	-0.56	-0.18	0.24
Thailand	0.18	0.18	0.24	0.26	0.26	-0.61	-0.19	0.26
Togo	0.14	0.15	0.18	0.21	0.21	-0.47	-0.15	0.20
Trinidad and Tobago	0.13	0.14	0.19	0.21	0.21	-0.46	-0.15	0.20
Turkey	0.15	0.16	0.20	0.22	0.22	-0.50	-0.16	0.22
Uganda	0.13	0.14	0.18	0.21	0.21	-0.46	-0.14	0.20
Uruguay	0.14	0.15	0.20	0.22	0.22	-0.49	-0.16	0.21
Venezuela	0.14	0.14	0.20	0.22	0.22	-0.48	-0.15	0.21
Zaire	0.14	0.15	0.19	0.21	0.21	-0.48	-0.15	0.21
Zambia	0.13	0.14	0.18	0.21	0.21	-0.45	-0.14	0.20
Zimbabwe	0.13	0.14	0.19	0.21	0.21	-0.46	-0.15	0.20
Maximum	0.21	0.20	0.26	0.29	0.29	-0.42	-0.13	0.28
Minimum	0.12	0.13	0.17	0.20	0.20	-0.68	-0.21	0.19
Average	0.15	0.15	0.20	0.22	0.22	-0.50	-0.16	0.22

Table A3. Bilateral Import Shares

(Imports as a share of total imports from industrial countries, average 1971-90)

	USA	JPN	GER	FRA	ITA	UK	CAN	AUS	AUT	BEL	DEN	FIN	GRE	IRE	ISR	NLD	NZL	NOR	POR	SPA	SWE	SWI
Algeria	0.10	0.06	0.14	0.29	0.13	0.03	0.03	0.00	0.02	0.05	0.01	0.01	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.06	0.02	0.02
Argentina	0.33	0.12	0.15	0.07	0.09	0.03	0.02	0.02	0.01	0.03	0.01	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.04	0.02	0.03
Bangladesh	0.22	0.25	0.08	0.03	0.01	0.09	0.09	0.05	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.06	0.00	0.02	0.00	0.00	0.02	0.03
Benin	0.08	0.07	0.07	0.38	0.05	0.12	0.01	0.00	0.02	0.04	0.01	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.02	0.00	0.01
Bolivia	0.43	0.20	0.14	0.03	0.03	0.05	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.03	0.02
Brazil	0.39	0.11	0.15	0.06	0.05	0.04	0.05	0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.01	0.02	0.03
Burkina Faso	0.10	0.06	0.07	0.54	0.05	0.03	0.01	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.02	0.00	0.00
Burundi	0.06	0.12	0.16	0.17	0.06	0.04	0.01	0.00	0.00	0.27	0.01	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.01	0.01	0.01
Cameroon	0.07	0.07	0.10	0.49	0.06	0.04	0.01	0.00	0.01	0.04	0.01	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.02	0.01	0.02
C. African Rep.	0.04	0.06	0.07	0.66	0.05	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.02	0.00	0.01
Chad	0.15	0.03	0.05	0.54	0.07	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.01	0.00	0.05	0.00	0.01	0.00	0.00	0.00	0.00
Chile	0.39	0.15	0.12	0.06	0.04	0.05	0.04	0.01	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.05	0.02	0.02
China	0.22	0.37	0.10	0.04	0.04	0.03	0.05	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.02
Colombia	0.50	0.13	0.09	0.05	0.03	0.04	0.04	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.04	0.02	0.03
Comoros	0.01	0.04	0.02	0.74	0.06	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.01	0.00
Congo	0.08	0.04	0.05	0.59	0.07	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.03	0.00	0.01
