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TRADE OPENNESS AND GROWTH: WHO BENEFITS?

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We investigate the relationship between economic growth and foreign trade, testing whether the benefits of trade vary over time and across countries. Our results confirm previous findings that specialization in primary exports is bad for growth. While trade openness promoted convergence in the 1960s and 1970s, we find that since 1980 the benefits of trade accrued mostly to the richer economies, with little benefit to the less developed economies. Most of the dynamic benefits of trade are obtained through productivity growth, with a small contribution coming through increased investment.

I. INTRODUCTION

In this paper we examine and contribute to debates on the dynamic benefits of trade. We focus on the distribution of such benefits between the more developed and the less developed economies. These issues are part of the broader debate over the distribution of the costs and benefits of globalization, which has been defined by Fischer (2003, p. 3) in his Ely Lecture to the American Economic Association as 'the ongoing process of greater economic interdependence among countries, reflected in the increasing amount of cross-border trade in goods and services, the increasing volume of international financial flows and increasing flows of labour'.

An important qualification to Fischer's definition is that the second era of globalization, since 1950, is characterized much less by flows of permanent migrants than was the first era of modern globalization, 1870–1913, as analysed in Williamson (1996). Furthermore, the World Bank (2002) defines a third wave of globalization that began around 1980, based on technological advances in transport and communications.

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The World Bank (2002) emphasizes the advantages of trade openness for developing economies in the context of the second and third waves of globalization. It classifies developing countries into the more globalized and the less globalized, summarizing their relative economic performance as follows:

> Some 24 developing countries—with 3 billion people—have doubled their ratio of trade to income over the past two decades. The rest of the developing world trades less today than it did 20 years ago. The more globalized developing countries have increased their *per capita* growth rate from 1 per cent in the 1960s to 3 per cent in the 1970s, 4 per cent in the 1980s, and 5 per cent in the 1990s. . . . much of the rest of the developing world—with about 2 billion people—is becoming marginalized. Their aggregate growth rate was actually negative in the 1990s. (World Bank, 2002, pp. 4–5)

The World Bank qualifies the benefits of trade openness, noting that the 'more globalized' group has been able to break into global markets for manufactured goods and services, rather than relying on traditional primary exports.

The emerging consensus that openness to trade is good for economic growth, based on studies such as Sachs and Warner (1995) and Frankel and Romer (1999), has come under recent challenge from a series of papers that have argued the importance, and in some cases the dominance, of 'governance', or 'institutional quality', or 'social infrastructure' as determinants of economic development. The claims of these papers are exemplified by the bold title of the Rodrik *et al*. (2002) paper: 'Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development.'

In section II we review these debates. In the course of our survey we come across evidence that the benefits of openness may have weakened since the onset of the third wave of globalization, particularly for the poorer developing countries. In sections III and IV we discuss our modelling strategy and present empirical results focusing on the differential growth effects of trade openness. Our conclusions are presented in section V, where we explain why our results differ so markedly from the World Bank's findings.

II. PREVIOUS STUDIES OF OPENNESS AND GROWTH

In the neo-classical analysis of welfare gains through exploitation of comparative advantage, a reduction in trade barriers increases trade and the level of productivity. GDP rises through the reallocation of resources and capital accumulation, but the higher growth lasts only for the duration of the transitional period as the economy approaches its new steady-state levels of capital and output per worker.

Theories relating trade openness to long-run growth are typically based on models of endogenous technological change.[2] Trade can increase the rate of technological progress, hence productivity growth, either through an expansion of the market for output or through an expansion of the market for inputs. Output-market expansion drives growth in the Smithian model of Borland and Yang (1992), allowing domestic producers to exploit economies of scale and economies of specialization. The gains from trade may be dynamic rather than static if specialization stimulates productivity growth through learning by doing, as in Lucas (1988).

Expansion of the input market drives growth in product-variety and product-quality models of endogenous technological progress. Romer (1990) suggests that openness gives domestic producers access to a wider variety of capital goods, effectively enlarging the base of productive knowledge. With access to more knowledge and a greater variety of intermediate goods, a more open economy is predicted to experience faster productivity growth. Coe and Helpman (1995) argue that Romer's product-variety model and the 'quality-ladder' models of Aghion and Howitt (1992) and Grossman and Helpman (1991) have similar implications: total factor productivity increases when a country trades more with research-intensive economies. (Their empirical study confirms this hypothesis in relation to growth and trade within the OECD.) Trade acts as a conduit for the transfer of technology.

An important consideration that comes from the analysis of multi-sector models of endogenous growth is that the dynamic benefits of trade may vary

[2] Winters (2004) reviews the mechanisms by which trade might impact on growth.

across countries. In the analysis of Lucas (1988), the sectoral composition of production and trade will affect the growth of aggregate productivity if opportunities for learning by doing vary across sectors. Theories of technological diffusion stress the importance of the host country having a sufficiently high level of 'social capability' in order to be able successfully to implement technologies developed in more advanced economies—see, for example, Abramovitz (1986) and Howitt (2000). Countries below a threshold level of development may be unable to make effective use of technology spillovers.

(i) What Does 'Trade Openness' Mean?

We distinguish between two concepts of trade openness, which we describe as 'revealed openness' and 'policy openness'.

Revealed openness—the ratio of total foreign trade (exports plus imports) to GDP—is the measure most often used in empirical studies. It has the advantage of being both clearly defined and well measured, although there are differing points of view as to whether domestic or international prices should be used to value the trade ratio, as seen in the discussion by Rodrik *et al*. (2002) of the 'real openness' measure used by Alcala and Ciccone (2001).

Studies that use revealed openness address the question of whether countries that engage in more foreign trade have superior economic performance to countries that trade less. The disadvantage of this approach is that it does not tell us why some countries might trade more. A high trade ratio might result from some combination of policy openness, easy access to foreign markets, and a small internal market. Alternative measures attempt to take account of these factors.

Measurement of policy openness is fraught with difficulties. Pritchett (1996) provides a comprehensive survey of approaches ranging from incidence measures of trade barriers (the frequency of non-tariff barriers and the average tariff level), to trade-flow measures adjusted for structural characteristics (size and endowments), to measures of price distortion. Pritchett discusses the problems associated with all of these measures. He finds that the most commonly used measures are uncorrelated with each other, highlighting the difficulty of finding a reliable measure of policy openness.

Sachs and Warner (1995) have produced what is probably the most influential attempt to define policy openness and to estimate its effects on economic performance. They classify a country as having an open trade regime if it exhibits none of the following characteristics for the duration of the 1970s and 1980s:

(i) average tariff rates of 40 per cent or more on imports of intermediate and capital goods;
(ii) non-tariff barriers covering 40 per cent or more of imports of intermediate and capital goods;
(iii) a black market exchange rate premium of 20 per cent or more;
(iv) a socialist economic system;
(v) a state monopoly on major exports.

