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Exports, Inflation, and Growth

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Abstract

This paper identifies some of the main determinants of exports and economic growth in cross-sectional data from the World Bank, covering 160 countries in the period 1985-1994. First, the linkages between the propensity to export and population, per capita income, agriculture, primary exports, and inflation are studied by statistical methods. Then, the relationship between economic growth and some of the above-mentioned determinants of exports and investment are scrutinized the same way. The main conclusion is that, in the period under review, high inflation and an abundance of natural resources tended to be associated with low exports and slow growth.

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SUMMARY

This paper attempts to identify some of the macroeconomic factors that affect exports and economic growth in cross-sectional data, covering 160 countries in the period 1985-1994. Specifically, the aim is to study the relationship between the propensity to export and some of its main potential determinants—population, per capita income, agriculture, primary exports, and inflation—and then to investigate the linkages (in part through total exports by hypothesis) between primary exports, agriculture, inflation, investment, and growth.

Do countries that export lots of primary commodities tend to neglect nontraditional exports to the detriment of total exports of goods and services—a symptom that might be expected to be associated with the Dutch disease and with pervasive rent seeking in the primary sector? Does inflation reduce exports—for example, through currency overvaluation and associated economic imbalances and distortions? And if exports and imports increase efficiency and economic growth through the gains from trade, do primary export dependence and inflation consequently retard economic growth, as suggested by some recent studies?

The above hypotheses are tested in two ways. First, the large sample of countries under review is split up in various ways to search for suggestive patterns in the data—to see if, for instance, high-inflation countries tend to export less than low-inflation countries. To this end, statistical tests are used to determine the significance of the empirical regularities observed. Second, the patterns observed are subjected to further scrutiny, inter alia, by regressing the ratio of exports to GDP on its main hypothesized determinants across countries, and by regressing the average rate of growth of real per capita GDP over the past decade on the determinants of export performance. The results indicate that high inflation and a heavy emphasis on the exploitation of natural resources have tended to be associated with low exports and slow growth.

I. INTRODUCTION

Exports are the mainstay of perhaps a fifth or more of the world's population. Also, they may be a major source of economic growth, both directly, because exports are part of production, and indirectly, as exports facilitate imports of goods and services, and of new ideas, knowledge, and technology. By encouraging specialization according to comparative advantage, high and rising exports enhance static and dynamic efficiency and hence also economic growth. The rapid expansion of exports relative to output in the fast-growing East Asian economies over the years is hardly an accident, for instance.

World exports reached 21 percent of world output in 1994, up from 14 percent in 1970. These well-known numbers may, however, understate the surge of exports in the world economy in recent years because of the weight of large, low-export countries in world trade and output. The ascendance of international commerce is, perhaps, more accurately reflected by the rapid increase of the *unweighted* average ratio of exports to Gross Domestic Product (GDP) across countries from 24 percent in 1970 to 38 percent in 1994.[1] Consider, for instance, Canada, Chile, Denmark, Finland, Iceland, Israel, Korea, New Zealand, Sweden, and Switzerland, to name but a few mostly small, open, advanced or rapidly advancing countries whose exports amount to about a third of GDP: their propensity to export is well below the unweighted world average.

Large countries are less dependent on foreign trade than smaller ones. Brazil, Japan, and the United States all export less than 10 percent of their GDP (Figure 1). Yet, in China, Indonesia, and Russia, exports account for about a quarter of GDP. In small countries, the propensity to export spans a wider range. Very small countries are generally quite dependent on exports: on average, their exports of goods and non-factor services are well over a half of their GDP (Figure 2). In Europe, the exports of Belgium and Ireland amount to more than two thirds of their GDP, for instance, while the exports of Denmark and Sweden correspond to only one third of GDP.

Belgium and Ireland send 20 percent and 30 percent of their exports to their close neighbors, France and the United Kingdom, while Sweden and Denmark send 13 percent and 20 percent of their exports to their slightly more distant neighbor, Germany. (Belgium and Luxembourg actually export more to Germany than to France.) This suggests that proximity and a common language may be conducive to trade. Yet, sharing languages and long borders with three large neighbors, Switzerland also exports only a third of its GDP.

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[1]The first average is simply $\Sigma X_i / \Sigma Y_i = 0.24$, where X_i denotes exports in country i and Y_i denotes GDP in country i. This average can be rewritten as a weighted average of the export ratios of many countries, where the weight of each country is its share in world output: $\Sigma X_i / \Sigma Y_i = \Sigma (Y_i / \Sigma Y_i) (X_i / Y_i)$, in contrast to the unweighted average $\Sigma (X_i / Y_i) / n = 0.38$, where n is the number of countries.

Likewise, the exports of many Latin American countries are smaller than the economic and cultural geography of the region would seem to warrant. Like in some much larger countries, exports in Argentina and Peru, for example, amount to less than 10 percent of their GDP, while in Poland and Romania—with populations similar to those of Argentina and Peru, respectively—exports correspond to more than a quarter of GDP. Thus, import substitution among other things may have done more harm to exports in Argentina and Peru than almost half a century of socialism in Poland and Romania. Thus, size seems to matter for exports, but so, it seems, do several other factors, among them institutions, economic structure, and policy.

In this article an attempt is made to identify some of the macroeconomic factors that affect exports and economic growth in cross-section data from the World Bank (1995a), covering 160 countries in the period from 1985 to 1994. Specifically, the aim is to study, first, the relationship between the propensity to export and some of its main potential determinants: population, *per capita* income, agriculture, primary exports, and inflation, and then to investigate the linkages—in part through total exports by hypothesis—between primary exports, agriculture, inflation, investment, and growth.

Do countries that export lots of primary commodities tend to neglect non-traditional exports to the detriment of total exports of goods and services?—a symptom that might be expected to be associated with the Dutch disease and with pervasive rent seeking in the primary sector.[2] Does inflation reduce exports?—for example, through currency overvaluation and associated economic imbalances and distortions. And, if exports and imports increase efficiency and economic growth through the gains from trade, do primary export dependence and inflation then consequently retard economic growth, as has been suggested by some recent studies?[3]

In this article, the above hypotheses will be tested along two main routes.

First, the large sample of countries under review is split up in various ways to search for suggestive patterns in the data—to see if, for instance, high-inflation countries tend to export less than low-inflation countries, in general. To this end, t-tests and F-tests are used *in tandem* to determine the statistical significance of the empirical regularities observed.

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[2]On the Dutch disease, see Corden and Neary (1982), Corden (1984), Neary and van Wijnbergen (1986), Gelb (1988), and Sachs and Warner (1995b). On rent seeking, see Krueger (1974), Bhagwati (1982), and Gelb, Hillman, Ursprung (1995).

[3]On trade orientation and growth, see Edwards (1992, 1993). On distortions and growth, see Easterly (1992, 1993). On primary exports and growth, see Sachs and Warner (1995a, 1995b), Gylfason and Herbertsson (1996), and Gylfason, Herbertsson, and Zoega (1997). On inflation and growth, see Fischer (1991, 1993), Gylfason (1991, 1997), Barro (1995), Bruno and Easterly (1995), and Gylfason and Herbertsson (1996).

However, the cross-section data employed in the article do not suffice to detect cause and effect;[4] for that, panel data and dynamic methods would be needed.[5] The aim here is primarily to provide a broad impression of the landscape.[6]

Second, the patterns observed are subjected to further scrutiny by regressing the ratio of exports to GDP on its main hypothesized determinants across countries, and also by regressing the average rate of growth of real *per capita* GDP over the past decade on the determinants of export performance, among other things. The results indicate, as we shall see, that high inflation and a heavy emphasis on the exploitation of natural resources have tended to be associated with low exports and slow growth.

It needs to be emphasized at the outset that the overvaluation of national currencies is not the sole possible source of the hypothesized links between inflation, exports, and growth. High inflation may also distort production by driving a wedge between the returns to real and financial capital. It may, moreover, reduce savings and the quality of investment by reducing real interest rates, often far below zero. Thus, the net depreciation of the capital stock accelerates. Further, high inflation may be a symptom of imperfect financial markets, social conflict, and other structural flaws that are harmful to growth. Rapid inflation can retard economic growth through one or all of these channels (Gylfason, 1997). Even so, the experience of, e.g., Hong Kong and Korea shows that moderate inflation (9 percent and 7 percent *per annum* on average in 1985-1994) does not preclude rapid, sustainable economic growth. The causation may run in both directions: for example, rapid growth may contribute to price stability by strengthening the tax base and thus diminishing the need for printing money to finance government budget deficits and also by reducing the risk that competing claims for shares in the national income by different social groups lead to price increases and cost inflation.

The article proceeds as follows. Section II describes the landscape and the tests of the empirical patterns observed. Section III reports the results of the regression analysis. Section IV provides a summary and a brief discussion of the main findings.

II. A Look at the Landscape

The sample includes 160 of the 209 countries covered by the *World Bank Atlas*, 1996 (World Bank, 1995a); the necessary data are not available for the remaining 49 countries. Specifically, we have data on population in all 160 countries, exports in 159, *per capita* GNP

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[4]This also applies to much of the recent empirical literature on growth, e.g., Barro (1991).

[5]See Gylfason and Herbertsson (1996).

[6]Empirical cross-country analysis of development patterns was initiated by Kuznets (1966). See also Chenery (1979) and Chenery, Robinson, and Syrquin (1986).

in 158, inflation in 155, growth in 154, agriculture in 153, investments and primary exports in 108. Countries for which the World Bank does not report exact estimates of, say, the export ratio or *per capita* GDP, but only a range of estimates, are not included in the sample. In a few cases, gaps in the World Bank data were filled from other sources, the International Monetary Fund (1995) and the World Bank (1992, 1995b).[7] The data on population, exports, GNP, agriculture, and investment refer to 1994 (except, in a few cases, the figures on GNP refer to 1993); the data on primary exports refer to 1993; and the figures on inflation and growth are averages for the years 1985-1994 (except, for a few countries, the growth averages refer to 1985-1993).