Costa Rica	0.59	0.14	0.07	0.02	0.03	0.03	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.01	0.01
Cotes d'Ivoire	0.08	0.07	0.08	0.50	0.06	0.04	0.01	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.04	0.01	0.01
Dominican Rep.	0.63	0.14	0.04	0.02	0.03	0.02	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.03	0.00	0.01
Ecuador	0.45	0.17	0.11	0.03	0.05	0.04	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.01	0.03
Egypt	0.23	0.06	0.14	0.11	0.10	0.06	0.01	0.04	0.01	0.02	0.01	0.02	0.03	0.01	0.00	0.04	0.00	0.00	0.00	0.03	0.02	0.03
El Salvador	0.60	0.11	0.08	0.02	0.02	0.03	0.02	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.02	0.01	0.01
Equatorial Guinea	0.06	0.00	0.03	0.17	0.14	0.07	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.39	0.00	0.00
Fiji	0.07	0.18	0.01	0.01	0.00	0.08	0.01	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
Gabon	0.09	0.06	0.05	0.61	0.04	0.04	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.01
Gambia, The	0.08	0.07	0.12	0.12	0.07	0.30	0.00	0.00	0.00	0.06	0.02	0.00	0.00	0.00	0.00	0.08	0.00	0.01	0.00	0.02	0.02	0.00
Ghana	0.17	0.08	0.16	0.05	0.05	0.30	0.02	0.01	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.05	0.00	0.02	0.00	0.01	0.01	0.02
Guatemala	0.58	0.11	0.10	0.02	0.03	0.03	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.01	0.02
Guinea	0.14	0.03	0.07	0.41	0.06	0.05	0.01	0.00	0.00	0.09	0.00	0.00	0.01	0.00	0.00	0.05	0.00	0.01	0.01	0.04	0.01	0.01
Guinea-Bissau	0.03	0.05	0.04	0.07	0.12	0.03	0.00	0.05	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.40	0.04	0.05	0.01
Guyana	0.43	0.06	0.04	0.02	0.02	0.27	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.01	0.00	0.00	0.00	0.00
Haiti	0.70	0.07	0.03	0.04	0.01	0.02	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.01
Honduras	0.64	0.12	0.05	0.02	0.02	0.03	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.01
Hong Kong	0.20	0.43	0.06	0.03	0.03	0.07	0.01	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.02	0.02	0.01	0.00	0.00	0.00	0.01	0.04
India	0.21	0.15	0.14	0.05	0.04	0.13	0.04	0.04	0.01	0.09	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.02	0.02
Indonesia	0.21	0.40	0.10	0.05	0.02	0.04	0.02	0.06	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.01	0.01	0.01
Jordan	0.20	0.11	0.15	0.08	0.10	0.12	0.01	0.00	0.02	0.04	0.01	0.01	0.02	0.00	0.00	0.05	0.00	0.00	0.00	0.03	0.02	0.03
Kenya	0.09	0.16	0.14	0.07	0.05	0.28	0.01	0.01	0.01	0.03	0.01	0.01	0.00	0.00	0.01	0.05	0.00	0.01	0.00	0.01	0.02	0.02
Korea	0.33	0.40	0.05	0.02	0.02	0.03	0.03	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01
Malawi	0.08	0.16	0.11	0.05	0.03	0.36	0.02	0.03	0.01	0.02	0.03	0.00	0.00	0.00	0.01	0.04	0.01	0.00	0.00	0.01	0.01	0.01