The Sachs–Warner index has been criticized by Rodriguez and Rodrik (2001). They argue that the crucial components of the index are the measures of export monopoly and black market premia, which identify all but one of the Sub-Saharan economies in Africa plus a group of largely Latin American economies with major macroeconomic and political difficulties. They argue that the links of the other variables with trade policy are questionable, while their links with revealed openness are even more tenuous, coming to the conclusion that 'The Sachs–Warner measure is so correlated with plausible groupings of alternative explanatory variables . . . that it is risky to draw strong inferences about the effect of openness on growth' (p. 292).[3]

Frankel and Romer (1999) produce an alternative measure of 'constructed' openness to trade: the predicted value obtained from regressions of bilateral trade ratios on geographic variables, aggregated to produce national 'constructed' trade shares. The Frankel–Romer measure has been used in subsequent studies by Dollar and Kraay (2003) and Rodrik *et al*. (2002). It has the advantage of being related only to geographic conditions, creating a presumption of exogeneity when used as an

[3] Perhaps it is through similar reasoning that Hall and Jones (1999) use the Sachs–Warner measure as one half of their own index of 'social infrastructure'.

explanator in regression analysis. By construction, however, it can tell us nothing about the contribution of policy to trade and economic performance.

(ii) What is the Effect of 'Openness' on Economic Growth?

Recent econometric studies—as summarized in World Bank (2002, pp. 37–8)—have tended to find a positive association between openness, however measured, and economic growth. Particularly influential have been the studies by Sachs and Warner (1995), Frankel and Romer (1999), and Dollar and Kraay (2003).

The principal finding of Sachs and Warner (1995) is that open economies experienced, *ceteris paribus*, faster growth in real GDP per capita over the period 1970–89. The estimated annual growth premium is remarkably high: nearly two and a half percentage points. Moreover, the growth premium is estimated to be higher for poorer countries, implying that openness promoted convergence in incomes. But we note that their measure of openness may be heavily influenced by factors other than trade policy.

Frankel and Romer (1999) analyse differences in levels of development across 150 countries, as measured by real GDP per person in 1985, using geographical variables as exogenous instruments to control for the potential endogeneity of trade. They report that a 10-percentage point increase in trade integration raises the level income per person by 20 percentage points. Dollar and Kraay (2003) use the Frankel–Romer measure of constructed openness to analyse decadal growth of per-capita GDP, reporting that a doubling of trade integration raises the annual growth rate by 2.5 percentage points.

Rodriguez and Rodrik (2001) have warned about potential conceptual and methodological problems in these studies and advise a stance of healthy scepticism in evaluating claims of strong growth benefits from trade. A contrary assessment of the empirical literature, which is quoted in World Bank (2002, p. 5), comes from Lindert and Williamson (2001, p. 252):

> Even though no one study can establish that trade openness has unambiguously helped the representative third world economy, the preponderance of evidence does seem to support this conclusion. One way to see the whole forest more clearly is to consider two sets, one almost empty and one completely empty. The almost-empty set consists of all statistical studies showing that protection helps third world economic growth, or that liberalization harms it. . . . The second, and this time empty, set contains those countries that chose to be less open to trade and factor flows in the 1990s than in the 1960s and rose in the global living-standard ranks at the same time.

There is, however, a more subtle point that Lindert and Williamson do not address. While the 'representative' third-world economy may, on average, benefit from openness to trade, the benefits may not be distributed evenly. In particular, the Lucas (1988) model suggests that specialization in technologically stagnant sectors may impede growth and the Abramovitz arguments about 'social capability' suggest that the least developed economies may not be able to realize the potential gains that arise when trading with more technologically advanced economies.

A few studies do, indeed, suggest that not all countries share equally in the dynamic gains from trade. Sachs and Warner (1997*b*) find that specialization in exporting primary products is bad for growth, while both De Long and Dowrick (2003) and Wacziarg and Welch (2003) sound a warning that the Sachs and Warner (1995) results may not hold for more recent history. De Long and Dowrick confirm that open economies (with openness defined by the Sachs–Warner index) grew substantially and significantly faster than closed economies over the period 1960–80, and that the growth premium was higher for the poorer countries. For the period 1980–98, however, the annual growth premium (estimated on an extension of the Sachs–Warner index) is estimated to be substantially lower at 1.3 percentage points—and in these latter decades the growth premium is higher for richer countries than it is for poorer countries.

Wacziarg and Welch also find that their extension of the Sachs–Warner index has no impact on growth for the decade of the 1990s. They report (p. 11):

> Moreover, it is no longer true that the Sachs–Warner openness dummy can effectively partition countries among which absolute convergence is observed from those that diverge—in fact the signs are reversed, with open economies displaying divergence while closed economies display convergence.

They proceed to investigate the within-country effects of trade liberalization, finding that the benefits include increases in both investment rates and growth rates of around 1.5 percentage points and an increase in the trade ratio of 5 per cent of GDP.

(iii) Explaining Levels or Growth Rates of GDP per capita

The focus of recent empirical analyses has shifted to differences in current levels of real income/output per capita—as opposed to differences in rates of growth—starting with Hall and Jones (1999) and Frankel and Romer (1999), followed by Acemoglu *et al*. (2001), Kaufmann *et al*. (1999, 2003), and Rodrik *et al*. (2002). All of these papers use a similar modelling strategy, specifying the 'deep' determinants of successful economic development in terms of three groups of variables: trade, institutional quality, and geography.[4]

Two related problems plague the estimation of these 'deep' determinants on levels of development. The first is the potential endogeneity of trade and institutional quality—for example, countries which trade more may be found to have higher incomes, but countries with higher incomes may find it easier to engage in foreign trade because they can afford better institutions for the enforcement of contracts. The second is a problem of identification. Collinearity between trade and institutions may lead to unstable econometric estimates of the coefficients on both variables, making it difficult to isolate the partial effects of each.

Recognizing these problems, recent studies of the level of development have employed a range of approaches to specifying valid instrumental variables, which need to be correlated with the endogenous variables but independent of shocks to the dependent variable. Acemoglu *et al.* (2001) use differences in the mortality rates among nineteenth-century European settlers—actually soldiers and clerics—as an instrument for current institutional quality. They note that these historic mortality rates are correlated with current institutional quality but are independent of current levels of income.

Rodrik *et al*. (2002) use Frankel and Romer's constructed trade ratio and Acemoglu *et al.*'s mortality variable as instruments for trade and institutional quality in their analysis. They come to the extreme and contentious conclusion that institutional quality (measured as a composite indicator from Kaufmann *et al*. that captures the strength of private property rights and the rule of law) is the dominant explanator of levels of development. Controlling for institutional quality, their results suggest that geography has only a weak direct effect on incomes, and trade is generally insignificant. Both geography and trade are found to have indirect effects through their impact on institutional quality.