A. Large and Small Countries

First, to set the stage, the sample is ranked by population. The ratio of exports to GDP is inversely related to population across the three groups shown in Table 1. The asterisk next to the average export ratio in the small countries, 52, indicates that this ratio is significantly larger than in the medium countries (at the 0.05 level in a one-tailed, homoscedastic t-test, i.e., assuming equal variances), as indicated by the t-statistic within parentheses below. The critical t-value is 1.66. Likewise, the average export ratio for the middle group, 38, is significantly larger than in the large countries. The F-value in the bottom line, 20.3, is also starred, because it exceeds the critical value, 3.1, indicating significant differences among the three average export ratios reported (at the 0.05 level). Thus, in general, large countries export significantly less than smaller ones, compare Figures 1 and 2, because internal trade replaces external trade in the larger countries. This pattern is confirmed by the scatter plot in Figure 3.

Because the three samples under review are rather large, with 42, 78, and 40 countries, the sampling distributions of the means approach normal distributions by the central limit theorem, as is necessary for the t-tests and F-tests to be valid.[8] On the other hand, the t–tests and, though to a lesser extent, the F-tests are not very sensitive to potential violation of the assumption of equal variances, as was confirmed by repeating the tests with unequal variances: the heteroscedastic tests results thus obtained proved similar to the ones shown in Table 1. The F-tests, nevertheless, need to be interpreted with caution, for they may be biased in favor of rejecting the null hypotheses of equal means. This is because the implicit alternative hypotheses postulate unequal means rather than increasing or decreasing means by category, which would perhaps be more natural alternatives to the null hypotheses.

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[7]The data are available on request from the author.

[8]For most practical purposes, samples of size 30 suffice to insure close approximation of the normal by the sampling distribution of the mean. Moreover, the t-tests are much more sensitive to violation of the assumption of equal means than to violation of the assumption of normality or of equal variances, especially when the samples are of the same or similar size. Therefore, there is no need here for nonparametric tests such as the Mann-Whitney U-test applied to the small samples studied by Gylfason (1991).

Table 1. The Export Ratio and *Per Capita* GNP in Large vs. Small Countries

Sample Size = 160	Population (Millions)	Export Ratio (Percent of GDP)	GNP Per Capita (U.S. Dollars)	Number of Countries
Small	<2	52*	5100	42
(t-value)		(3.0)	(0.0)	
Medium	2-20	38*	5200	78
(t-value)		(3.9)	(0.5)	
Large	>20	21*	6100	40
(t-value)		(8.2)	(0.5)	
F-value		20.3*	0.2	

Source: Author's computations.

Note: All data refer to 1994. An asterisk (*) next to an export ratio indicates that the average value reported is significantly different from the average value shown next below, at the 0.05 level. An asterisk and t-statistic in the third line refer to a comparison with the first line. An asterisk next to an F-value in the bottom line means that it exceeds the critical value, which is 3.1 in this case. Throughout the article, figures on *per capita* GNP are rounded off to the nearest one hundred dollars. The sample size shown in the top left corner refers to the number of countries for which information is available on the variable shown in the first numerical column of the table.

Export ratios without adjustment for population or other indicators of country size should not be expected to be significant explanatory variables in regressions aimed at explaining economic growth (Dowrick, 1995). For example, Cameroon and China both export about a quarter of their GDP despite a hundredfold difference in population. Cameroon's economy can thus be said to be less open to external trade than the Chinese economy. This phenomenon probably explains the absence of export variables from most of the recent empirical literature on growth (but see Edwards, 1992, 1993, and Helliwell, 1992).

On the other hand, it is also conceivable that the export propensities of small nations may at times be circumscribed by a strong sense of cultural identity and an equally strong desire for self-sufficiency. For example, this may to some extent explain the restrictive stance of Irish trade policies earlier in this century, and hence, perhaps, also in part the decline of Irish living standards relative to most other European countries during this period. If so, however, this hypothesis does not seem to square well with the fact that, today, Ireland is one of the most avid exporters in all of Europe. Its export ratio was 0.68 in 1994, and its *per capita* GDP has grown by two thirds since 1980, or by 3.5 percent a year on average.

B. Income *Per Capita*

Table 1 also shows that *per capita* incomes (unadjusted for differences in purchasing power across countries) do not seem significantly related to the pattern of exports and population. A similar pattern is observed when purchasing-power-parity-adjusted measures of *per capita* income are used instead (not shown here).

Table 2. The Export Ratio and Agriculture in High-Income vs. Low-Income Countries

Sample Size = 158	GNP *Per Capita* (U.S. dollars)	Export Ratio (Percent of GDP)	Agriculture (Percent of GDP)	Number of Countries
Low	< 700	29*	34*	53
(t-value)		(3.4)	(9.4)	
Middle	700-9000	41	15*	76
(t-value)		(0.8)	(5.5)	
High	> 9000	46*	3*	29
(t-value)		(3.0)	(13.2)	
F-value		6.2*	95.0*	

Source: Author's computations.
Note: See note following Table 1.

When the sample is ordered by Gross National Product (GNP) *per capita*, with definitions of "low-income," "middle-income," and "high-income" countries commensurate with a recent classification of the World Bank (1995a), we see that low-income countries export significantly less on average than middle-income and high-income countries (Table 2, Figure 4); yet, the difference between the export propensities of middle-income and high-income countries is not significant in a statistical sense. The causation here may run in both directions. High-income countries are, in general, well endowed with factors that strengthen the export potential, such as, for example, a well-educated labor force and efficient infrastructure, including services, transport, and communications. At the same time, large exports are likely to stimulate efficiency and growth, at least for a while, and thus raise the level of *per capita* GNP over time.

C. Agriculture

Table 2 also confirms the strong tendency for income per head to be inversely related to the role of agriculture in the economy. Ranking the countries in the sample by their reliance on agriculture reveals a strong inverse relationship between the share of agriculture in GDP and the export ratio (Table 3, Figure 5).

Table 3. The Export Ratio and Primary Exports in Agricultural vs. Industrial Economies

Sample Size = 153	Agriculture (Percent of GDP)	Export Ratio (Percent of GDP)	Primary Exports (Percent of Merchandise Exports)	Number of Countries
Industrial	< 10	46*	39*	55
(t-value)		(2.4)	(3.7)	
Middle range	10-40	35*	61*	72
(t-value)		(3.2)	(1.9)	
Agricultural	> 40	22*	76*	26
(t-value)		(3.6)	(4.4)	
F-value		9.2*	12.6*	

Source: Author's computations

Note: See note following Table 1. In a few cases, data on primary exports refer to earlier years.

World trade in farm commodities is, in general, considerably less free than international trade in manufacturing products and most services, not least because of the restrictive stance of the Common Agricultural Policy of the European Union and the exclusion, until recently, of most farm products from the General Agreement on Tariffs and Trade (GATT). Therefore, specialization in agricultural production for export is likely to reduce total exports compared with other countries that emphasize manufacturing and services. Moreover, unlike many types of manufacturing and services, agriculture in developing countries does not generate significant educational and technological externalities that reinforce the export potential and expansion of other industries.

D. Primary Exports

There is a strong positive correlation between the share of agriculture in GDP and the share of primary exports in total merchandise exports across the three subgroups shown in Table 3. Roughly, the industrial countries earn only half as much of their merchandise export revenues from primary exports as the agricultural countries on average, and export twice as much of their output.

We next divide up the sample on the basis of primary exports. The share of primary exports in total exports, reported in the *World Development Report* (World Bank, 1995b), is available for only 108 countries. This reduces the sample by a third. As shown in Table 4 and Figure 6, there is an apparent tendency for the exporters of primary commodities to export less *in toto* in proportion to GDP than the exporters of manufactures, but this pattern is not statistically significant. The primary group includes 8 exporters of fuels (mainly oil) and 24 exporters of nonfuel primary products. The average export ratio of the fuel exporters is 37, compared with 27 for the nonfuel group, but the difference is insignificant (with $t = 1.6$). The oil exporters' average inflation rate in 1985-1994 was much lower than that of the nonfuel

exporters, or 15 percent per year compared with 95 percent, but, again, the difference is not significant (with t = 0.8).

If the manufacturing group is redefined to include countries where primary exports are less than *or equal to* 20 percent of merchandise exports and if the middle range is extended to include up to 90 percent of merchandise exports, then the export ratio of the manufacturing countries, at 44 percent of GDP, becomes significantly higher (with t = 2.0) than in the other two groups, where the export ratio is 32 percent of GDP. The F-value rises from 0.8 to 2.4 in this case, but even so the differences among the three average export ratios above (44, 32, and 32) are insignificant. These numbers may be taken to provide some support, albeit not strong, for the idea that primary exports can be a drag on total exports: the results depend on where the lines are drawn between the country groups.

Table 4. The Export Ratio, Inflation, and Primary vs. Manufacturing Exports

Sample Size = 108	Primary Exports (Percent of Merchandise Exports)	Export Ratio (Percent of GDP)	Average Rate of Inflation Per Year 1985–1994 (Percent)	Number of Countries
Manufacturing	< 20	36	11	20
(t-value)		(0.0)	(1.4)	
Middle range	20-80	36	53	56
(t-value)		(1.3)	(0.5)	
Primary	> 80	30	74	32
(t-value)		(1.0)	(1.1)	
F-value		0.8	0.9	

Source: Author's computations.

Note: See note following Table 1. Data on primary exports refer to earlier years in a few cases.

E. Inflation

In Table 4, we also see a tendency for the exporters of primary commodities to have more inflation than the exporters of manufactures, even if the pattern is statistically insignificant. Next, therefore, we split up the sample according to the average inflation rate during 1985-1994. On average, the high-inflation countries export a third less than the low-inflation countries (Table 5). There is, however, no significant difference between the export propensity of the medium-inflation countries and the high-inflation countries. Moreover, the difference between the investment ratios (i.e., investment relative to GDP) of the three country groups is not significant, even if the medium-inflation countries invest more than either the high-inflation or the low-inflation countries (the difference between the low-inflation group and medium-inflation group is marginally significant at the 0.05 level). The corresponding scatter plots are shown in Figures 7 and 8.

On the other hand, the average rate of growth of real *per capita* GNP in 1985-1994 was markedly lower in the high-inflation countries than in the low-to-medium-inflation group.