Malaysia	0.25	0.38	0.07	0.03	0.02	0.08	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.02	0.01

Table A3 (concluded). Bilateral Import Shares

(Imports as a share of total imports from industrial countries, average 1971-90)

	USA	JPN	GER	FRA	ITA	UK	CAN	AUS	AUT	BEL	DEN	FIN	GRE	IRE	ISR	NLD	NZL	NOR	POR	SPA	SWE	SWI
Mali	0.06	0.03	0.12	0.48	0.06	0.05	0.01	0.00	0.00	0.06	0.01	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.03	0.00	0.01
Malta	0.07	0.03	0.15	0.06	0.32	0.20	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.00	0.04	0.00	0.01	0.00	0.02	0.01	0.01
Mauritania	0.10	0.02	0.09	0.47	0.04	0.03	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.12	0.01	0.00
Mauritius	0.07	0.13	0.10	0.24	0.05	0.18	0.00	0.07	0.00	0.03	0.01	0.00	0.00	0.01	0.01	0.02	0.03	0.00	0.00	0.01	0.01	0.02
Mexico	0.73	0.06	0.06	0.03	0.02	0.02	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.01
Morocco	0.11	0.03	0.10	0.36	0.08	0.04	0.03	0.00	0.00	0.04	0.01	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.11	0.02	0.02
Myanmar	0.08	0.51	0.10	0.03	0.01	0.11	0.01	0.03	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.02	0.00	0.00	0.01	0.01
Nepal	0.11	0.41	0.10	0.07	0.01	0.06	0.02	0.01	0.01	0.03	0.02	0.02	0.00	0.00	0.00	0.02	0.08	0.00	0.00	0.01	0.01	0.02
Niger	0.07	0.05	0.08	0.55	0.06	0.06	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.01	0.01	0.01
Nigeria	0.14	0.10	0.15	0.11	0.08	0.23	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.05	0.00	0.01	0.00	0.02	0.01	0.02
Oman	0.12	0.29	0.10	0.05	0.03	0.23	0.00	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.06	0.01	0.00	0.00	0.01	0.02	0.02
Pakistan	0.22	0.23	0.12	0.05	0.05	0.11	0.03	0.03	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.03	0.01	0.01	0.00	0.01	0.01	0.03
Panama	0.65	0.13	0.04	0.02	0.02	0.02	0.02	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.02	0.01	0.01
Papua New Guinea	0.10	0.19	0.02	0.01	0.00	0.04	0.01	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.00
Paraguay	0.29	0.23	0.14	0.05	0.04	0.13	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.01	0.02
Peru	0.45	0.12	0.11	0.03	0.03	0.04	0.03	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.03	0.03
Philippines	0.36	0.34	0.07	0.03	0.01	0.04	0.02	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.01	0.01
Rwanda	0.06	0.18	0.15	0.12	0.05	0.04	0.02	0.00	0.00	0.28	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.01	0.01	0.02
Senegal	0.08	0.03	0.06	0.54	0.06	0.04	0.01	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.01	0.05	0.01	0.01
Seychelles	0.13	0.11	0.05	0.15	0.06	0.34	0.00	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.01	0.01	0.00