Dollar and Kraay (2003) find that strong collinearity between the exogenously instrumented components of trade intensity and institutional quality makes it difficult to distinguish their separate contributions to the level of development. As an alternative, they run growth regressions using a GMM dynamic panel estimator to explain changes in decadal rates of growth as a function of changes in trade and changes in institutional quality. The correlation between the changes in these variables is much lower than the correlation between the levels, so the problem of collinearity is diminished. They find that changes in trade intensity do cause significant changes in rates of growth, suggestive of a relatively larger role for trade than for institutions—at least over their observational periods.

A common problem with the 'levels' literature is that the regression specifications typically pool observations on all countries for which data are available, with the implicit assumption that the institutional and legal settings which currently characterize the rich OECD economies are equally appropriate for development in the mid-income Latin American economies or the poorest African and Asian economies. This approach stands in contrast to some of the empirical growth literature which tests for, and typically rejects, the assumption of common parameter values across groups of economies at different levels of development.[5]

[4] This empirical literature draws on the previous contributions of authors such as North (1990) with respect to the importance of institutions. Studies such as Gallup *et al*. (1999) and Sachs and Warner (1997*a*) find that certain geographic features, such as distance from the equator, whether or not a country is landlocked, or whether a country is subject to a tropical climate, influence growth and development.

[5] See, for example, Brander and Dowrick (1994) and Durlauf and Johnson (1995).

Perhaps the most fundamental problem with the levels literature is that it does not explain the process by which the advanced economies have built up the physical capital, human capital, and knowledge which generate their currently high flows of income—nor does it explain how they have come to their current institutional and legal settings. No evidence is given as to the nature of the policies and institutions which were present in the USA or Western Europe in the nineteenth and twentieth centuries when their economies were laying the crucial foundations for current high levels of development. The use of historical variables, such as settler mortality, as exogenous instruments does not alter the fact that the direct explanator of development is a measure of current institutional quality. The approach is fundamentally anhistorical, giving little policy guidance for countries at earlier stages of economic, human, and institutional development.

III. A NEW EMPIRICAL STUDY OF OPENNESS AND GROWTH

We have argued that there is little of policy relevance to be gained from analysing the relationship between current levels of development and current variables. Much more informative about the process of development is to examine the impact of current and lagged variables on rates of economic growth. This enables us to capture the determinants of medium-run economic performance and may provide some guidance to countries seeking to raise standards of living via higher rates of income growth, regardless of their current level of development. Nevertheless, some of the methodology and the data sources that have been used in the levels studies may prove to be useful additions to the analysis of growth rates. In particular, we need to include institutional quality as a potentially important determinant of growth.

Based on our reading of the theoretical and empirical literature, we want to test the extent to which the impact of openness on growth varies over time and across levels of development. We also want to distinguish between the direct impact of openness on productivity (as implied by models of endogenous technological progress) and the indirect effects that operate through investment (as implied by the neoclassical model).

(i) Modelling Strategy

Our strategy is to estimate a structural model consisting of a growth equation, an investment equation, and an equation explaining openness. It allows us to estimate the impact of policy measures on revealed openness, the direct effect of openness on productivity growth, and the indirect effect of openness operating through investment. We use two 20-year periods, allowing us to investigate medium-run growth without the complications of the business cycle. The specification for each period is as follows:

(1) *Growth of real GDP per capita*

$$\begin{aligned}(\ln y_{20} - \ln y_0)_i = {} & \alpha_0 + \alpha_1 \ln y_{0,i} + \alpha_2 (I/Y)_i \\ & + \alpha_3 GWAP_i + \alpha_4 LE_{0i} + \alpha_5 OPEN_i \\ & + \alpha_6 [OPEN_i \times \ln y_{0,i}] \\ & + \alpha_7 PRIMEX_i + \alpha X_{1i} + \varepsilon_{1i}\end{aligned}$$

(2) *Investment ratio*

$$\begin{aligned}(I/Y)_i = {} & \beta_0 + \beta_1 \ln y_{0,i} + \beta_2 (PI/PY)_i \\ & + \beta_3 [OPEN]_i + \beta X_{2i} + \varepsilon_{2i}\end{aligned}$$

(3) *Trade ratio*

$$\begin{aligned}\ln(OPEN)_i = {} & \gamma_0 + \gamma_1 \ln POP_i + \gamma_2 GEO_i \\ & + \gamma_3 POL_i + \gamma X_{3i} + \varepsilon_{3i}.\end{aligned}$$

The subscript i indexes countries, subscripts 0 and 20 indicate the beginning and end of period values, and the absence of a time subscript indicates that the variables are averaged over the whole period. The symbol y represents real GDP *per capita*; I/Y is the ratio of investment to GDP; *GWAP* is the growth rate of the ratio of working-age to total population; *LE* is life expectancy; *OPEN* is the ratio of trade to GDP; *PRIMEX* is a dummy variable equal to 1 if a country specializes in the export of primary commodities; *PI/PY* is the ratio of the price of investment goods to the price of GDP; ***GEO*** and ***POL*** are vectors of geographic and policy variables; and $\boldsymbol{X}_{ni}$ represents a vector of additional explanatory variables.

The system of equations is recursive, allowing us to use single-equation estimation methods if there is no correlation between the error terms—a condition for which we test.

The point estimate of the direct impact of openness on productivity growth is ($\alpha_5 + \alpha_6 . \ln y_{0i}$). The total effect, taking into account the impact of openness on investment is ($\alpha_5 + \alpha_6 . \ln y_{0i} + \alpha_2 . \beta_3$). The growth impact of trade policy variables is given by ($\alpha_5 + \alpha_6 . \ln y_{0i} + \alpha_2 . \beta_3$) γ_3 $OPEN_i$.

(ii) Specification of Variables

Equation (1) is a fairly standard growth specification. The initial income variable captures conditional convergence if the coefficient is negative.[6] The interpretation of conditional convergence is ambiguous. In the context of the neo-classical growth model, it is the rate of convergence towards steady state, where the value of the steady state is determined by the other explanatory variables—see Mankiw *et al*. (1992). In the context of a model of endogenous technological progress, the conditional convergence coefficient captures the rate of diffusion of technology. Dowrick and Rogers (2002) demonstrate that we can distinguish between these two models in a growth regression using capital stock rather than investment data. We are unable to do the same here because our data source, the latest version (6.1) of the Penn World Table (Heston *et al*., 2002) does not yet contain capital stock data. However, given that we are considering growth rates over 20-year periods, the distinction between transitional neo-classical effects and long-run endogenous effects may not be important for practical policy considerations.