There is, however, no significant difference between the average rates of growth in the low-inflation group and the medium-inflation group. A similar cross-section pattern was reported in Gylfason (1991), where, on average, high-inflation economies (those with annual inflation rates of 20 percent or more 1980-1985) were shown to grow significantly less rapidly than low-inflation economies (with annual inflation rates of 5 percent or less 1980-1985). Similarly, Bruno and Easterly (1995) have found that inflation rates above 40 percent per year are generally harmful to growth.

Table 5. The Export Ratio, the Investment Ratio, and Economic Growth in High-Inflation vs. Low-Inflation Countries.

Sample Size = 155	Average Inflation 1985-1994 (Percent)	Export Ratio (Percent of GDP)	Investment Ratio (Percent of GDP)	Average Growth of GNP Per Capita 1985–1994 (Percent)	Number of Countries
Low	< 5	45*	20*	1.0	48
(t-value)		(2.4)	(1.8)	(0.2)	
Medium	5-50	34	24	1.1*	79
(t-value)		(0.5)	(1.5)	(5.4)	
High	> 50	32*	20	-3.3*	28
(t-value)		(2.0)	(0.1)	(4.5)	
F-value		3.7*	2.3	18.0*	

Source: Author's computations.

Note: See note following Table 1. Data on average inflation and growth refer to 1985-1993 in a small number of cases.

These findings are not necessarily a sign that inflation reduces growth or *vice versa*. About a half of the countries in the high-inflation group, 14 out of 27, are former socialist countries whose legacy of central planning and subsequent transition to a market economy have involved temporarily high inflation and a collapse of recorded output. When these erstwhile planned economies are removed from the high-inflation group, the average export ratio and growth rate of *per capita* GNP in the remaining 13 high-inflation countries are 21 percent (with $t = 2.7$) and 0.6 percent (with $t = 0.5$). Hence, both the export ratio and the growth rate remain lower in the high-inflation group than in the low-inflation group. The export differential has actually increased, but the growth differential is no longer statistically significant, which is not surprising in view of the small sample with only 13 high-inflation countries. It is not clear, however, that the former socialist countries should be considered separately from the rest of the high-inflation group, because their experience includes some important features and linkages involved in the interaction between inflation and growth in other countries, as discussed by Bruno and Easterly (1995), Fischer (1991, 1993), Fischer, Sahay, and Vegh (1996), and Gylfason (1991, 1997), among others.

F. Growth

We proceed by reordering the sample based on economic growth. More than a third of the countries in the sample, 59 out of 159, experienced a decline in *per capita* GDP in the period under review, 1985-1994. The export ratio in the high-growth countries is significantly higher than in either of the other two groups (Table 6, Figure 9). Without indicating cause and effect, this pattern seems consistent with the view that high exports are conducive to growth, and perhaps also *vice versa*. Moreover, the low-growth countries had significantly lower *per capita* GNP in 1994 than either the medium-growth or high-growth countries, which, in turn, had less income per head than the medium-growth countries, but the latter difference is not significant. Thus, broadly speaking, we observe economic divergence across countries: slow growth tends to be associated with low incomes, and rapid growth with high incomes.

Table 6. The Export Ratio and *Per Capita* GNP in High-Growth vs. Low-Growth Countries

Sample Size = 154	Average Growth of GNP *Per Capita* 1985-1994 (Percent)	Export Ratio (Percent of GDP)	GNP *Per Capita* (U.S. dollars)	Number of Countries
Low	< 0	36	2300*	59
(t-value)		(1.5)	(3.8)	
Medium	0-3	31*	7900	68
(t-value)		(4.5)	(0.7)	
High	> 3	56*	6300*	27
(t-value)		(3.1)	(3.1)	
F-value		11.5*	7.5*	

Source: Author's computations.

Note: See note following Table 1. Data on *per capita* GNP refer to 1993 in a few cases and data on average growth refer to 1985-1993 in a few cases.

This is not just because slow growth results in low incomes, for a similar pattern emerges from a comparison of *initial* income per head—defined as *per capita* GNP in 1994 divided by $(1+g)^{10}$, where g is the average annual rate of growth of *per capita* GNP, 1985-1994—in the low-growth countries ($2900, with t = 3.1), medium-growth countries ($7100, with t = 1.7), and high-growth countries ($3800, with t = 0.9). The corresponding F-statistic is 6.3, indicating that the three average income levels are significantly different from one another as in Table 6.

This impression is strengthened by returning to the division of the sample into low-, middle-, and high-income countries (see Table 2), whose average rates of growth are −1.0 percent per year (with t = 2.2), 0.6 percent (with t = 1.8), and 1.9 percent (with t = 3.3), respectively. These significant differences may be viewed as evidence against broad (i.e., unconditional) convergence, but they have to be interpreted with care. Many low-income countries are agrarian and inflation-prone, and too much agriculture and inflation tend to reduce exports and economic growth (see Tables 2 and 5), without there necessarily being a

direct link between low incomes and slow growth. It is also possible that the broad averages reported above mask convergence within each group or in different groups and classifications. For example, Sachs and Warner (1995a) report evidence of strong convergence among "open" economies 1970-1989, but no convergence across "closed" economies in the same period. Reynolds (1986, p. 81), in a study of economic growth in 37 developing countries from 1950 to 1980, reports a sharp pulling apart of growth rates within the third world. Little (1982, p. 279), by contrast, finds no connection between initial income and subsequent growth in either Latin America and the Caribbean or in Africa from 1960 to 1978, and claims that "the strong positive relationship in Asia comes entirely from the fact that East Asia outgrew South Asia and started better off."

G. Exports

The findings reported thus far can now be summarized as follows. High-export countries are generally characterized by (i) small population, (ii) large GNP *per capita*, (iii) small agriculture, (iv) little inflation, (v) less-than-average dependence on primary exports, (vi) more-than-average investment; and (vii) more than average growth of real *per capita* GNP.

These general impressions from Tables 1 to 6 and Figures 3 to 9 are confirmed by Table 7, where the sample is divided first into high-, medium-, and low-export countries and then into above- vs. below-average export countries. The results are somewhat mixed. The share of agriculture in GDP is inversely and significantly related to the export ratio throughout. The inflation rate also is inversely related to the export ratio everywhere, significantly so in the high-export and above-average-export countries. The share of primary exports in merchandise exports is substantially and significantly less in the high-export countries than in the low-to-medium-export countries, but the difference between the above-average- and below-average-export countries is much smaller and insignificant. At last, both the share of investment in GDP and economic growth varies directly with the export ratio throughout, but the pattern is not significant.

Table 7. High-Export vs. Low-Export Countries: An Overview

Sample Size = 159	Export Ratio (Percent of GDP)	Population (Millions)	GNP *Per Capita* (U.S. dollars)	Agriculture (Percent of GDP)	Average Rate of Inflation, 1985–1994 (Percent)	Primary Exports (Percent of merchandise exports)	Investment Ratio (Percent of GDP)	Average Rate of Growth of GNP *Per Capita*, 1985-1994 (Percent)
Low	< 20	66	3900	28*	71	56	20	0.4
(t-value)		(1.1)	(0.8)	(2.3)	(0.8)	(0.0)	(1.2)	(0.6)
(# of countries)		(33)	(32)	(33)	(33)	(24)	(33)	(32)
Medium	20-50	35	5300	20*	44	57*	22	-0.0
(t-value)		(1.5)	(0.9)	(3.0)	(1.0)	(2.0)	(0.8)	(1.1)
(# of countries)		(87)	(87)	(85)	(85)	(67)	(82)	(85)
High	> 50	3*	6900	12*	20*	40*	24	0.9
(t-value)		(2.4)	(1.4)	(4.4)	(1.7)	(1.7)	(1.4)	(0.5)
(# of countries)		(39)	(38)	(36)	(36)	(16)	(34)	(36)
F-value		2.4	1.1	9.9*	1.2	2.1	1.2	0.8
Below-average	< 38	53*	5000	24*	59*	55	21	0.2
(t-value)		(2.5)	(0.7)	(4.1)	(1.8)	(0.4)	(1.6)	(0.5)
(# of countries)		(95)	(94)	(94)	(95)	(72)	94	(94)
Above-average	≥ 38	5*	6000	13*	19*	52	24	0.5
(t-value)		(2.5)	(0.7)	(4.1)	(1.8)	(0.4)	(1.6)	(0.5)
(# of countries)		(64)	(63)	(58)	(59)	(35)	55	(59)
F-value		6.0*	0.5	16.8*	3.1	0.2	2.6	0.2

Source: Author's computations.

Note: See note following Table 1. In the three-way comparison in the upper panel of the table, the critical F-value is 3.1 as before. In the two-way comparison in the lower panel, the critical F-value is 3.9.

The partial correlations among the key variables under review impart a similar overall impression (Table 8). These correlations are computed from the smaller sample of 105 countries for which all the variables under review are available. The export ratio is positively correlated with initial income, investment, and growth (see Figures 4, 8, and 9 for comparison), and negatively correlated with population, agriculture, primary exports, and inflation (see Figures 3, 5, 6, and 7). Growth is positively correlated with exports, population, initial income, and investment, and negatively correlated with agriculture, inflation, and primary exports (see Figures 10 to 13).

Table 8. Partial Correlations

Sample Size = 105	Export Ratio (Percent of GDP)	Population (Logarithm)	Initial GNP *Per Capita* (U.S. dollars)	Agriculture (Percent of GDP)	Average Rate of Inflation, 1985-1994 (Percent)	Primary Exports (Percent of Merchandise Exports)	Investment Ratio (Percent of GDP)	Average Rate of Growth of GNP *Per Capita*, 1985-1994 (Percent)
Export ratio (percent of GDP)	1	-0.37	0.23	-0.26	-0.21	-0.22	0.23	0.11
Population (logarithm)		1	-0.12	0.02	0.07	-0.27	0.13	0.16
Initial GNP *per capita* (U.S. dollars)			1	-0.76	-0.14	-0.45	-0.14	0.04
Agriculture (percent of GDP)				1	0.25	0.44	-0.14	-0.35
Average rate of inflation, 1985-1994 (percent)					1	0.14	-0.08	-0.46
Primary exports (percent of merchandise exports)						1	-0.18	-0.27
Investment ratio (percent of GDP)							1	0.44
Average rate of growth of GNP *per capita*, 1985-1994 (percent)								1

Source: Author's computations.