Sierra Leone	0.13	0.11	0.14	0.09	0.05	0.29	0.00	0.00	0.01	0.04	0.02	0.00	0.00	0.01	0.00	0.08	0.00	0.00	0.00	0.02	0.01	0.01
Singapore	0.29	0.38	0.06	0.04	0.03	0.06	0.01	0.04	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.01	0.02
Sri Lanka	0.15	0.30	0.10	0.06	0.02	0.15	0.03	0.05	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.02	0.02
Sudan	0.14	0.09	0.14	0.09	0.08	0.22	0.01	0.01	0.01	0.05	0.01	0.00	0.01	0.00	0.00	0.08	0.00	0.00	0.00	0.01	0.02	0.02
Syrian Arab Rep.	0.10	0.10	0.17	0.14	0.15	0.06	0.01	0.00	0.03	0.05	0.01	0.01	0.03	0.00	0.00	0.05	0.00	0.00	0.00	0.04	0.02	0.04
Taiwan	0.32	0.42	0.06	0.02	0.02	0.02	0.02	0.04	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.02
Thailand	0.20	0.46	0.08	0.03	0.02	0.04	0.02	0.03	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.01	0.02
Togo	0.06	0.06	0.10	0.40	0.04	0.09	0.01	0.00	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.04	0.00	0.02
Trinidad & Tobago	0.51	0.10	0.03	0.02	0.01	0.16	0.08	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.01	0.01
Turkey	0.16	0.07	0.24	0.08	0.12	0.08	0.02	0.01	0.02	0.04	0.01	0.01	0.01	0.00	0.00	0.04	0.00	0.00	0.00	0.03	0.02	0.05
Uganda	0.06	0.12	0.17	0.05	0.11	0.31	0.01	0.01	0.01	0.04	0.02	0.00	0.01	0.00	0.00	0.04	0.00	0.01	0.00	0.02	0.01	0.02
Uruguay	0.27	0.09	0.18	0.08	0.08	0.09	0.03	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.03	0.00	0.01	0.00	0.03	0.02	0.04
Venezuela	0.53	0.09	0.09	0.04	0.06	0.04	0.04	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.01	0.01
Zaire	0.13	0.04	0.12	0.12	0.05	0.06	0.01	0.00	0.00	0.33	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.01	0.05
Zambia	0.16	0.11	0.13	0.04	0.05	0.30	0.02	0.02	0.01	0.03	0.01	0.01	0.00	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.03	0.02
Zimbabwe	0.15	0.09	0.16	0.07	0.05	0.24	0.02	0.02	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.04	0.00	0.01	0.00	0.01	0.02	0.04
Maximum	0.73	0.51	0.24	0.74	0.32	0.36	0.09	0.55	0.03	0.33	0.03	0.02	0.03	0.01	0.02	0.12	0.20	0.02	0.40	0.39	0.05	0.05
Minimum	0.01	0.00	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average	0.23	0.15	0.10	0.16	0.05	0.10	0.02	0.03	0.01	0.04	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.01	0.02	0.01	0.02

Table A4. Imports from Industrial Countries as a Share of GDP
(Ratios)

	Five-year changes to:				1971-90			
	1975	1980	1985	1990	Maximum	Minimum	Average	Standard Deviation
Algeria	0.21	-0.13	-0.07	0.01	0.35	0.08	0.19	0.07
Argentina	0.01	-0.01	-0.01	-0.01	0.05	0.02	0.03	0.01
Bangladesh	-0.10	-0.00	-0.02	-0.00	0.19	0.06	0.08	0.03
Benin	0.14	-0.06	0.02	-0.06	0.33	0.10	0.20	0.07
Bolivia	0.04	-0.02	-0.03	-0.02	0.15	0.05	0.10	0.03
Brazil	0.03	-0.02	-0.02	-0.00	0.08	0.02	0.04	0.01
Burkina Faso	0.06	0.04	0.01	-0.04	0.16	0.05	0.13	0.03