The growth of the working-age to total population ratio captures growth in the potential labour supply (divided by total population because the dependent variable is measured per capita). We use this variable rather than the actual growth of the labour-force participation rate to avoid problems in measuring the labour force, especially in the rural sector, and to avoid the potential endogeneity of labour-force participation. Given that we also control for the investment rate, the coefficients of other variables in the growth regression should be interpreted as estimates of impacts on productivity growth.

The direct impact of openness on productivity growth is given by the coefficient α_5. By including an interactive variable, $OPEN\ x \ln y_0$, we are able to test whether the impact of openness varies by the level of development by testing the statistical significance of the coefficient α_6.

It is, of course, important to control for the impact of other exogenous determinants of growth in order to minimize the likelihood of omitted variable bias. We control for initial life expectancy, which is a good proxy for the average level of human capital, following the robust findings on the importance of this variable in studies by Sachs and Warner (1997*a*) and others. In the light of the claims of the recent levels literature, we test a number of other variables, capturing various dimensions of geographical factors and indicators of 'institutional quality', some of which have been shown by previous studies to affect growth as well as levels.

In the investment equation (2) we allow for income effects, captured by ln *y*, and substitution effects, captured by *PI*/*PY*, in the determination of the investment rate. We test for the impact of trade openness on investment, and control for other potentially important factors such as the level of human capital, which we expect to be complementary to physical investment, and geographic and institutional factors.

In equation (3) we have specified the dependent variable as the logarithm of *OPEN* following specification tests (the Davidson–McKinnon test) which suggest that this functional form has more explanatory power than the linear model. The explanatory variables include the log of population and the population density, to control for the size of the internal market, geographical barriers to trade, institutional quality measures, and a range of measures of trade policy.

(iii) Potential Econometric Issues

We suspect that the investment rate and the level of openness may be endogenous in the growth regression, in the sense that these variables may be correlated with the structural error term. Accordingly we perform the Hausman test for exogeneity, using population, population density, and the price of investment goods as instruments.

[6] We note that estimation bias may arise if y_0 is subject to measurement error. To the extent that the error is random, the coefficient is likely to be biased towards zero. To the extent that the error is negatively correlated with measurement error in the dependent variable—see De Long (1988)—the bias is downwards.

We test for the influence of outliers in the growth regression by excluding the three city-states which have exceptionally high ratios of trade to GDP: Hong Kong, Singapore, and Luxembourg.

We are particularly concerned to allow for parameter heterogeneity. We allow for full heterogeneity across time by estimating the equations separately for the periods before and after 1980, noting that the World Bank (2002, pp. 4–5), distinguishes the 1950–80 'second wave of globalization' from the 1980–98 'third wave', with the latter being distinguished by technological advance in transport and communication technologies and the ability of poor countries to break into global markets for manufactures.

We are also concerned to test whether the effects of openness may be different for the less-developed and the developed economies. Our regression specification (1) allows for such differences to be a continuous function of the log of initial income. A more general test is to estimate separate growth regressions for the less-developed and the more-developed, allowing all parameters to vary in a dichotomous fashion. We perform sequential Chow tests, ranking the observations by initial income levels, to test whether such parameter heterogeneity is statistically significant.

(iv) Data

Details of data sources and definitions are provided in the Appendix. Summary statistics are listed in Table 1. We note that the average level of openness increased from 55 per cent of GDP pre-1980 to 73 per cent of GDP in the later period. While the classification of countries as specializing in primary exports is based on more recent data, we use this as a variable for the first period on the assumption that those countries which were primary exporters after 1980 are very likely to have also been primary exporters before 1980.

In light of the criticisms from Rodriguez and Rodrik (2001) we treat the Sachs–Warner measure of openness as a potential determinant of trade intensity, rather than as a direct determinant of growth. We also use the two individual components of the Sachs–Warner variable which are most obviously aspects of trade policy, the average level of tariffs and the prevalence of non-tariff barriers.

We use a number of measures of institutional quality, including the number of revolutions, an index of the 'rule of law', and a set of dummy variables indicating the legal origin of each country: British, French, German, Scandinavian, or Socialist. The use of legal origin variables follows the reasoning in Edison *et al.* (2002), who in turn draw on La Porta *et al.* (1999) to suggest that the evolution of English common law emphasized the protection of private property rights, while the French and German codes were constructed to preserve the power and rights of the state rather than of individuals. Countries with a socialist legal tradition typically afford much less protection to individual property rights. As such, these variables provide a measure of the institutional background of each country and may provide evidence of some link between institutions and growth.

IV. ESTIMATION RESULTS

(i) Growth Regressions, 1960–80 and 1980–2000

Details of the growth regressions are summarized in Table 2. Since we fail to reject the null of exogeneity of investment and openness at even the 20 per cent level of significance (the p-values are 0.85 and 0.76 for the first and second periods, respectively), we report OLS results. We recognize that the Hausman test for exogeneity is of limited power in cases where the instruments are only weakly linked to the suspect variables, but we are reassured by the finding that the explanatory power of the instrumenting regressions is high.

Looking at the first-period results in Table 2, columns 1 and 2, a number of points are worth emphasizing. The included explanatory variables explain about 60 per cent of the variation in growth rates. Investment, distance from the equator, life expectancy, a low initial level of income, and the growth of the working-age population all contribute to faster growth. Countries with a French or German legal tradition tend to grow faster—but note that the omission of the legal-origin variables has virtually no effect on the other coefficients (comparing columns 1 and 2). Other variables (being landlocked, being distant from major exporting centres, the frequency of revolutions, and the 'rule of law' index) are not statistically significant.