H. Open Economies

In Table 9, the sample is ranked by openness, defined as the difference between the actual ratio of exports to GDP in 1994 and the export ratio predicted by a linear regression of the export ratio on the logarithm of the population across countries to adjust for country size (see Figure 3).

Table 9. Open vs. Closed Economies: Actual Exports Less Predicted Exports in Percent of GDP, 1994

1.	Singapore	136	41.	Fiji	8	81.	Egypt	-2	121.	Dominican Rep.	-12
2.	Hong Kong	102	42.	Namibia	8	82.	Poland	-3	122.	Nepal	-12
3.	Malaysia	60	43.	Russia	8	83.	Turkey	-3	123.	Australia	-12
4.	Bahrain	56	44.	St. Lucia	8	84.	Kazakstan	-3	124.	Greece	-12
5.	Malta	41	45.	Indonesia	7	85.	Romania	-4	125.	Mali	-12
6.	Belgium	35	46.	Gambia	7	86.	Cameroon	-4	126.	Ethiopia	-14
7.	Luxembourg	34	47.	Croatia	7	87.	Pakistan	-4	127.	Bhutan	-14
8.	Slovak Rep.	33	48.	Iran	6	88.	Denmark	-4	128.	Nicaragua	-15
9.	Lithuania	31	49.	Zimbabwe	5	89.	Chile	-4	129.	Guatemala	-15
10.	Latvia	30	50.	Norway	4	90	Kyrgiz Rep.	-5	130.	Dominica	-15
11.	Guyana	29	51.	Honduras	3	91.	Malawi	-5	131.	Sao Tome	-16
12.	Ireland	28	52.	India	3	92.	Panama	-5	132.	Guinea	-17
13.	Estonia	25	53.	Sri Lanka	3	93.	Ukraine	-5	133.	Laos	-17
14.	United Arab Emirates	24	54	Seychelles	3	94.	Finland	-5	134.	Central African Republic	-19
15.	Czech Rep.	23	55.	Oman	3	95.	Hungary	-5	135.	Bolivia	-19
16.	Swaziland	22	56.	Tanzania	3	96.	Algeria	-6	136.	Argentina	-20
17.	Macao	22	57.	Austria	2	97.	United States	-6	137.	Peru	-20
18.	Djibouti	21	58.	Equat. Guinea	2	98.	Barbados	-6	138.	Sierra Leone	-22
19.	Netherlands	19	59.	Korea	2	99.	Ghana	-6	139.	Iceland	-22
20.	Azerbaijan	19	60.	Congo	2	100.	Israel	-7	140.	Niger	-22
21.	Bulgaria	19	61.	Canada	2	101.	Moldova	-7	141.	Burundi	-22
22.	China	19	62.	Nigeria	1	102.	Togo	-7	142.	Burkina Faso	-22
23.	Jamaica	16	63.	Belize	1	103.	Spain	-7	143.	Uganda	-23
24.	Botswana	16	64.	United Kingdom	1	104.	Vanatu	-7	144.	Uruguay	-23
25.	Gabon	15	65.	Senegal	1	105.	Ecuador	-8	145.	Myanmar	-24
26.	Thailand	15	66.	Mauritania	0	106.	Morocco	-8	146.	Chad	-24
27.	Slovenia	15	67.	Viet Nam	0	107.	Bangladesh	-8	147.	Maldives	-24
28.	Cote d'Ivoire	15	68.	Switzerland	0	108.	Portugal	-8	148.	El Salvador	-24
29.	Mauritius	14	69.	Germany	0	109.	Mozambique	-8	149.	Trinidad	-25
30.	Papua New Guinea	14	70.	Costa Rica	0	110.	Mexico	-9	150.	Western Samoa	-26
31.	Mongolia	14	71.	Georgia	-1	111.	New Zealand	-9	151.	Guinea-Bissau	-28
32.	Solomon Is.	12	72.	St. Vincent	-1	112.	Colombia	-10	152.	Albania	-28
33.	Belarus	12	73.	Armenia	-1	113.	Bahamas	-11	153.	Lesotho	-28
34.	Philippines	11	74.	Venezuela	-1	114.	Madagascar	-11	154.	Rwanda	-29
35.	Kuwait	11	75.	France	-1	115.	Zambia	-11	155.	Haiti	-32
36.	Tunisia	10	76.	Italy	-1	116.	Grenada	-11	156.	Comoros	-33
37.	Jordan	10	77.	Sweden	-2	117.	Benin	-11	157.	Cape Verde	-37
38.	Kenya	9	78.	Cyprus	-2	118.	Japan	-11	158.	Tonga	-39
39.	Saudi Arabia	9	79.	Macedonia	-2	119.	Paraguay	-11	159.	Surinam	-47
40.	St. Kitts and Nevis	9	80.	South Africa	-2	120	Brazil	-12			

Source: Author's computations.

Note: Openness is defined as the difference between the actual ratio of exports to GDP in 1994 and the export ratio predicted by the following regression: $X/Y = 86.3 - 5.7 \ln(N)$, where X/Y is the export ratio measured in percent of GDP and N is the population in millions. The t-statistics are 11.0 and 6.4, respectively, and $R^2 = 0.21$. Thus, each doubling of the population reduces the export ratio by 4 points (as ln(2) times 5.7 =4). The regression is based on the largest possible sample, 159 countries.

Unsurprisingly, the list is headed by Singapore and Hong Kong. Belgium and Ireland, as mentioned in the introduction, are also high up on the list, as are the Baltic countries, while Denmark and Sweden export slightly less in proportion to GDP than predicted by the regression. Japan is far below average: its actual export ratio is 9 percent (see Figure 1), compared with 20 percent based on the regression. Argentina and Peru are very closed: their actual export ratios, 7 percent and 9 percent, respectively, are 20 points below par according to the regression.

Table 10. Open vs. Closed Economies: An Overview

Sample Size = 159	Openness (Percent of GDP)	Population (Millions)	GNP *Per Capita* (U.S. dollars)	Agriculture (Percent of GDP)	Average Rate of Inflation, 1985-1994 (Percent)	Primary Exports (Percent of Merchandise exports)	Investment Ratio (Percent of GDP)	Average Rate of Growth of GNP *Per Capita*, 1985–1994 (Percent)
Closed	< -10	14	3100*	30*	82*	68*	21	0.2
(t-value)		(1.6)	(2.0)	(4.4)	(2.0)	(2.2)	(0.0)	(0.1)
(# of countries)		(47)	(46)	(45)	(47)	(26)	(45)	(46)
Medium	-10-10	41	6000	17*	27	53*	21*	0.3
(t-value)		(0.0)	(0.6)	(4.4)	(0.2)	(2.0)	(1.9)	(0.1)
(# of countries)		(77)	(77)	(74)	(75)	(61)	(72)	(75)
Open	> 10	42	7100*	11*	26	38*	25	0.4
(t-value)		(0.9)	(2.2)	(5.6)	(1.3)	(4.0)	(1.3)	(0.2)
(# of countries)		(35)	(34)	(33)	(32)	(20)	(32)	(32)
F-value		0.8	2.7	17.7*	2.7	6.5*	1.4	0.0
Below-average	≤ 0	23	4900	24*	60*	57	21*	-0.1
(t-value)		(1.3)	(0.8)	(3.9)	(1.8)	(1.4)	(2.1)	(1.4)
(# of countries)		(94)	(93)	(89)	(93)	(66)	(93)	(92)
Above-average	> 0	49	6000	14*	19*	49	24*	0.8
(t-value)		(1.3)	(0.8)	(3.9)	(1.8)	(1.4)	(2.1)	(1.4)
(# of countries)		(65)	(64)	(63)	(61)	(41)	(66)	(61)
F-value		1.7	0.7	15.5*	3.2	1.9	4.4*	2.0

Source: Author's computations.

Note: See notes following Tables 7 and 9.

Table 10 provides yet another view of the landscape by classifying the sample by openness rather than by high vs. low exports, see Table 7. According to this classification, some large countries (e.g., China, India, Indonesia, and Russia) are in the open category (i.e., with openness > 0), even though their export ratios are below the world average. Likewise, a few small countries (e.g., Armenia, Barbados, Costa Rica, and Cyprus) are classified as closed (i.e., with openness ≤ 0) despite export ratios above the world average. The table shows that the closed economies are generally smaller (i.e., less populous) and poorer than the open economies, but the pattern is generally not significant, except the closed economies have significantly less *per capita* GNP than the medium-to-open economies. Agriculture, inflation,

and primary exports all vary inversely and significantly with openness, except the inflation differential between the medium-range and open economies is very small and insignificant and the primary export differential is insignificant in a two-way comparison between the above-average- and below-average-open economies. The investment ratio and economic growth both vary directly with openness, but the pattern of significance is mixed.

III. Regression Analysis

International trade lifts the level of output that can be produced from given inputs through increased efficiency. Trade is thus tantamount to an improvement in technology: it raises the level of income *per capita*, at least until all profitable trading opportunities have been exploited in full, and perhaps also its rate of growth in the long run (see, e.g., Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991; and Dowrick, 1995). In models of exogenous growth (Solow, 1956; see also Mankiw, Romer, and Weil, 1992, and Mankiw, 1995), the effects of trade on growth are temporary: they peter out over time. In models of endogenous growth (Romer 1986, 1994), however, increased trade provides a permanent boost to growth.

In empirical work, it may be difficult to distinguish the temporary, medium-term effects of trade on growth in neoclassical, exogenous-growth models from the permanent, long-run effects of trade on endogenous growth. Indeed, Kuznets (1966) and Chenery (1979), among others, studied the empirical relationship between economic structure and development long before the advent of endogenous growth theory. In any case, some of the major determinants of exports are potential sources also of economic growth, but not all: for example, a large population, as we have seen, is likely to be associated with low exports, other things being equal, but this is no reason to expect large (i.e., populous) countries to grow less rapidly than small ones, because an increase in population *replaces* exports by increasing the domestic market.

