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TRADE OPENNESS AND ECONOMIC GROWTH CAN WE ESTIMATE THE PRECISE EFFECT?

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Abstract

While various theoretical models predict that openness to international trade accelerates productivity and promotes economic growth, the empirical evidence has been mixed or imprecise. This paper investigates the issue using two panel data sets: one of 56 countries covering the period 1951-1998, and another of 105 countries over 1960-1997. The results show that the effect of trade openness on economic growth is positive, permanent, statistically significant, and economically sizable. This effect is robust across the two data sets used and a number of different estimation methods and lag lengths. Specifically, it is shown that increasing trade (exports plus imports) as a fraction of *GDP* by 10 percentage points, *permanently* increases the real growth rate of *GDP* per capita by 0.25 to 0.3 percent.

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1. Introduction

Increased openness to international trade is one of the most obvious aspects of globalization, and indeed one of its defining characteristics. Any attempt, therefore, to assess the effects of globalization on economic growth, development, and convergence in income levels across countries must take into account the effects of trade openness. It is not surprising then that the subject has attracted considerable attention from both the theoretical and empirical points of view.

Theoretically, there seems to be little doubt that long-run economic growth should be positively influenced by openness. Most theoretical models generate this relationship through transfers in technology and innovation which are facilitated by openness and trade. The more open the economy is, the easier it becomes to Aimport≅ and adopt technological innovations from higher-productivity trading partners, and thus the higher the growth rate.[1]

Empirically, however, the attempts to identify and measure the effects of openness on growth have had mixed results. As the overwhelming majority of the studies have relied on cross-sectional data, they have been often criticized for ignoring reverse causation and the endogeneity of openness. The problem is clearly illustrated in Frankel and Romer=s (1999) contribution, one of the most influential recent papers on the topic. A simple cross-sectional regression of income on trade and other variables yields a large and highly statistically significant trade coefficient. However, when the same regression is estimated with instrumental variables in order to address the endogeneity problem, the statistical significance of the trade coefficient disappears, while its point estimate *increases* (the result of a much higher standard error). The same pattern characterizes their estimated effects of trade on physical capital, schooling, and productivity. Edwards (1998) also relies on cross-sectional data, but his study is remarkable in that it uses nine different measures of openness, demonstrating that they are all positively related to total factor productivity. Recognizing the problem, however, Edwards (1999) concludes that Aalthough the use of instrumental variables goes a long way towards dealing with endogeneity, issues related to causality are still somewhat open and will require *time series* analyses to be adequately addressed≅ (emphasis added).[2]

The goal of the present paper is to contribute to the empirical side of the question using annual data from the post-war period for a total of 105 developed and developing economies. In particular, two panel data sets will be used: the first consists of 56 countries with annual observations over 1951-1998, and the second covers 105 countries for the period 1960-1997. The results show that the effect of trade openness on economic growth is positive, permanent, statistically significant, and economically sizable. Additionally, the effect is robust across the two data sets used and a number of different estimation methods and lag lengths. On average, the findings support the conclusion that increasing trade (exports plus imports) as a fraction of *GDP* by 10 percentage points, *permanently* increases the real growth rate of *GDP* per capita by approximately 0.25 to 0.3 percent.

The rest of the paper is organized as follows. Section 2 discusses the sources of the data and defines the variables to be used in the estimation. Section 3 proposes the estimation methodology, presents the empirical results, and implements a number of robustness checks. Section 4 discusses the findings and some policy implications, and concludes.

2. Data Sources and Definitions

All data are obtained from the Penn World Table (PWT, Mark 6.0), documented in Heston, Summers, and Aden (2001; see also Summers and Heston, 1991). The variable *growth* measures the growth rate of real GDP per capita, y, in constant dollars. Openness is captured by the variable *open* which measures total trade (computed as the sum of exports, *EX*, and imports, *IM*) as a fraction of aggregate *GDP*. Specifically, for country i and year t,

$$growth_{i,t} = \frac{y_{i,t} - y_{i,t-1}}{y_{i,t-1}} \quad \text{and} \quad open_{i,t} = \frac{EX_{i,t} + IM_{i,t}}{GDP_{i,t}}.$$

The rest of the variables to be used are those predicted to have steady-state effects by the standard neoclassical growth model: (i) *inv* is Investment as a fraction of *GDP*, (ii) *pop* is the population growth rate, and (iii) *gov* is government purchases as a fraction of *GDP*.