Table 1
Descriptive Statistics of Key Variables

Variable name (units)	No. of observations	Mean	Std dev.	Minimum	Maximum
Period 1					
Growth of real GDP per capita (% p.a.)	112	2.41	1.91	–1.88	7.46
Trade share: *OPEN* (%)	114	55.0	36.5	7	281.1
Sachs–Warner index	104	0.315	0.435	0	1
I/Y (%)	114	17.5	10.1	1.5	42.1
Initial income (y_0)	112	3,344	3,135	373	14,818
Life expectancy (LE_0)	116	53.7	12.7	32.0	73.6
Growth of working-age population (% p.a.)	118	0.05	0.34	–0.68	1.10
Revolutions	101	0.13	0.19	0	0.95
Population (1,000s)	114	25,952	89,533	51	778,140
Price of investment (*PI/PY*)	114	1.61	0.98	0.55	6.23
Period 2					
Growth of real GDP per capita (% p.a.)	118	1.28	1.94	–3.5	6.2
Trade share: *OPEN* (%)	124	73.1	47.6	16.2	368.3
Sachs–Warner index	104	0.411	0.426	0	1
Average tariff rate	92	0.174	0.169	0	1.32
Coverage of non-tariff barriers	90	0.204	0.247	0	0.89
I/Y (%)	124	15.8	7.84	2.5	48.2
Initial income (y_0)	124	5,875	5,499	547	21,677
Growth of working-age population (% p.a.)	119	0.29	0.33	–0.58	1.04
Life expectancy (LE_0)	125	61.6	11.3	35.5	76.9
Rule of law	98	3.5	1.4	0.99	6
Population (1,000s)	124	35,844	124,220	43	1,092,900
Price of investment (*PI/PY*)	124	1.75	0.74	0.83	4.24
Both periods					
EXPRIM	127	0.29	0.46	0	1
LAT	124	23.0	16.3	0.23	63.9
LOCK	127	0.18	0.39	0	1
DIST	85	5.9	2.4	1.3	11.5
LEGB	125	0.36	0.48	0	1
LEGF	125	0.53	0.50	0	1
LEGG	125	0.04	0.20	0	1
LEGS	125	0.03	0.18	0	1
LEGSC	125	0.04	0.20	0	1

There is some evidence that export specialization in primary commodities harms growth, with the point estimate suggesting that the magnitude amounts to nearly one-half of a percentage point of annual growth; but we cannot reject the hypothesis of a zero coefficient at the 5 per cent level of significance.

The overall trade share is an important explanator of growth. The interaction term with initial income is statistically significant, and negative, while the coefficient on the trade share itself is positive—implying that the productivity benefits from additional trade are higher for the poorer countries. Referring to column 1, the partial derivative of growth with respect to the percentage trade share is given by:

$$\textit{marginal impact of trade}_i = 0.11 - 0.012 * \ln y_{0i}. \quad (4)$$

The predicted contribution of an additional 10 percentage points of GDP being traded internationally is a rise in annual productivity growth of 0.39 percentage points for the poorest country in the sample, Tanzania, with 1960 real GDP per capita of 373 dollars ($\ln y = 5.9$). For the median income country, Bolivia at $2,355, the predicted growth increase is 0.17. While for the richest countries the predicted increase is close to zero.

Turning to the second period, 1980–2000, the results presented in the third column of Table 2 allow us to compare how the impact of variables has changed compared with period 1. The legal origin variables are not statistically significant for this period, and hence are not included in the period 2 regression. The signs on all of the non-trade variables are the same as reported for period 1 and the magnitudes are generally quite similar.

The primary exporter dummy variable is now statistically significant at the 5 per cent level and the point estimate predicts that a country specializing in primary exports will, *ceteris paribus*, suffer a 0.8 percentage point reduction in annual productivity growth. This confirms the result of Sachs and Warner (1997*b*) who attribute the 'natural resource curse' to a combination of dynamic Dutch disease effect and incentives for rent-seeking in resource-abundant economies.

The major differences between our post-1980 and pre-1980 results occur with the openness and initial income variables and with their interactive term. The results provide the opposite conclusion to that drawn for period 1. The derivative of growth with respect to the percentage trade share in period 2 is given by:

$$\textit{marginal impact of trade}_i = -0.072 + 0.0091 \ln y_{0i}. \quad (5)$$

The marginal impact of trade on growth in the 1980s and 1990s is higher for the richer countries than it is for the poorer countries. Indeed, the marginal impact is estimated to be negative for countries below the initial productivity level of Syria, approximately $3,000 per capita. This estimate of negative effects of trade must be qualified by consideration of the precision of the estimates. The standard error on the openness term is 0.031. So, allowing for just a one standard error increase in the point estimate to –0.041, we cannot reject the hypothesis that the marginal impact for the poorest country (Uganda, RGDP1980 = $550, $\ln y = 6.3$) is zero or slightly positive.

Nevertheless, the interactive term is positive and statistically significant at the 1 per cent level, so we can assert with some confidence that, since 1980, the benefits of trade openness have been higher for the richer countries. The richest country is predicted to earn a growth premium from a 10-point increase in the trade ratio that is one-third of a percentage point higher than the premium for the poorest country. This is the opposite of the Sachs and Warner (1995) result, but it confirms the findings of both De Long and Dowrick (2003) and Wacziarg and Welch (2003).

The reversal in the relative benefits of trade is summarized in Table 3. We divide our sample of countries into the rich and poor halves, based on real GDP per capita at the beginning of each period, and examine the predicted contributions of trade to growth averaged over the countries in each sub-group.

In the first period, trade shares of the poorer countries averaged only two-thirds of the trade shares of the richer countries. But trade had stronger growth effects for the less developed, so the total contribution of trade to growth was higher for the poor countries, averaging 1.3 percentage points, compared with 0.7 percentage points for the richer countries.

Table 2
Growth Regression Estimates
Dependent Variable: Growth of Real GDP per capita (average annual %)

	1960–80	1960–80	1980–2000
No. of observations	107	107	111
Explanatory variables	Coefficients (heteroskedasticity-consistent t-statistic)		
Trade share (% of GDP)	0.11 (4.3)	0.10 (3.8)	–0.072 (2.3)
Trade share × log initial RGDP	–0.012 (4.2)	–0.012 (3.7)	0.0091 (2.7)
Primary exporter dummy	–0.46 (1.6)	–0.51 (1.8)	–0.80 (2.3)
Log initial real GDP per capita	–0.86 (3.2)	–0.74 (3.0)	–1.68 (4.5)
Investment rate (% of GDP)	0.074 (4.2)	0.074 (4.2)	0.091 (2.8)
Latitude (absolute value)	0.027 (2.1)	0.023 (1.8)	0.026 (2.3)
Life expectancy (initial)	0.067 (3.0)	0.060 (2.6)	0.078 (2.6)
Growth of working age/ total population (average annual %)	0.94 (2.5)	0.89 (2.2)	0.37 (0.8)
Legal origin: British	0.36 (1.1)		
French	0.82 (3.1)		
German	1.49 (2.4)		
Socialist	–0.03 (0.1)		
Regression statistics and tests			
Adj. R^2	0.588	0.577	0.480
s.e. of estimate	1.18	1.20	1.34
Mean of dependent variable	2.40	2.40	1.12
Exogeneity of trade and investment variables[a] (p-value)		0.85	0.76
Omitted variable tests[b] (p-values)			
Legal origin variables		0.004	0.26
Geographic variables[c]		0.67	0.16
Institutional quality variables[d]		0.63	0.78

Notes: [a] The instrumental variables used are population density, the log of population, log population × log initial RGDP, and the ratio of the price of investment goods to the price of GDP. The three variables suspected of endogeneity are the trade share, the trade share × initial RGDP, and the investment rate. The adjusted R^2 statistics for the regressions are 0.73, 0.76, and 0.67 respectively. The reported p-values are for the F-statistic testing the joint significance of the residuals from the three regressions when added to the growth regression. According to the Hausman test, joint significance of the residuals means that we are unable to reject the null hypothesis that the suspect variables are exogenous. [b] Reporting the p-value of the F-test for the exclusion of the specified set of variables. A value greater than 0.05 implies that the variables are not significant at the 5 per cent level. [c] The variables are: distance to major exporting countries and landlocked dummy. [d] The variables are: revolutions and (second period only) the rule of law.