Burundi	0.03	0.00	0.01	0.01	0.13	0.06	0.10	0.02
Cameroon	-0.02	-0.01	-0.07	-0.00	0.21	0.09	0.16	0.04
Central African Rep.	-0.03	-0.03	0.04	-0.01	0.16	0.06	0.10	0.02
Chad	-0.05	-0.00	0.12	-0.05	0.16	0.04	0.09	0.04
Chile	0.08	0.00	-0.01	0.04	0.14	0.02	0.09	0.03
China	-0.04	0.00	0.05	-0.03	0.10	0.04	0.06	0.02
Colombia	-0.00	0.03	-0.03	0.01	0.14	0.08	0.10	0.02
Comoros	-1.19	-0.37	-0.05	0.07	1.86	0.23	0.57	0.46
Congo	-0.04	0.00	0.04	-0.01	0.28	0.17	0.21	0.03
Costa Rica	0.01	0.01	-0.02	0.06	0.28	0.16	0.20	0.03
Cotes d'Ivoire	0.01	0.00	-0.03	-0.04	0.24	0.12	0.18	0.03
Dominican Republic	-0.24	-0.03	0.02	0.03	0.43	0.07	0.20	0.09
Ecuador	0.02	-0.05	-0.06	0.04	0.19	0.08	0.13	0.03
Egypt	0.12	-0.02	-0.08	0.12	0.26	0.05	0.15	0.06
El Salvador	0.03	-0.07	0.02	0.00	0.20	0.10	0.15	0.03
Equatorial Guinea	-0.85	0.11	-0.56	0.22	1.51	0.20	0.65	0.34
Fiji	0.01	0.05	-0.05	0.09	0.43	0.23	0.33	0.04
Gabon	0.05	0.00	0.07	-0.06	0.20	0.07	0.15	0.04
Gambia, The	-0.05	0.11	0.02	-0.01	0.75	0.25	0.38	0.13
Ghana	-0.02	-0.08	0.04	0.08	0.18	0.02	0.09	0.05
Guatemala	0.02	-0.01	-0.05	0.07	0.14	0.07	0.11	0.02
Guinea	-0.18	-0.09	0.01	-0.01	0.43	0.12	0.21	0.08
Guinea-Bissau	-0.30	0.06	-0.09	0.20	0.54	0.16	0.33	0.12
Guyana	0.22	-0.24	-0.15	0.40	0.60	0.19	0.38	0.13
Haiti	0.03	0.03	0.09	-0.08	0.33	0.11	0.19	0.07
Honduras	0.03	0.05	-0.12	-0.05	0.26	0.09	0.18	0.05
Hong Kong	-0.12	0.06	-0.00	0.00	0.49	0.37	0.43	0.03
India	0.01	0.00	0.00	0.01	0.05	0.02	0.04	0.01
Indonesia	0.03	-0.02	-0.00	0.05	0.14	0.07	0.10	0.01
Jordan	0.14	0.03	-0.03	0.04	0.46	0.18	0.31	0.08
Kenya	-0.06	0.04	-0.08	0.05	0.24	0.13	0.18	0.03
Korea	0.07	-0.01	-0.01	-0.01	0.24	0.15	0.21	0.02
Malawi	0.05	-0.01	-0.06	0.04	0.19	0.09	0.15	0.03
Malaysia	0.01	0.07	-0.04	0.19	0.43	0.19	0.26	0.06
Mali	0.02	-0.03	0.11	-0.04	0.18	0.06	0.12	0.04
Malta	0.09	-0.02	-0.09	0.07	0.92	0.59	0.70	0.08
Mauritania	-0.46	-0.12	-0.01	0.05	0.82	0.19	0.34	0.15
Mauritius	0.17	-0.13	-0.00	0.12	0.40	0.19	0.29	0.06
Mexico	0.01	0.02	-0.01	0.04	0.33	0.05	0.09	0.06
Morocco	0.07	-0.06	0.04	-0.00	0.23	0.13	0.17	0.02
Myanmar	-0.01	0.05	-0.05	-0.02	0.08	0.01	0.04	0.02
Nepal	-0.03	-0.02	0.01	0.02	0.09	0.03	0.06	0.02
Niger	-0.01	0.08	-0.02	-0.05	0.16	0.08	0.11	0.02
Nigeria	0.08	-0.04	-0.08	0.08	0.23	0.06	0.13	0.05
Oman	0.22	-0.06	0.03	-0.10	0.25	0.02	0.18	0.06
Pakistan	0.04	0.00	0.00	-0.01	0.11	0.06	0.09	0.01
Panama	-0.01	0.00	-0.05	0.00	0.22	0.10	0.18	0.03
Papua New Guinea	-0.14	-0.01	0.01	0.04	0.44	0.26	0.32	0.04
Paraguay	-0.02	-0.01	-0.02	0.07	0.11	0.03	0.06	0.02
Peru	0.03	-0.02	-0.02	-0.01	0.11	0.05	0.08	0.02
Philippines	0.03	-0.02	-0.06	0.07	0.18	0.09	0.14	0.02
Rwanda	0.02	0.03	-0.03	-0.03	0.14	0.06	0.10	0.02
Senegal	-0.01	0.00	-0.00	-0.03	0.28	0.14	0.22	0.04
Seychelles	-0.11	-0.01	0.05	-0.08	0.53	0.23	0.33	0.07