Two data sets have been constructed, depending on the length of the period for which the series defined above are available in PWT 6.0 for the various economies. *Data Set I* consists of the 56 economies for which data on all series exist for each year of the 1951-1998 period. Appendix 1 provides a list of these 56 economies together with country averages over 1951-1998 for the *growth* and *open* series.[3] Both developed and developing economies are represented in *Data Set I*. Average growth of real *GDP* per capita has ranged from 0.05% in Bolivia to 6.30% in Taiwan; trade openness from 13.60% in India to 173.00% in Luxembourg; the investment rate has varied from 1.78% of *GDP* in Uganda to 35.85% of *GDP* in Norway; the population growth rate from 0.32% in Austria to 3.21% in Kenya; and government consumption from 7.9% of *GDP* in Nigeria to 34.74% of *GDP* in Israel.

Data Set II consists of the 105 economies for which data on the series are available for each year of the 1960-1997 period. The trade off between the two data sets is obvious: *Data Set I* covers a longer time period (by ten years, roughly one fourth of the shorter period) for each country, but *Data Set II* contains almost twice the number of economies, including a much larger number of developing countries. Appendix 2 provides a list of these 105 economies together with country averages over 1960-1997 for the *growth* and *open* series. In *Data Set II*, average growth of real *GDP* per capita has ranged from -2.89% in the Democratic Republic of Congo (former Zaire) to 7.51% in Singapore; trade openness from 13.78% in India to 319.53% in Singapore; the investment rate has varied from 1.75% of *GDP* in Mozambique to 42.01% of *GDP* in Singapore; the population growth rate from 0.30% in Belgium to 4.60% in Jordan; and government consumption from 4.17% of *GDP* in Guinea to 47.02% of *GDP* in the Central African Republic.

Both data sets will be employed in each of the estimated models below, but the results, at least with respect to openness, will be shown to be quite robust to the choice of data set.

3. Long-Run Effects of Openness on Growth

3.1. The benchmark model

Following the methodology of Jones (1995) in his study of investment and growth, the present paper will investigate whether changes in openness permanently affect growth by estimating a dynamic time-series model. We start with the general specification

$$growth_{i,t} = w_i + v_t + C(L)growth_{i,t-1} + A(L)open_{i,t} + u_{i,t}\,,$$

where, once again, *growth* is the growth rate of real *GDP* per capita, *open* is our measure of openness (the sum of exports plus imports as a fraction of *GDP*), the *w*=s and *v*=s are parameters, *A*(*L*) and *C*(*L*) are p^{th}-order polynomials in the lag operator *L* with roots outside the unit circle, *u* is a spherical error term, and i and t index over countries and time, respectively.[4]

This specification can be rewritten as

$$growth_{i,t} = w_i + v_t + C(L)growth_{i,t-1} + b \cdot open_{i,t} + B(L)\Delta open_{i,t} + u_{i,t}\,, \qquad (1)$$

where *b*=*A*(1) is a parameter equal to the sum of the coefficients of the *A*(*L*) polynomial, $\Delta = 1\,.\; L$ is the difference operator, and *B*(*L*) is a $(p-1)^{\text{th}}$-order polynomial whose coefficients are related to those of *A*(*L*) according to $\beta_k = -\sum_{j=k+1}^{p} \alpha_j$. It follows that estimating b in model (1) can be used to examine whether changes in openness have a permanent effect on the rate of economic growth, as well as the sign and magnitude of this effect.

Table 1 estimates equation (1) for the two data sets and various lag lengths. Focusing on *Data Set I* first, the first column (AOLS ≅) of Table 1 reports the results for the model without fixed effects, effectively imposing the restrictions $w_i = \overline{w}$ for all *i*, and $v_t = 0$ for all *t*. These restrictions are imposed not because they are thought to be plausible, but in order to compare the specifications with and without fixed effects. The estimated *b*=s have the expected positive sign, but are statistically insignificant and very small in magnitude. These results are not sensitive to the number of lags included in the model.

The AFixed Effects≅ column for *Data Set I* in Table 1 repeats the estimation of equation (1), but now including country- and year-specific fixed effects. Formal statistical testing easily shows that these are the appropriate specifications, as the null hypotheses of $w_i = \overline{w}$ for all *i*, and $v_t = 0$ for all *t*, are comfortably rejected in every specification.

The results are now much more favorable for the openness-growth link. In particular, the estimated *b*=s are all positive, highly statistically significant, and of an economically meaningful size. Using the $p = 1$ or $p = 2$ specifications, an estimate of b ˜ 0.028 implies that the growth effects of openness are remarkable: an increase in trade (exports plus imports) as a fraction of *GDP* by 10 percentage points results in a *permanent* increase in the real growth rate by approximately 0.28 percent. This result is not sensitive to lag length, the point estimates of the *b*=s ranging from $b = 0.025$ to $b = 0.028$.