A. Exports

Table 11 shows the results of regressing the ratio of exports to GDP in 1994 on three variables: (i) the logarithm of the population in 1994; (ii) the distortion caused by inflation, measured (as in Gylfason, 1997) by $\pi/(1+\pi)$,[9] where π is the average annual rate of inflation in 1985-1994; and (iii) the share of primary exports in merchandise exports in 1993 (or earlier in a few cases, depending on available data). The sample now contains 105 countries, mainly because data on primary exports are not available in a number of cases, see Table 4.

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[9]This variable measures the magnitude of the inflation distortion and, equivalently, the inflation tax rate. It is intended to capture the nonlinear relationship between inflation and growth; growth is less sensitive to an increase in inflation from 500 percent a year to 600 percent than to an increase from 0 to 100 percent.

Table 11. Export-Ratio Equations without Agriculture

Dependent Variable = Export Ratio	All Countries	Low-Income Countries (< $700)	Middle-Income Countries ($700-9000)	High-Income Countries (> $9000)	Open Economies (> 0)	Closed Economies (≤ 0)
Constant	110.1*	99.7*	87.8*	223.8*	162.3*	64.6*
	(8.2)	(6.3)	(5.8)	(3.7)	(7.0)	(9.1)
	[6.0]	[6.3]	[4.6]	[2.8]	[6.0]	[6.9]
Population	-6.4*	-6.1*	-3.7*	-16.2*	-9.9*	-3.8*
	(5.0)	(4.6)	(2.5)	(3.0)	(4.4)	(5.8)
	[4.4]	[4.7]	[2.1]	[2.5]	[5.3]	[4.3]
Inflation	-15.9*	-8.6	-27.0*	-217.2	-15.8	-3.6
	(1.5)	(1.0)	(2.3)	(1.0)	(0.6)	(0.8)
	[2.7]	[1.2]	[2.6]	[1.2]	[0.9]	[0.8]
Primary exports	-0.26*	-0.14*	-0.27*	-0.7*	-0.4*	-0.1*
	(3.6)	(2.0)	(2.8)	(2.0)	(3.0)	(2.2)
	[2.9]	[1.8]	[2.5]	[2.0]	[2.6]	[2.4]
Mean of dependent variable	34.4	29.9	33.2	42.8	51.0	23.8
SE	21.1	11.0	16.7	33.7	24.2	8.2
R^2	0.27	0.43	0.33	0.31	0.41	0.38
Chow's F-test	1.7	0.4	1.7	2.8*	18.5*	18.5*
(p-value)	(0.10)	(0.81)	(0.10)	(0.03)	(0.00)	(0.00)
White's F-test	1.6	0.4	1.0	1.1	1.0	4.3*
(p-value)	(0.17)	(0.86)	(0.42)	(0.41)	(0.42)	(0.0)
Sample size	105	33	47	25	41	64

Source: Author's computations.

Note: The dependent variable is the ratio of exports to GDP expressed in percent. Two sets of t-statistics are shown within parentheses and within brackets below each coefficient estimate. The ones within parentheses are conventional. The ones within brackets have been corrected for heteroscedasticity by White's (1980) method. An asterisk (*) indicates either that the coefficient in question is significantly different from zero at the 0.05 level in a one-tailed test or that the F-test statistic in question is significantly higher than the critical value at the 0.05 level in a two-tailed test, as indicated by the associated probability value ($p < 0.05$) shown within parentheses. SE denotes the standard error of regression. For the division of the sample into subgroups, see Tables 2 and 8.

The regression was first run for the sample as a whole. Chow-tests for structural differences indicated a need to run the regression also separately for low-, middle-, and high-income countries, see Table 2, and for open and closed economies, see Table 10. Specifically, the regression for the high-income group differs significantly from the regression (not shown) for the other two groups combined, as indicated by Chow's F-statistic of 2.8* (with $p = 0.03$), and the difference between the regressions for the open and closed economies is also highly significant.[10]

[10]Similarly, the Chow-test reported for the low-income countries applies to a comparison

(continued...)

White's (1980) method was used to correct for heteroscedasticity: corrected t-statistics are shown within brackets below the uncorrected t-values in the table. If the corrected and uncorrected t-values differ markedly, heteroscedasticity may be inferred. White's F-test for heteroscedasticity, assuming no cross terms, is also reported for each regression near the bottom of the table. The test statistics indicate that the regressions are all free of heteroscedasticity except the one for the closed economies.

The pattern of the means of the dependent variables in the low-, middle-, and high-income countries is similar to that shown in Table 2, but the means are not identical in the two tables, because the samples in Table 11 are smaller due to the inclusion of primary exports in the regressions.

The population is highly significant in all six equations. The estimated coefficient -6.4 in the sample at large means that each doubling of the population reduces the export ratio by 4.4 percentage points (i.e., ln(2) times 6.4). In general, large countries export less than small ones.

The effect of inflation is also highly significant in the sample as a whole at the 0.05 level (in a one-tailed test, corrected for heteroscedasticity). An increase in inflation from 5 to 50 percent per year from one country to another increases the inflation distortion $\pi/(1+\pi)$ from 0.048 to 0.333, and thus reduces the export ratio by 4.5 percentage points (i.e., (0.333-0.048) times 15.9). In the middle-income group, which, with 47 countries, is the largest of the three income groups, the inflation effect is significant, but it is not significant in either the low-income or high-income group, where the coefficient is large, because the variation in the inflation distortion is small, nor is it significant in the open and closed categories. Even so, the inflation coefficient is negative everywhere.

The effect of primary exports is negative and significant throughout. An increase in the share of primary exports in merchandise exports by 4 percentage points from one country to another reduces the export ratio by one point in the sample as a whole. Thus, other things being equal, in countries that are highly dependent on natural resources (with a primary export share of, say, 80 percent), the export ratio is about 16 points below that of other countries that depend on primary exports for only 20 percent of merchandise exports (because 0.26 times (80-20) is 15.6). The effect of primary exports is somewhat smaller in the low-income and closed economies, and it is larger in the high-income countries, where the variation in natural resource dependence is smaller, and also in the open economies.

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[10](...continued)
between them and the medium and high-income countries combined. The Chow-test for the middle-income countries and also for the sample as a whole is based on a comparison between the three subregressions, one for each income group.

Table 12 shows the results obtained when the share of agriculture in GDP is added to the list of explanatory variables in the export equations, see Table 3. The Chow tests now bear witness to significant differences among all the subgroups, even though the standard error of the regression for the low-income group does not differ significantly from the standard error of the regression (not shown) for the middle- and high-income groups combined. The White tests indicate the absence of heteroscedasticity everywhere except in the high-income group and the closed economies.

The effect of agriculture on exports is negative in all six regressions in Table 12, but this effect is significant only in the low-income and high-income countries. As suggested in Section II above, too much agriculture may ultimately harm total exports, because international trade in farm products is generally less free than trade in manufactured products and in most services, and also because agriculture does generally not make intensive use of highly qualified manpower and high technology that confer significant external benefits on other industries. Because of multicollinearity, the effects of primary exports on total exports are now significant only in the middle-income and closed economies as well as in the sample as a whole. The externality argument about agriculture advanced above may also apply to some forms of primary production involving raw labor and low technology. The effects of inflation on exports are reduced by the inclusion of agriculture in the equations, but the qualitative pattern and significance of these effects are hardly affected at all. The inferences drawn thus far are generally not sensitive to the correction for heteroscedasticity.

Table 12. Export-Ratio Equations with Agriculture

Dependent Variable = Export Ratio	All Countries	Low-Income Countries (< $700)	Middle-Income Countries ($700-9000)	High-Income Countries (> $9000)	Open Economies (> 0)	Closed Economies (≤ 0)
Constant	109.1*	98.6*	92.3*	287.5*	160.0*	64.8*
	(8.1)	(6.6)	(5.9)	(5.4)	(6.3)	(9.0)
	[6.1]	[7.4]	[5.2]	[3.6]	[6.3]	[7.1]
Population	-6.2*	-5.4*	-3.9*	-21.4*	-9.6*	-3.8*
	(4.8)	(4.6)	(2.6)	(4.6)	(3.8)	(5.8)
	[4.4]	[4.4]	[2.4]	[3.3]	[5.4]	[4.3]
Inflation	-13.8*	-3.5	-25.6*	-74.4	-12.4	-3.2
	(1.3)	(0.4)	(2.1)	(0.4)	(0.4)	(0.7)
	[2.3]	[0.4]	[2.4]	[0.3]	[0.7]	[0.7]
Primary exports	-0.22*	-0.10	-0.25*	-0.26	-0.34*	-0.07*
	(2.8)	(1.3)	(2.6)	(0.8)	(2.2)	(1.7)
	[2.8]	[1.2]	[2.5]	[1.0]	[2.7]	[1.7]
Agriculture	-0.16	-0.31*	-0.27	-9.8*	-0.10	-0.05
	(1.0)	(1.9)	(1.1)	(3.3)	(0.2)	(0.7)
	[1.3]	[1.7]	[1.3]	[2.1]	[0.4]	[0.7]
Mean of dependent variable	34.4	29.9	33.2	42.8	51.0	23.8
SE	21.1	10.5	16.7	27.7	24.5	8.2
R^2	0.27	0.49	0.35	0.56	0.41	0.39
Chow's F-test	4.3*	0.6	4.3*	8.0*	14.2*	14.2*
(p-value)	(0.00)	(0.67)	(0.00)	(0.00)	(0.00)	(0.00)
White's F-test	1.4	0.2	0.8	4.4*	1.0	2.9*
(p-value)	(0.21)	(0.99)	(0.59)	(0.01)	(0.47)	(0.01)
Sample size	105	33	47	25	41	64

Source: Author's computations.

Note: See note following Table 11.

B. Economic Growth

Table 13 shows the results obtained by regressing the average annual rate of growth of real *per capita* GNP, 1985-1994 on (i) the logarithm of initial income per person, defined as before as *per capita* GNP in 1994 divided by (1+g), where g is the average annual rate of growth of *per capita* GNP, 1985-1994; (ii) the share of investment in GDP in 1994, which may be viewed as a proxy for the investment climate in 1985-1994; (iii) the inflation

distortion, as defined above; and (iv) the share of primary exports in total merchandise exports in 1993 (or earlier, as before).[11] As in the export equations, the Chow tests indicate significant differences among the subgroups, except the regression for the high-income group does not differ significantly from the regression (not shown) for the other two groups combined. According to the White test, the residuals of the regression for the sample as a whole and for the closed economies are heteroscedastic, but the regressions for all the other subgroups appear to be free of heteroscedasticity.