By the second period, 1980–99, world trade shares had increased substantially—from an average of 50 per cent across the sample of 110 countries to an average of 67 per cent. Moreover, the poorer countries had increased their trade shares more rapidly than the rich countries. But the effects were perverse. The rapid increase in trade openness of the less developed economies occurred at a time when the benefits of trade switched to favouring the rich. Indeed, the estimated contribution of trade to growth is negative for the poor countries but averages 1 percentage point per year for the richer

sample. Trade has promoted strong divergence of productivity since 1980.

(ii) Testing the Robustness of the Growth Regressions

Measuring investment shares at constant international prices rather than current international prices yields results that are almost identical. Similarly, when we replace current international price trade shares with constant international price trade shares, the results are robust.

In Table 4 we report further tests for the post-1980 growth regression—the results that are most in conflict with orthodoxy. When we omit the city-state trade outliers, the coefficients on the trade variables are very similar to those in the full sample, although the standard error on the interaction is slightly higher.

When we split the sample between the 33 poorest countries and the rest, we clearly reject the hypothesis of parameter stability (the p-value for the Chow test is 0.007). Because we are allowing for parameter heterogeneity by level of development, we have dropped the income-openness interaction term. We now estimate that the average trade premium is strictly positive for the richer countries, while we fail to reject the hypothesis that the trade premium is zero for the poorer countries. This confirms our previous finding that trade openness has been more beneficial for the rich countries than for the poorer countries during the 'third wave' of globalization.

We also find that the negative effects of specialization in primary exports are substantially greater for the group of poorest countries, who are predicted to lose nearly 2 percentage points of annual growth from such specialization.

The sequential Chow test applied to our growth regressions for the 1960–80 period reveals no structural breaks that are significant at the 5 per cent level.

(iii) Investment Share Regressions

We have seen that the share of real investment in GDP contributes significantly to growth. Our growth regressions have estimated the impact of openness on total factor productivity, since we control for both the growth in the labour force and for the growth in capital (proxied by the investment share). However, it is possible that openness may have additional, indirect effects on economic growth, operating through the investment channel.

Table 5 summarizes the results of our investment regressions, following the specification of equation (2). The legal origin and geographic variables are not statistically significant for the first period and the 'rule of law' index is available only for the second period. Our preferred regression for period 2 is presented in the third column of the table, but we also present the regression without the additional variables, in column 2, for purposes of comparison with the first-period regression.

We confirm the findings of Brander and Dowrick (1994) that the price of investment goods relative to GDP, capturing the opportunity cost of investment, has a significant negative impact on investment. Higher levels of life expectancy tend to increase investment, suggesting that human capital is complementary to physical capital. The coefficients on the Sachs–Warner openness variable are also positive, implying that a country with liberal economic policy settings—as defined by Sachs and Warner—will invest around 3 percentage points more of GDP.

The relationship between revealed openness and investment is stable across the three regressions. Openness has a significant positive effect, suggesting that opportunities for international trade raise the marginal product of investment. A 10 percentage point increase in the trade share is predicted to increase the investment rate by half of a percentage point.

The overall impact of openness on economic growth is the sum of the direct productivity effects, as previously reported, and the indirect effect working through investment. The magnitude of the indirect effect is the product of the regression coefficients $\alpha_2.\beta_3$ as defined in equations (1) and (2), i.e. approximately 0.08×0.05 (taking rough averages of the point estimates reported in Tables 2 and 5) which equals 0.004. The indirect effect is positive but rather small. Via its impact on investment, a 10-point increase in the trade share increases annual growth by less than one-twentieth of a percentage point.

Table 3
The Contribution of Trade to Convergence/Divergence

	Trade shares % GDP	Estimated total contribution of trade to growth in real GDP per capita[a] percentage points per year
1960–79		
Poor half[b]	41	1.1
Rich half	60	0.6
1980–9		
Poor half	63	–0.5
Rich half	71	1.0

Notes: [a] Calculated for each country as $\alpha_5 open_i + \alpha_6 open_i \times \ln y_{0,i}$ using the regression coefficients from columns 1 and 3 of Table 2. [b] The 'poor' and 'rich' halves of the sample are based on rankings by real GDP per capita at the beginning of each period.

Table 4
Further Growth Regression Estimates for 1980–2000
Dependent Variable: Growth of Real GDP per capita (average annual %)

	1980–2000 omitting trade outliers[a]	1980–2000 less developed economies[b]	1980–2000 more developed economies
No. of observations	109	33	78
Explanatory variables	Coefficients (heteroskedasticity-consistent t-statistic)		
Trade share (% of GDP)	–0.079 (1.86)	–0.004 (0.4)	0.012 (4.1)
Trade share × log initial RGDP	0.010 (1.98)		
Primary exporter dummy	–0.80 (2.3)	–1.76 (3.7)	–0.65 (1.6)
Log initial real GDP per capita	–1.73 (4.1)	–3.51 (3.4)	–0.86 (2.1)
Investment rate (% of GDP)	0.094 (2.8)	–0.02 (0.2)	0.12 (3.7)
Latitude (absolute value)	0.025 (2.1)	0.069 (2.3)	0.026 (2.4)
Life expectancy (initial)	0.079 (2.6)	0.21 (4.5)	0.026 (0.8)
Growth of working age/ total population (average annual %)	0.36 (0.8)	–0.71 (0.9)	–0.04 (0.1)
Regression statistics and tests			
Adj. R^2	0.455	0.672	0.435
s.e. of estimate	1.36	1.27	1.23
Mean of dependent variable	1.07	0.49	1.39
Test equality of coefficients between the less and more developed sub-samples[c]			$F_{9,93} = 2.73$ p-value = 0.007

Notes: [a] Omitting the two countries in the regression sample with the highest trade shares: Hong Kong (234 per cent of GDP) and Luxembourg (210 per cent of GDP). Singapore is not in the second-period regression sample. [b] The 33 countries with real GDP per capita in 1980 less than $1,870 are: UGA, ETH, MWI, ZAR, BDI, BFA, NPL, MLI, BEN, BGD, HTI, STP, MDG, CHN, RWA, NGA, PAK, IND, NER, MOZ, GHA, SLE, KEN, TGO, ZMB, TCD, COG, SEN, CPV, CAF, AGO, LKA, MRT. [c] This follows the sequential Chow test which is carried out by sorting the observations in order of 1980 real GDP per capita and testing for structural breaks at every observation. The procedure was carried out using Shazam version 9—see SHAZAM (2001).