The last two columns of Table1 repeat the exercise for *Data Set II*. The AOLS ≅ results here (unlike those for *Data Set I*) do not lack statistical significance, but still imply a relatively small effect. Once again, however, fixed effects can be shown to belong in the regression, so the AOLS≅ model is mis-specified. Including the fixed effects gives the results of the last column of Table 1. As was the case for *Data Set I*, all estimated *b*=s have the expected positive sign, are quite precisely estimated, and their magnitude is economically important.

Point estimates range from $b = 0.020$ to $b = 0.028$, leading to virtually the same implications for the quantitative importance of trade openness for growth: a permanent increase in openness by 10 percentage points is associated with a *permanent* increase in the growth rate of real *GDP* by approximately one fourth of one percent. Once again, the results are quite robust to the number of lags included in the model.

Overall, Table 1 shows that the effect of trade openness on economic growth is positive, permanent, statistically significant, and sizable. Moreover, the effect is shown to be robust across the two data sets used and a number of different lag lengths.

The remainder of this section extends the investigation of robustness along two additional dimensions: (i) two different estimation methods, and (ii) controlling for a number of other steady-state determinants.

3.2. Two Additional Robustness Extensions

First, as Evans (1997) has pointed out in his study of government consumption and long-run growth, consistent estimation of an equation like (1) may not be straightforward. If *growth* and *open* are both I(1) processes, the OLS estimator of b is superconsistent, but inference based on the OLS standard errors will be generally invalid. Hamilton (1994) proves that the problem can be dealt with by including n leads and lags of the differenced right-hand side variable, where n is large enough for the correlation between $u_{i,t}$ and $\Delta open_{i,t\ s}$ to be zero for $s > n$. 0.

Following Hamilton's correction procedure, the model is actually estimated as:

$$growth_{i,t} = w_i + v_t + b \cdot open_{i,t} + \sum_{j=-n}^{n} \zeta_j \Delta open_{i,t-j} + u_{i,t} \,. \qquad (2)$$

Then, estimating an auxiliary AR(p) process for the residuals of (2),

$$\hat{u}_{i,t} = \sum_{j=1}^{p} c_j \hat{u}_{i,t-j} + e_{i,t} \,,$$

can be used to obtain asymptotically consistent t-ratios. Hamilton (1994, section 19.3) shows that the OLS t-ratios need to be adjusted as follows for their asymptotic distribution to be standard normal:

$$adj.T - ratio \equiv (OLS.t - ratio)\left(\frac{\hat{\sigma}_u}{\hat{\sigma}_e}\right)\left(1 - \sum_{j=1}^{p} \hat{c}_j\right) \xrightarrow{d} N(0,1) \,.$$

Alternatively, as proposed by Evans (1997), the estimated c=s can transform equation (2) to

$$\hat{c}(L) growth_{i,t} = w_i + v_t + b \cdot \hat{c}(L) open_{i,t} + \sum_{j=-n}^{n} \zeta_j \hat{c}(L) \Delta open_{i,t-j} + z_{i,t} \,, \qquad (3)$$

where z is asymptotically equivalent to e. It follows that estimating (3) with OLS (including fixed effects) using White's (1980) heteroskedasticity correction will produce a consistent estimate of b, and consistent estimates of its standard error and t-statistic.

The results from the estimation of models (2) and (3) for both data sets are reported in Table 2 for various lag lengths. Table 2 reports only the specifications with country and time fixed effects.[5] The first thing to note is that all the estimated *b*=s are positive and (with two exceptions) highly statistically significant. Unsurprisingly, the magnitude and precision of the estimates generally decline as more lags are added, but the effect remains statistically significant for up to $n = 3$ with the Hamilton adjustment, and $n = 2$ with the Evans adjustment. As it is unlikely, however, that $u_{i,t}$ will be correlated with more than the first or second lags of $\Delta open_{i,t}$ (recall that the data frequency is annual), the adjustments using $n = 1$ or $n = 2$ should be considered the most reliable. It is worth observing that there are only small differences between the results obtained by the Evans and Hamilton adjustments, and that the results are also robust to different choices for p.

The results of Table 2, therefore, confirm that there is a positive, sizable, permanent, and statistically significant relationship between trade openness and economic growth. Using an estimate of $b \,\tilde{}\, 0.03$ as cautiously representative, these results imply that the growth effects of openness are quantitatively very similar to those obtained from the unadjusted models of Table 1: an increase in trade openness as a percentage of *GDP* by 10 percentage points results in a *permanent* increase in the growth rate by approximately 0.3 percent.

The second robustness check considered in this subsection involves the possibility that the results obtained so far are biased because other steady-state determinants have been omitted from the estimated regressions.

Suppose, for example, that trade openness does not affect economic growth directly, but instead through some other variable, such as investment. If this is the case, omitting investment may generate a positive estimated relationship between openness and growth, but only because of the mis-specification. To settle the issue, investment should be included in the regression in order to test whether openness has growth effects even when those of investment are controlled for.