Table 13. Growth Equations without Agriculture

Dependent Variable = Average Growth 1985–1994	All Countries	Low-Income Countries (< $700)	Middle-Income Countries ($700–9000)	High-Income Countries (> $9000)	Open Economies (> 0)	Closed Economies (≤ 0)
Constant	0.09	20.8*	6.7	24.2*	4.3	-0.9
	(0.0)	(4.7)	(1.3)	(4.5)	(1.1)	(0.3)
	[0.0]	[5.6]	[1.6]	[3.4]	[1.3]	[0.4]
Initial income	-0.11	-3.4*	-1.0*	-2.5*	-0.4	-0.1
	(0.5)	(5.7)	(1.8)	(4.9)	(1.2)	(0.3)
	[0.7]	[5.8]	[2.3]	[3.9]	[1.6]	[0.4]
Investment	0.18*	0.07	0.16*	0.17*	0.17*	0.20*
	(4.6)	(1.5)	(2.6)	(4.1)	(3.0)	(3.8)
	[4.0]	[1.2]	[2.4]	[3.2]	[2.8]	[2.6]
Inflation	-8.0*	-8.5*	-2.8	-11.5	-19.3*	-6.5*
	(5.2)	(3.8)	(1.5)	(1.7)	(5.8)	(3.6)
	[3.0]	[3.2]	[1.4]	[1.7]	[4.1]	[2.2]
Primary exports	-0.02*	-0.02	-0.02	-0.01	-0.05*	-0.02
	(1.8)	(1.4)	(0.9)	(1.3)	(2.8)	(0.9)
	[2.0]	[1.6]	[0.9]	[1.0]	[3.8]	[1.2]
Mean of dependent variable	0.5	-1.4	0.9	2.2	1.1	0.0
SE	3.2	2.6	2.8	1.0	2.8	3.2
R^2	0.40	0.78	0.32	0.75	0.61	0.36
Chow's F-test	7.6*	13.1*	7.67*	1.0	2.8*	2.8*
(p-value)	(0.00)	(0.00)	(0.00)	(0.42)	(0.02)	(0.02)
White's F-test	5.6*	2.0	0.8	2.2	0.7	4.8*
(p-value)	(0.00)	(0.10)	(0.64)	(0.08)	(0.67)	(0.00)
Sample size	105	33	47	25	41	64

Source: Author's computations.

Note: See note following Table 11. The dependent variable is the average annual rate of growth of *per capita* GNP, 1985-1994, expressed in percent.

[11]Early studies of economic growth across countries by regression analysis include Kormendi and Meguire (1985), Chenery, Robinson, and Syrquin (1986), and Barro (1991).

The effect of initial income on growth is negative in all six equations, other things being equal, and significant in each income group *per se*. Within the low-income group, doubling of initial *per capita* GNP reduces growth by 2.4 percent per year (i.e., ln(2) times 3.4), *ceteris paribus*. In the high-income group, a doubling of initial income per head—say, from $10,000 to $20,000 per year—reduces growth by 1.7 percent (i.e., ln(2) times 2.5). These results seem consistent with conditional convergence within each of the three income groups (or convergence clubs), but the evidence for the sample as a whole is weak (see Sachs and Warner, 1995a, Barro and Sala-i-Martin, 1992, and de la Fuente, 1995).

For comparison, in the growth regressions reported by Barro and Sala-i-Martin (1995, p. 425) for a large sample of high-income and low-income countries, the coefficient on the logarithm of initial *per capita* income is -0.026, which means that each doubling of initial income per head reduces growth by 1.8 percent and that convergence occurs at the rate of 3 percent per year.[12] They do not find a significant difference between the speed of convergence in high-income and low-income countries (p. 436). They also report that using World Bank data on GNP without regard to differences in purchasing power across countries rather than the purchasing-power-parity-adjusted data compiled by Summers and Heston (1993) reduces the coefficient on initial income by almost a half, or from -0.026 to -0.014, and they attribute this difference to the greater spread in the World Bank data (1995, p. 445).

The effect of investment on the rate of growth of *per capita* GNP is strong and significant everywhere except in the low-income group. An increase in investment by 5 percent to 6 percent of GDP from one country to another increases growth by 1 percent per year. This result needs to be taken with a grain of salt, however, because investment is endogenously determined in the growth process and the investment figures are not adjusted for quality. Barro and Sala-i-Martin (1995, p.425) report a much weaker and less stable link between investment and growth; their sole significant estimate of the investment coefficient is 0.07 (t = 3.7).

The inflation coefficient is also negative and highly significant everywhere except in the medium-to-high-income countries, where the inflation effects are only marginally insignificant. An increase in the annual average inflation rate from 5 percent to 50 percent from one country to another reduces the average rate of growth of GNP per head by 2.3 percent (i.e., (0.333-0.048) times 8.0). The corresponding reduction in growth implied by the estimates for the low-income countries is 2.4 percent, and 5.5 percent and 1.9 percent in the open and closed economies, respectively. For comparison, Fisher's (1993) regression estimates based on the Summers-Heston data indicate that an increase in inflation from 5 percent to 50 percent per year from one country to another reduces the rate of growth of GDP by 1.8 percent per year.

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[12]Barro (1991) and Mankiw, Romer, and Weil (1992) report a similar result.

The effect of primary exports on growth is also negative in all the regressions, and statistically significant in the sample as a whole as well as in the open economies. Other things being equal, in countries with a primary export share of 80 percent, the rate of growth of *per capita* GNP will be 1.2 percent below that of other countries where primary exports account for only 20 percent of merchandise exports (because 0.02 times (80-20) is 1.2). In the open economies, the effect of primary exports on growth, like the effects of initial income and inflation, is even stronger. These results rhyme well with the recent evidence produced by Sachs and Warner (1995a).

For the record, the export ratio and openness, as defined in Table 9, were also included among the regressors in the growth equations, but neither variable proved significant.

Table 14 shows the results obtained when agriculture is added to the list of regressors in the growth equations in the spirit of Chenery, Robinson, and Syrquin (1986). The Chow tests and the White tests show the same pattern of structural differences and of hetero- *vs.* homoscedasticity as the results in Table 13. The effect of agriculture on growth is negative in all six regressions, and is highly significant everywhere except in the middle-to-high-income countries and the open economies. In the sample as a whole, each 8 point increase in the share of agriculture in GDP from one country to another reduces growth by one percentage point, *ceteris paribus*. The negative effects of primary exports on growth become marginally insignificant in the sample as a whole, but this link remains significant in the open economies. As in the export equations before, the negative effects of inflation on growth are reduced slightly by the inclusion of agriculture, but the qualitative pattern and significance of these effects remain approximately the same. The effect of initial income on growth remains negative throughout, and is now substantial and significant in the sample as a whole as well as in all the subregressions except the open economies: in the sample at large, each doubling of initial income per head reduces growth by 0.7 percent (i.e., ln(2) times 1.0).

Table 14. Growth Equations with Agriculture

Dependent Variable = Average Growth 1985–1994	All Countries	Low-Income Countries (< $700)	Middle-Income Countries ($700-9000)	High-Income Countries (> $9000)	Open Economies (> 0)	Closed Economies (≤ 0)
Constant	9.4*	29.0*	13.2*	24.6*	6.5	10.9*
	(2.6)	(5.8)	(1.9)	(3.9)	(1.2)	(2.4)
	[3.2]	[6.9]	[2.5]	[3.7]	[1.7]	[2.6]
Initial income	-1.0*	-4.2*	-1.7*	-2.6*	-0.6	-1.1*
	(2.9)	(6.8)	(2.3)	(4.4)	(1.2)	(2.7)
	[3.3]	[7.0]	[2.9]	[4.2]	[1.7]	[2.6]
Investment	0.13*	0.02	0.14*	0.16*	0.17*	0.12*
	(3.3)	(0.5)	(2.1)	(3.6)	(2.9)	(2.4)
	[3.9]	(0.5)	[2.1]	[3.8]	[3.0]	[2.2]
Inflation	-7.0*	-6.1*	-2.6	-11.2	18.4*	-5.9*
	(4.7)	(2.8)	(1.3)	(1.6)	(5.1)	(3.6)
	[3.1]	[2.9]	[1.3]	[1.5]	[3.9]	[2.5]
Primary exports	-0.02	-0.02	-0.01	-0.01	-0.04*	-0.01
	(1.7)	(1.2)	(0.8)	(1.0)	(2.4)	(0.9)
	[1.8]	[1.5]	[0.8]	[0.8]	[3.2]	[1.2]
Agriculture	-0.12*	-0.11*	-0.07	-0.02	-0.04	-0.14*
	(3.5)	(2.7)	(1.4)	(0.1)	(0.6)	(3.4)
	[3.0]	[3.5]	[1.7]	[0.1]	[0.6]	[2.7]
Mean of dependent variable	0.5	-1.4	0.9	2.2	1.1	0.0
SE	3.0	2.4	2.7	1.0	2.8	2.9
R^2	0.46	0.83	0.35	0.75	0.61	0.46
Chow's F-test	6.1*	10.0*	6.1*	1.5	2.5*	2.5*
(p-value)	(0.00)	(0.00)	(0.00)	(0.20)	(0.03)	(0.03)
White's F-test	2.8*	1.2	0.6	2.6	1.0	2.9*
(p-value)	(0.00)	(0.36)	(0.80)	(0.05)	(0.48)	(0.01)
Sample size	105	33	47	25	41	64

Source: Author's computations.
Note: See note following Table 13.

But if the share of agriculture in GDP falls by, say, 6 points when income per head doubles, the rate of growth will remain unchanged. Moreover, if increased income per head from one country to another coincides with a contraction of agriculture and of primary exports and a deceleration of prices (see Tables 7 and 10), then the rate of growth of *per capita* GNP may increase. Thus, the evidence of conditional convergence presented above is fully consistent with broad *di*vergence of incomes per head across countries. However, more importantly, economic policies and institutions aimed at less dependence on agriculture and primary exports and less inflation appear likely to lift the level of output *and* its rate of growth, especially in the low-to-medium-income countries. This possibility needs further empirical scrutiny in future work.