Table 5
Investment Regression Estimates
Dependent Variable: Real Investment (% of real GDP)

Period	1960–80		1980–2000		1980–2000	
No. of observations	100		104		91	
Explanatory variables	Coefficients (heteroskedasticity-consistent t-statistic)					
Log initial real GDP per capita	–0.09	(0.1)	–0.94	(1.1)	–1.9	(2.1)
Price of investment rel. to GDP	–5.0	(5.0)	–5.5	(6.0)	–5.3	(6.6)
Life expectancy (initial)	0.28	(3.0)	0.23	(3.4)	0.22	(2.8)
Trade share (% of GDP)	0.049	(3.6)	0.043	(2.3)	0.050	(3.3)
Sachs–Warner average years of openness	2.9	(1.5)	4.0	(2.6)	3.1	(2.0)
Rule of law					0.94	(2.1)
Landlocked					–2.4	(3.0)
Latitude (absolute)					–0.03	(0.9)
Legal origin: British					–2.0	(1.1)
French					–1.3	(0.7)
German					7.9	(3.1)
Socialist					1.1	(0.5)
Regression statistics and tests						
Adj. R^2	0.700		0.766		0.818	
s.e. of estimate	5.5		4.0		3.6	
Mean of dependent variable	17.3		15.6		16.4	
Omitted variable tests[a] (p-values)						
Legal-origin variables	0.12		0.0002			
Geographic variables[b]	0.98		0.012			

Notes: [a] Reporting the p-value of the F-test for the exclusion of the specified variable or set of variables; [b] landlocked and latitiude.

This contrast with the direct effects of revealed openness which, although varying by income level, are estimated to be of an order of magnitude of up to one-third of a percentage point on annual productivity growth in response to a 10-point increase in the trade share.

(iv) Trade-share Regressions

We have shown that variations in trade intensity do have a significant impact on economic growth. This raises the question of what factors influence a country's trade share and what the role of policy instruments might be. We report in Table 6 our estimates of the trade intensity regression based on equation (3).

We find that the regressions reported in the first two columns explain around two-thirds of the variance in log trade shares for each period. A larger population does seem to allow more opportunity for internal trade, hence reducing the need for foreign trade. For a given population, higher density increases foreign trade. A country that is landlocked is likely to trade less than a country with direct access to the sea. Policy openness, as defined by Sachs and Warner, does, indeed, tend to increase trade, and tariff barriers do reduce trade.

The estimated impact of differing legal origins is somewhat confusing. British origins appears to increase trade, although the effects are not statistically significant for the first period, raising the trade share by between one-tenth and one-fifth. Countries with socialist origins have significantly lower trade shares pre-1980 but significantly higher trade shares post-1980. (There are only four such countries in our second regression sample: China, Hungary,

Table 6
Trade Regression Estimates
Dependent Variable: Logarithm of *OPEN* (trade as % of GDP)

	1960–80	1980–2000	1980–2000
No. of observations	100	102	87
Explanatory variables	Coefficients (heteroskedasticity-consistent t-statistic)		
Log average population	–0.28 (10.5)	–0.24 (9.8)	–0.20 (9.7)
Population density × 1,000	0.36 (5.6)	0.25 (5.2)	0.30 (5.7)
Landlocked dummy	–0.17 (1.8)	–0.17 (2.3)	–0.20 (2.3)
Sachs–Warner average years of openness	0.22 (2.3)	0.26 (2.8)	
Tariff barriers			–0.47 (2.3)
Non-tariff barriers			–0.09 (0.6)
Legal origin: British	0.12 (1.0)	0.22 (2.2)	
French	–0.05 (0.4)	0.14 (1.5)	
German	0.09 (0.7)	0.14 (0.7)	
Socialist	–0.46 (2.5)	0.49 (3.0)	
Regression statistics and tests			
Adj. R^2	0.663	0.611	0.613
s.e. of estimate	0.34	0.33	0.35
Mean of dependent variable	3.78	4.03	4.03
Omitted variable tests[a] (p-values)			
Legal origin variables	0.002	0.04	0.52
Latitude	0.40	0.84	
Distance from major exporters	0.28	0.12	
Tariff and non-tariff barriers		0.55	0.02

Notes: [a] Reporting the p-value of the F-test for the exclusion of the specified variable or set of variables.

Poland, and Romania.) When we test for the effects of tariff and non-tariff barriers, the sample is reduced to 87 countries and only China remains in the sample. In this instance, as reported in column 3, the set of legal-origin variables loses statistical significance. Nevertheless, the results for our other variables are robust and we estimate a statistically significant coefficient of –0.47 on tariff barriers. (Note that we have presented results separately for the Sachs–Warner policy variable and the trade barrier variables because the latter are a component of the former.)

We can use the tariff coefficient to predict the effects of tariff reduction for a country which reduces its average import tariff from 0.5 (i.e. 50 per cent) to zero. Since the dependent variable is the logarithm of the trade share, the estimated impact of the trade liberalization is a 25 per cent increase in the trade ratio. This implies an increase in the trade ratio from, say, 60 per cent of GDP under the tariff regime to 75 per cent of GDP after abolition. Taking the point estimates of the impact of trade shares in the growth regressions from Table 2, this implies that trade liberalization would increase the annual growth rate of an average-income country by about 0.2 percentage points for the period 1960–80 and by 0.1 percentage points in the period since 1980. (Allowing for the differential impact of openness by level of development suggests a stronger effect of trade liberalization for poor countries and a negligible effect for the richest countries in the earlier period, and vice versa for the later period.)

V. CONCLUSIONS

We sound a note of caution that the results we have presented are potentially sensitive to alternative

econometric approaches, and are subject to the well-known problems in testing for exogeneity. Nevertheless, our results do appear to be robust and lead us to conclude the following. Contrary to the recent literature analysing levels of development, an increase in trade does, on average, have direct and substantial benefits on economic growth. These effects operate primarily through the rate of productivity growth, with only minor effects operating through the investment channel. Tariff barriers do affect the level of trade, hence growth.

However, the growth-promoting benefits of trade vary by level of development, by trade specialization, and by time period.

For the period 1960–79 we confirm previous findings that openness to international trade stimulates the growth of productivity and investment. We find, however, that we need to state several important qualifications.

(i) Trade openness promoted convergence in the 1960s and the 1970s. That is to say, the benefits of openness were greater for the less developed economies than for the more advanced economies.