Sierra Leone	-0.01	-0.05	-0.07	0.10	0.27	0.06	0.14	0.06
Singapore	-0.03	0.26	-0.27	0.22	1.00	0.71	0.82	0.09
Sri Lanka	0.02	0.16	-0.09	-0.01	0.23	0.04	0.12	0.06
Sudan	0.06	-0.04	-0.02	-0.05	0.14	0.02	0.09	0.03
Syrian Arab Rep.	0.08	-0.01	-0.08	-0.03	0.25	0.04	0.12	0.06
Taiwan Province of China	0.08	0.02	-0.08	0.03	0.36	0.21	0.27	0.03
Thailand	0.01	-0.00	-0.02	0.10	0.25	0.13	0.17	0.03
Togo	0.06	0.08	-0.04	-0.01	0.42	0.20	0.30	0.07
Trinidad and Tobago	0.04	0.01	-0.11	0.00	0.30	0.16	0.23	0.04
Turkey	0.04	-0.04	0.06	0.01	0.13	0.04	0.09	0.03
Uganda	-0.82	-0.05	0.04	0.05	0.88	0.01	0.11	0.19
Uruguay	0.03	-0.01	-0.02	0.01	0.07	0.04	0.05	0.01
Venezuela	0.07	-0.01	-0.04	0.01	0.22	0.07	0.14	0.04
Zaire	-0.15	-0.10	0.09	0.02	0.31	0.05	0.13	0.07
Zambia	0.02	-0.13	-0.02	0.06	1.92	0.08	0.26	0.39
Zimbabwe	-0.18	-0.08	-0.04	0.03	0.41	0.09	0.18	0.09
Maximum	**0.22**	**0.26**	**0.12**	**0.40**	**1.92**	**0.71**	**0.82**	**0.46**
Minimum	**-1.19**	**-0.37**	**-0.56**	**-0.10**	**0.05**	**0.01**	**0.03**	**0.01**
Average	**-0.03**	**-0.01**	**-0.03**	**0.03**	**0.35**	**0.11**	**0.19**	**0.06**

Table A5. Secondary School Enrollment as a Share of Secondary School Age Population
(Ratios)

	Five-year changes to:				1971-90			
	1975	1980	1985	1990	Maximum	Minimum	Average	Standard Deviation
Algeria	0.07	0.13	0.17	0.12	0.62	0.13	0.37	0.16
Argentina	0.08	0.02	0.15	0.03	0.74	0.46	0.61	0.09
Bangladesh	0.05	-0.08	0.00	-0.02	0.26	0.15	0.19	0.03
Benin	0.03	0.07	0.01	-0.01	0.22	0.06	0.14	0.05
Bolivia	0.06	0.05	0.01	-0.03	0.37	0.25	0.33	0.03
Brazil	0.09	0.08	0.02	0.04	0.40	0.17	0.32	0.07
Burkina Faso	0.01	0.01	0.02	0.02	0.07	0.01	0.04	0.02
Burundi	0.01	0.00	0.01	0.00	0.04	0.02	0.03	0.01
Cameroon	0.05	0.05	0.05	0.03	0.26	0.08	0.19	0.06
Central African Rep.	0.03	0.06	0.02	-0.07	0.16	0.05	0.11	0.03
Chad	0.01	0.02	0.01	0.02	0.08	0.02	0.05	0.02
Chile	0.07	0.05	0.14	0.09	0.76	0.41	0.58	0.11
China	0.18	-0.01	-0.07	0.05	0.83	0.29	0.45	0.12
Colombia	0.11	0.02	0.05	0.06	0.52	0.28	0.43	0.07
Comoros	0.07	0.11	0.06	-0.11	0.28	0.04	0.17	0.07
Congo	0.08	0.00	0.00	0.00	0.33	0.25	0.32	0.02
Costa Rica	0.11	0.06	-0.08	0.01	0.48	0.31	0.42	0.04
Cotes d'Ivoire	0.03	0.06	0.01	0.00	0.20	0.10	0.17	0.04
Dominican Republic	0.12	0.06	0.09	0.23	0.74	0.24	0.48	0.17
Ecuador	0.14	0.11	0.04	0.01	0.56	0.26	0.47	0.10
Egypt	0.06	0.11	0.12	0.30	0.96	0.37	0.56	0.15
El Salvador	-0.02	0.05	0.04	-0.04	0.29	0.19	0.24	0.03
Equatorial Guinea	-0.04	0.02	0.01	0.00	0.15	0.11	0.13	0.01
Fiji	0.11	-0.11	-0.04	0.01	0.66	0.51	0.56	0.04
Gabon	0.07	0.00	0.00	0.00	0.17	0.10	0.16	0.02
Gambia, The	0.02	0.01	0.06	-0.01	0.17	0.08	0.13	0.03
Ghana	0.18	0.04	-0.01	-0.03	0.41	0.19	0.36	0.06
Guatemala	0.03	0.06	0.01	0.02	0.21	0.09	0.16	0.04