The inferences drawn from the growth equations in Tables 13 and 14 are generally not sensitive to the correction for heteroscedasticity.

IV. Conclusion

Because inflation is a monetary phenomenon and economic growth is real, many economists believe that inflation is unlikely to have lasting, systematic effects on growth.[13] Others disagree, including central bankers: they argue that price stability is a prerequisite for rapid growth.

Up to a point, the evidence reported in this article can be viewed as support for the latter view. High inflation over the last ten years has tended to be associated with low exports in proportion to GDP and also with slow growth in a large group of countries at all income levels. Three possible sources of the reported linkages between inflation, exports, and growth have been suggested: (i) inflation-induced overvaluation of national currencies in real terms (Edwards, 1992, 1993); (ii) inflation-induced production distortions driving a wedge between the returns to real and financial capital (Fischer, 1974, Gylfason, 1997); and (iii) the potentially deleterious effects of inflation on saving and investment (Gylfason and Herbertsson, 1996). These possibilities merit further investigation.

Moreover, we have seen that abundant natural resources may be a mixed blessing, if excessive dependence on primary exports tends to be associated with low total exports and slow growth, as found also by Sachs and Warner (1995a), and Gylfason, Herbertsson, and Zoega (1997). The most likely explanation for this link is that an abundance of natural resources leads to the Dutch disease, involving overvaluation of the national currency and wage distortions, in addition to rent seeking that is costly from a macroeconomic point of view (see, e.g., Bhagwati, 1982, and Lane and Tornell, 1995). Nations rich in natural resources (oil, minerals, fish, forests, etc.) need to manage their wealth in ways that are consistent with rapid, sustainable growth of the modern sector, including manufacturing, trade, and services, by creating appropriate market-based incentives through property rights and Pigovian fees (see, e.g., Hannesson, 1996).

Economic theory and experience suggest, as is well known, that exports, investment, and education are important potential sources of economic growth (see, e.g., World Bank, 1994).[14] Even so, opinions are divided on the relative importance of exports and investment,

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[13]For example, Barro and Sala-i-Martin (1995) do not mention inflation as a potential determinant of growth. See also Sala-i-Martin's skeptical discussion of Fischer (1991, pp. 368-378). But see also Barro (1995), where inflation is reported to be inversely associated with economic growth across countries.

[14]In the words of Lewis (1955, p. 164), "The proximate causes of economic growth are the

(continued...)

for instance, in the East Asian miracle (Krugman, 1994, Rodrik, 1994, and Young, 1995). Regressions of growth rates across countries on direct measures of these variables are not likely to settle the issue. This article is no exception. It has been argued here that only those factors that reduce, rather than replace, exports can be expected also to reduce economic growth. Small countries generally export more of their output than large countries without necessarily growing more rapidly, *ceteris paribus*.

Similarly, gigantic investment does not guarantee rapid, sustainable growth, because only those factors that encourage high-quality investment (e.g., stable prices and proper incentives) can be expected to foster economic growth. The determinants of good investment (e.g., business climate indicators, inflation, and the share of state enterprises in total investment, see World Bank, 1995c) are probably better suited as regressors in growth equations than investment rates without adjustment for quality, even though unadjusted investment rates exert a fairly strong and robust influence on economic growth across countries according to the results reported here. This is a topic for further empirical research, and so is the development and econometric implementation of indicators of good governance and of the quality of human capital as needed to quantify the international linkages between education and economic growth without measuring output (education) by input (school enrollment or expenditure on education).

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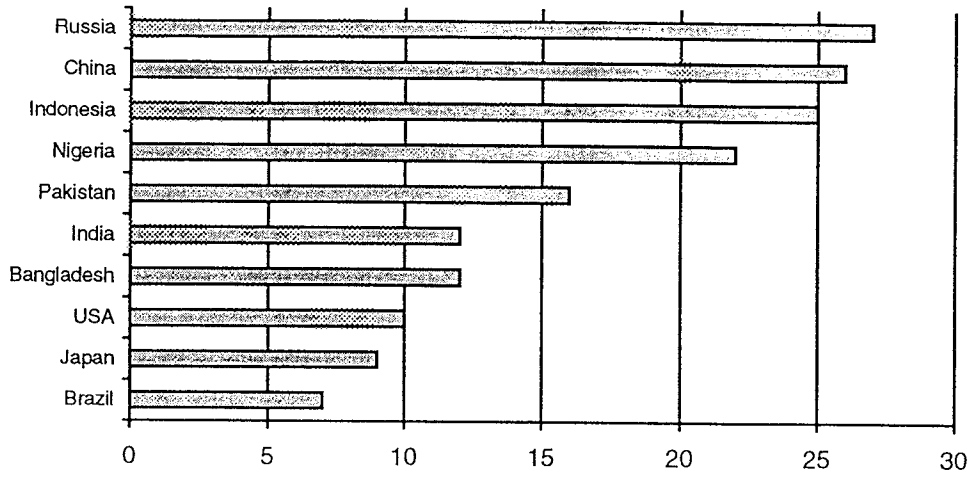
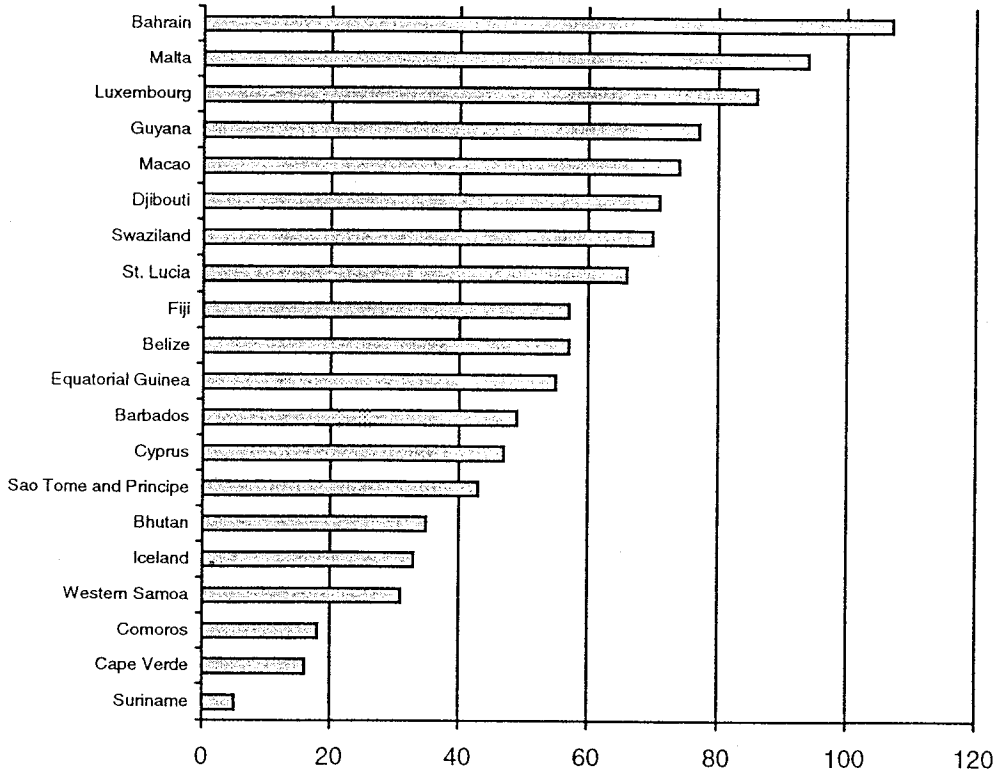
[14](...continued)
effort to economize, the accumulation of knowledge, and the accumulation of capital."

Figure 1. Ten Large Countries: Exports in Per Cent of GDP, 1994



Source: World Bank *Atlas*, 1996.
Note: The figure includes countries with populations of 100 million or more.

Figure 2. Twenty Small Countries: Exports in Per Cent of GDP, 1994



Source: World Bank *Atlas*, 1996.
Note: The figure includes countries with populations between 100.000 and 1 million, and for which data on exports are available.