(ii) Trade was less beneficial for growth in countries specializing in the export of primary products. Such specialization has been particularly harmful for the growth performance of the poorest economies over the 1980s and 1990s.

Both of these qualifications echo the findings of Sachs and Warner (1997*b*) who analyse sources of long-run growth for 79 countries over the period 1965–90. We interpret the first of these qualifications as evidence that, over the 1960s and 1970s, less developed economies were able to access more advanced technologies through trade. The second qualification suggests, however, that these opportunities for rapid productivity growth were not available for those countries that specialized in agricultural and mining products.

Our most startling finding is that the role of trade openness in promoting convergence is reversed after 1980. Over the 1980s and the 1990s, the effects of openness were smaller than over previous decades, and openness generated substantially greater benefits for the more advanced economies than for the less developed economies.

We do not know the reason for this perverse switch in the benefits of trade. Nevertheless, two hypotheses come to mind. First, to the extent that trade promotes growth by acting as the conduit of international technology transfer, it is conceivable that the benefits of trade changed due to changes in the nature of the technology being transferred. Pre-1980, technology transfer involved mostly the knowledge and capital goods required for well-established manufacturing processes that developing economies were able to adopt readily. Since 1980, the nature of technology transfer may have changed to highly complex processes, such as information and communication technologies, for which the less developed economies lack the requisite human capital and physical infrastructure.

Second, it is possible that countries that had adopted relatively free trade policies before 1980 had also adopted a variety of internal growth-friendly policies and institutions and that it was the latter, rather than trade *per se*, which promoted growth. It could be argued that many of the less developed economies that subsequently liberalized trade, perhaps under pressure from the IMF and the World Bank, did so without introducing the appropriate internal policies and institutions, only to find that trade reform alone was not the magic solution. Further research is clearly required to disentangle these hypotheses in order to provide clear policy guidance for the future.

Finally, the reader may wonder how our finding of negligible dynamic benefits from trade openness for the poorest countries after 1980 can be reconciled with the World Bank (2002) evidence that the more-globalized developing countries increased their growth rates over each of the past four decades. There are two principal factors: the World Bank's rather peculiar definition of 'more-globalized' and its use of population-weighted growth rates. The Bank's 23 'more globalized' developing countries, taken from Dollar and Kraay (2001), are those which displayed the highest proportional increase in their trade share between the late 1970s and the late 1990s. A country such as India, which increased its trade share from 14 per cent to 22 per cent of GDP,

is, according to this definition, 'more globalized', despite the fact that its trade share is well below the global average in both periods. (A country that increased its trade share from, say, 70 per cent to 90 per cent would be classified as 'less globalized'.) This classification has the effect of including China (with its trade share increasing from 14 per cent to 34 per cent) in the Bank's 'more globalized' group.

If we exclude China and India from the World Bank's sample, we find that the remaining group of 22 'more globalized' developing countries actually grew more slowly than the 'less globalized' over the period 1980–2000. This is the case whether or not we weight growth rates of each country by population.

It appears that the World Bank's evidence of a rapid increase in the population-weighted growth rates of the more-globalized developing countries is telling us nothing more than what is already well-known: India and China have recorded accelerating growth over the past few decades, despite having relatively low, albeit increasing, trade ratios. In contrast to the World Bank's evidence based on bi-variate relationships with essentially two observations, our findings are based on multi-variate analysis of over 100 observations.

APPENDIX: DATA SOURCES

Our data comes from the Penn World Table (PWT6.1);[7] the World Development Indicators from World Bank (2003) (WDI); Dollar and Kraay (DK, 2003);[8] the 'Social Indicators and Fixed Factors' spreadsheet compiled by Easterly and Sewadeh (2001) (ES);[9] and Sachs and Warner (SW).[10] The complete data set begins with the 127 countries for which the relevant real GDP per-capita data are available in the Penn World Table. The number of observations and summary statistics for each variable are given in Table 1. Further definitions and details of sources are provided below.

Real GDP per capita: [PWT6.1] For this and the other PWT variables, levels of variables are calculated as 5-year moving averages (or 3-year if the 5-year is not available) for the beginning and end of each period for the variable labelled RGDPCH which is measured at 1996 international prices. For example, the '1980' level of real GDP is calculated as the average 1978–82. Growth rates are calculated as the annual average percentage rate of growth over the period.

OPEN: [PWT6.1] The share of exports and imports in total GDP, measured at current international prices using the variable 'openc'.

I/Y: [PWT6.1] The share of investment in total GDP measured at current international prices—the variable 'ci'.

PI/PY: [PWT6.1] The ratio of the price level of investment to the price level of GDP, calculated as the ratio of the variables 'pi' and 'p'.

POP: [PWT6.1] Average population over the period from the variable 'POP'.

TB: [BL] Tariff barriers. These are own-import weighted tariff rates on intermediate inputs and capital goods for the period 1985–8, the variable 'OWTI'.

QB: [BL] Non-tariff barriers. These are own-import weighted non-tariff frequency on intermediate inputs and capital goods for the period 1985-88, the variable 'OWQI'.

DIST: [BL] Average distance to the capital cities of the 20 major exporting countries measured in 1,000s of kilometres, weighted by bilateral imports.

SWO: [SW] This variable has been constructed using Sachs and Warner's 'Trade Openness Indicators'. Following the index developed in their 1995 paper, this dataset ranks each country as 'open' = 1 or 'closed' = 0 for each year between 1960 and 1992 (where such an assessment is possible). SWO is the fraction of years in which a country ranks as 'open' rather than 'closed'.

[7] From http://pwt.econ.upenn.edu/
[8] From www.worldbank.org/research/growth
[9] http://www.worldbank.org/research/growth/GDNdata.htm
[10] From http://www.cid.harvard.edu/ciddata/ciddata.html under Sachs and Warner's Trade Openness Indicators.

LE: [WDI] Initial life expectancy, using 1962 and 1982 data for periods 1 and 2 respectively.
GWAP: [WDI] Average annual percentage growth rate of the ratio of the labour force (economically active population) to the total population.
PRIMEX: [ES] A dummy variable which takes a value of 1 if more than 50 per cent of a country's exports were non-fuel primary products during the period 1988–92.
LAT: [ES] The absolute value of latitude.
LOCK: [ES] A dummy variable for whether a country is landlocked or not.
LEGB/LEGF/LEGG/LEGS/LESC: [ES] A set of dummy variables indicating the legal origin of each country: British, French, German, Socialist, or Scandinavian.
REV: [DK] Average number of revolutions constructed using DK's 'REVOLAV' variable for the 1960s and 1970s.
RUL: [DK] Average measure of rule of law constructed using DK's RULELAWAV' variable for the 1980s and 1990s, which is taken in turn from the Law and Order Rating provided by the International Country Risk Guide (ICRG).

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