Guinea	0.01	0.03	-0.04	-0.05	0.17	0.08	0.13	0.02
Guinea-Bissau	-0.04	0.03	0.03	0.01	0.11	0.03	0.07	0.02
Guyana	-0.01	0.12	-0.03	0.01	0.66	0.54	0.60	0.04
Haiti	0.02	0.06	0.04	0.01	0.20	0.06	0.14	0.05
Honduras	0.02	0.14	0.05	-0.03	0.35	0.14	0.26	0.08
Hong Kong	0.03	0.01	0.05	0.05	0.74	0.60	0.66	0.04
India	0.00	0.06	0.06	0.07	0.45	0.26	0.33	0.06
Indonesia	0.03	0.09	0.12	0.04	0.48	0.17	0.31	0.11
Jordan	0.09	0.16	0.03	0.00	0.79	0.51	0.71	0.10
Kenya	0.03	0.07	0.01	0.02	0.23	0.10	0.18	0.04
Korea	0.11	0.20	0.14	-0.03	0.91	0.45	0.73	0.16
Malawi	0.01	-0.01	0.01	0.00	0.04	0.03	0.04	0.00
Malaysia	0.06	0.06	0.05	0.08	0.61	0.36	0.49	0.07
Mali	0.02	0.02	-0.02	-0.01	0.09	0.05	0.07	0.01
Malta	0.20	-0.08	0.11	0.08	0.86	0.55	0.73	0.07
Mauritania	0.02	0.07	0.04	0.01	0.16	0.02	0.10	0.05
Mauritius	0.07	0.04	0.08	0.03	0.54	0.32	0.46	0.07
Mexico	0.10	0.12	0.07	0.00	0.55	0.24	0.44	0.10
Morocco	0.02	0.10	0.08	0.02	0.37	0.14	0.25	0.09
Myanmar	0.00	0.01	0.01	0.01	0.24	0.20	0.22	0.02
Nepal	0.02	0.09	0.04	0.06	0.32	0.11	0.20	0.07
Niger	0.01	0.03	0.00	0.01	0.06	0.01	0.04	0.02
Nigeria	0.03	0.11	0.10	-0.12	0.29	0.05	0.17	0.09
Oman	0.00	0.13	0.19	0.22	0.55	0.01	0.19	0.17
Pakistan	0.02	-0.01	0.04	0.03	0.21	0.13	0.16	0.02
Panama	0.14	0.06	-0.02	-0.02	0.66	0.41	0.57	0.06
Papua New Guinea	0.03	0.00	-0.00	0.01	0.13	0.09	0.11	0.01
Paraguay	0.02	0.06	0.04	-0.01	0.31	0.18	0.26	0.05
Peru	0.12	0.13	0.04	0.07	0.70	0.34	0.55	0.11
Philippines	0.06	0.11	-0.01	0.11	0.75	0.48	0.63	0.08
Rwanda	0.00	0.01	0.03	0.02	0.08	0.02	0.04	0.02
Senegal	0.00	0.01	0.03	0.02	0.16	0.10	0.12	0.02
Seychelles	0.02	0.02	0.02	0.02	0.30	0.22	0.26	0.02
Sierra Leone	0.02	0.03	0.05	-0.01	0.19	0.09	0.14	0.04
Singapore	0.02	0.08	0.05	0.06	0.69	0.49	0.58	0.07
Sri Lanka	0.01	0.07	0.08	0.13	0.76	0.42	0.57	0.10
Sudan	0.06	0.02	0.04	0.00	0.20	0.08	0.16	0.04
Syrian Arab Rep.	0.04	0.04	0.13	-0.09	0.60	0.39	0.49	0.07
Taiwan Province of China	0.06	0.09	0.11	0.13	0.69	0.30	0.47	0.12
Thailand	0.07	0.03	0.01	-0.02	0.31	0.19	0.27	0.03
Togo	0.10	0.14	-0.12	-0.01	0.33	0.09	0.22	0.06
Trinidad and Tobago	0.05	0.22	0.10	0.03	0.84	0.43	0.67	0.15
Turkey	0.02	0.06	0.07	0.10	0.52	0.27	0.37	0.08
Uganda	0.00	0.01	0.05	0.03	0.13	0.04	0.07	0.04
Uruguay	0.01	0.02	0.10	0.24	0.96	0.58	0.67	0.10
Venezuela	0.08	-0.02	0.04	0.15	0.60	0.35	0.44	0.07
Zaire	0.06	0.08	-0.01	0.01	0.49	0.10	0.24	0.10
Zambia	0.02	0.01	0.02	0.03	0.21	0.13	0.17	0.02
Zimbabwe	0.02	-0.01	0.34	0.11	0.53	0.07	0.24	0.18
Maximum	**0.20**	**0.22**	**0.34**	**0.30**	**0.96**	**0.60**	**0.73**	**0.18**
Minimum	**-0.04**	**-0.11**	**-0.12**	**-0.12**	**0.04**	**0.01**	**0.03**	**0.00**
Average	**0.05**	**0.05**	**0.04**	**0.03**	**0.42**	**0.21**	**0.31**	**0.06**

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