Figure 3. The Export Ratio and Population in 159 Countries

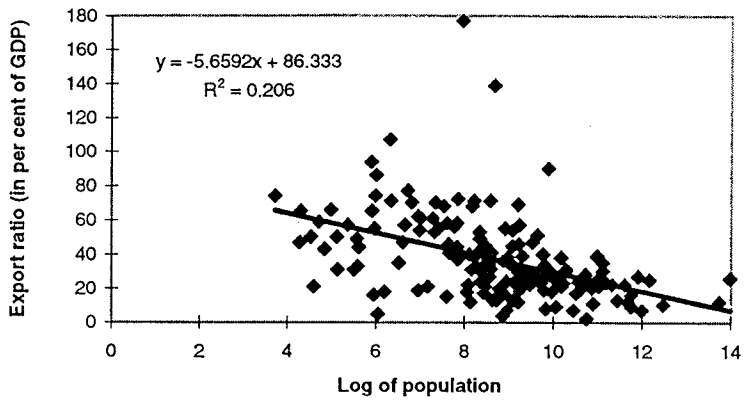


Figure 4. The Export Ratio and Income Per Head in 157 Countries

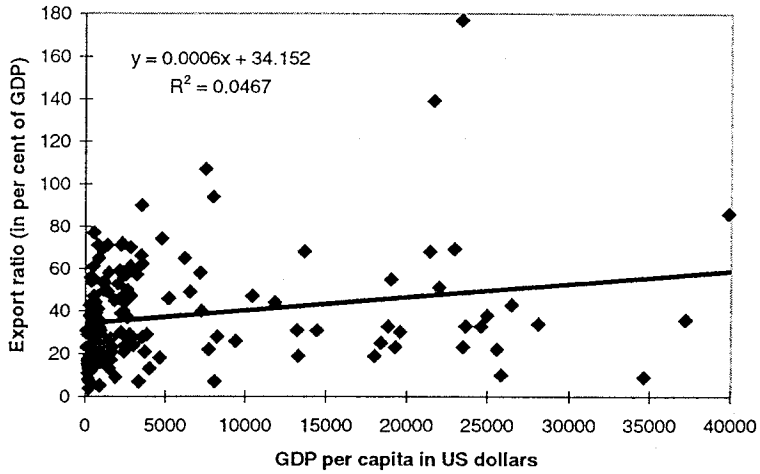


Figure 5. The Export Ratio and Agriculture in 148 Countries

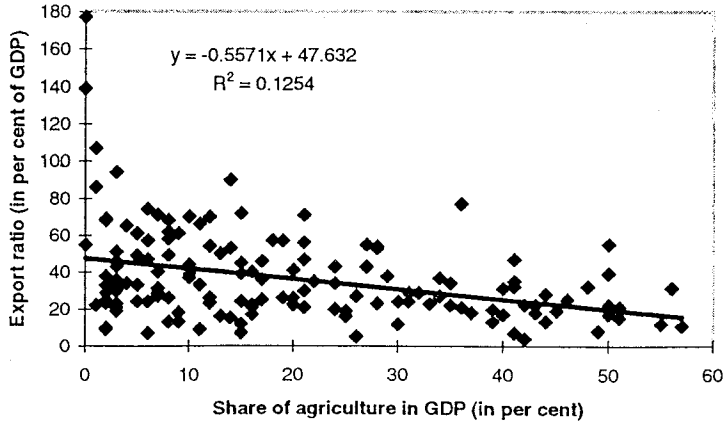


Figure 6. The Export Ratio and Primary Exports in 108 Countries

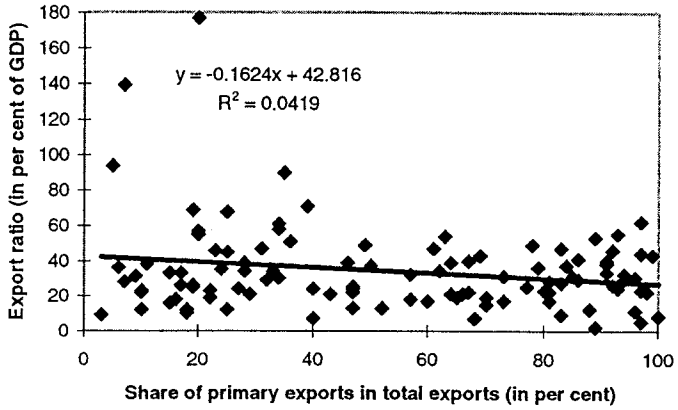


Figure 7. The Export Ratio and Inflation in 159 Countries

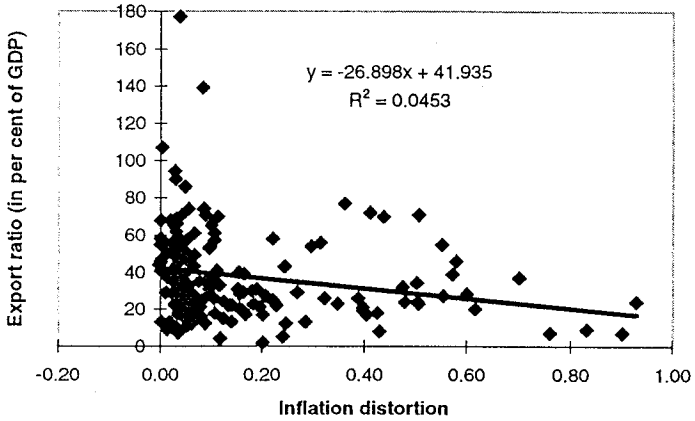


Figure 8. The Export Ratio and Investment in 149 Countries

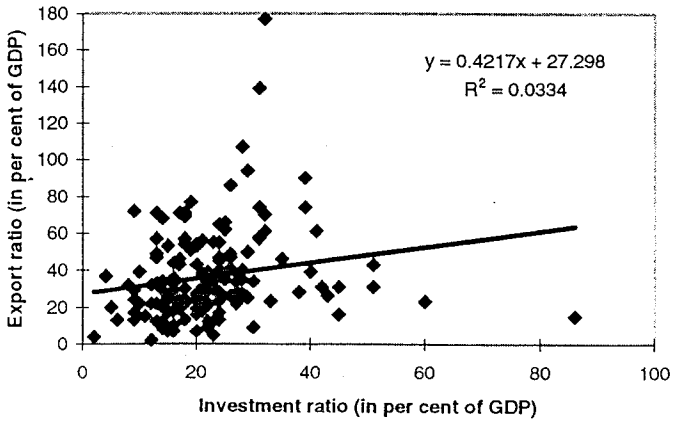


Figure 9. The Export Ratio and Growth in 153 Countries

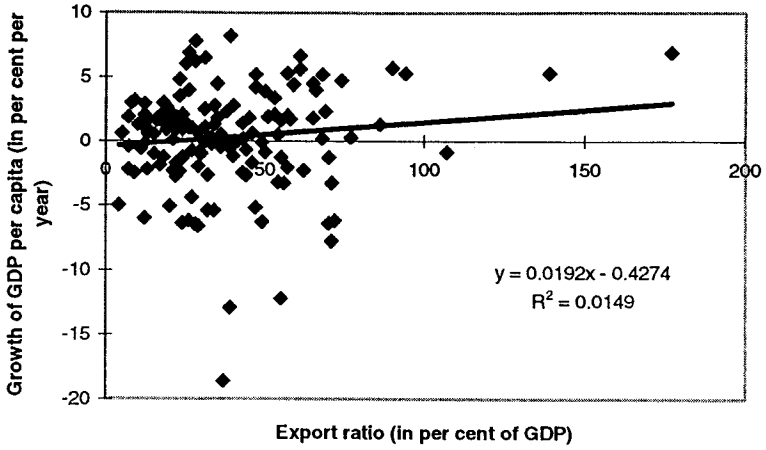


Figure 10. Growth and Investment in 147 Countries

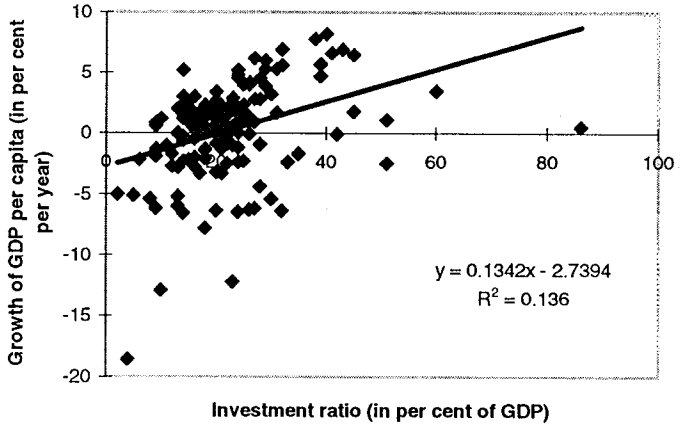


Figure 11. Growth and Inflation in 154 Countries

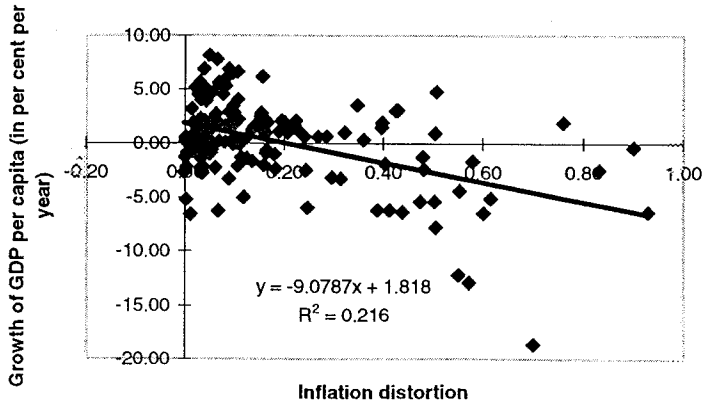


Figure 12. Growth and Agriculture in 148 Countries

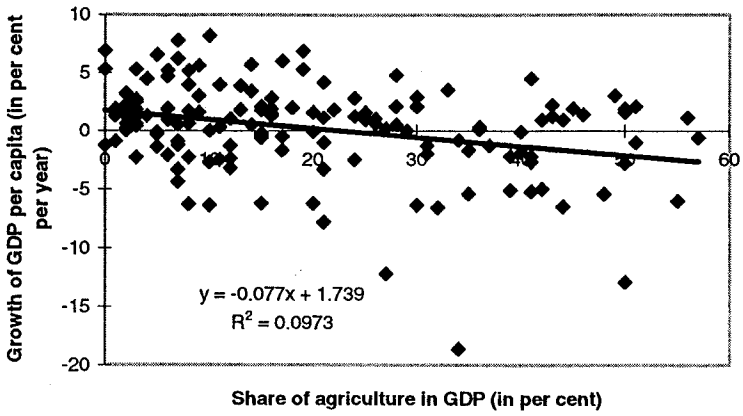
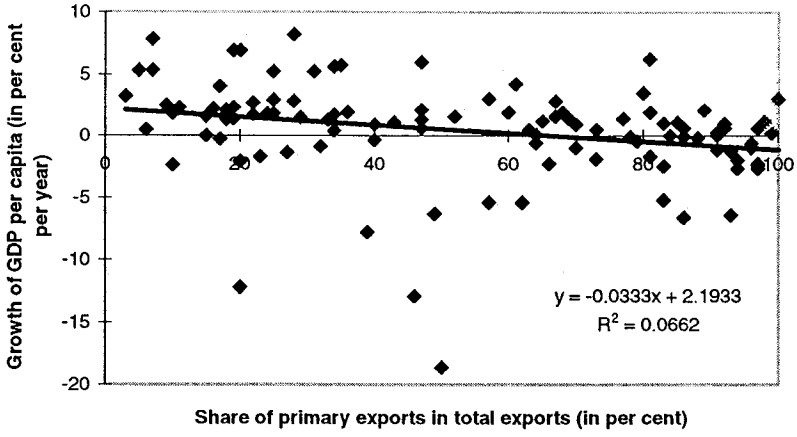


Figure 13. Growth and Primary Exports in 107 Countries



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