As mentioned in section 2, we will consider three variables predicted to have steady-state effects by the standard neoclassical growth model: *inv*, the investment-to-*GDP* ratio; *pop*, the population growth rate; and *gov*, the government-purchases-to-*GDP* ratio. For empirical evidence on the relevance of these variables, see Mankiw, Romer and Weil (1992) and Barro and Sala-i-Martin (1995).

To take into account these variables, we generalize the original time-series specification to

$$growth_{i,t} = w_i + v_t + C(L)growth_{i,t-1}$$

$$+ A_{inv}(L)inv_{i,t} + A_{pop}(L)pop_{i,t} + A_{gov}(L)gov_{i,t} + A_{open}(L)open_{i,t} + u_{i,t}$$

,
where the notation is straightforward. This model then can be rewritten as

$$growth_{i,t} = w_i + v_t + C(L)growth_{i,t-1}$$
$$+ b_{inv} \cdot inv_{i,t} + b_{pop} \cdot pop_{i,t} + b_{gov} \cdot gov_{i,t} + b_{open} \cdot open_{i,t}$$

$$+ B_{inv}(L)\Delta inv_{i,t} + B_{pop}(L)\Delta pop_{i,t} + B_{gov}(L)\Delta gov_{i,t} + B_{open}(L)\Delta open_{i,t} + u_{i,t}$$

, (4)

where $b_{inv} = A_{inv}(1)$, $b_{pop} = A_{pop}(1)$, $b_{gov} = A_{gov}(1)$, and $b_{open} = A_{open}(1)$ are parameters, each equal to the sum of the coefficients of the respective $A(L)$ polynomial, and the relationship between the coefficients of the $B(L)$ and A(L) polynomials is as described below equation (1).

Estimation of equation (4) can proceed along the lines described above for equation (1). Because of space considerations, however, Table 3 reports only specifications of model (4) that use the Hamilton adjustment and include country and time fixed effects.[6] The top panel relies on *Data Set I*, while *Data Set II* is used for the bottom panel.

Starting with the three variables other than openness, the results of Table3 are largely as expected and consistent with the theoretical predictions. First, b_{inv}, the estimated growth effect of the investment ratio, is positive and highly statistically significant, consistent with the theory=s prediction that a higher investment rate raises the economy=s steady-state. This result holds for both data sets and all lag lengths tried.

Second, b_{pop} , the estimated coefficient of *pop* is either statistically insignificant (Data Set I), or negative and statistically significant (Data Set II), consistent with the neoclassical model=s prediction that a higher population growth rate leads to a lower steady state.

The most likely explanation for the greater precision of the estimated b_{pop} when *Data Set II* is used is that this data set includes a larger number of developing economies with a greater range of population growth experiences, and thus significantly greater identification power with respect to the effect of that variable.

Third, b_{gov} , the coefficient of government size*,* is neither unambiguously nor (with a single exception) statistically significantly estimated, suggesting that a higher government size has an ambiguous effect on the steady state.

This is not surprising or even disappointing, since the theoretical steady-state effect of *gov* is ambiguous, as the inefficiencies and distortions of taxation may or may not outweigh the productivity of government activities.

For the purposes of the present paper, of course, the most important estimates are those of b_{open} in the last column of Table 3. These are not only positive and statistically significant, but also very little different from those reported by Tables 1 and 2 (with fixed effects).

Once again, their size and statistical significance tend to decline as more lags are added, but the estimates are even similar for the two data sets. It follows that controlling for the additional steady-state determinants alters neither the size nor statistical significance of the growth effects of openness to trade.

4. Discussion and Conclusions

This paper investigated the effects of openness to international trade on economic growth. While a number of theoretical economic models predict that openness promotes economic growth and convergence, a lot of the empirical evidence (most of which is based on cross-sectional studies) has been inconclusive or imprecise.

The relationship between openness, defined as total trade (the sum of exports and imports) as a fraction of *GDP*, and growth is examined here using annual data from (i) the 1951-1998 period for a sample of 56 economies, and (ii) the 1960-1997 period for a sample of 105 economies. Both data sets include countries at various stages of development. The findings show that the effect of openness on economic growth is positive, permanent, and not just statistically significant, but also economically substantial: raising trade as a fraction of *GDP* by 10 percentage points, *permanently* increases the real growth rate of *GDP* per capita by approximately 0.25 to 0.3 percent.

It is difficult to exaggerate the importance of such a finding for economic growth around the world, and for developing countries in particular. It means, for example, that if India=s (average) total trade is raised from 13% to 25% of *GDP*, its (average) growth rate will increase from 2.7% to around 3.0%, a significant difference for the country=s standard of living and its prospects of convergence with more developed economies. Similarly, Ghana=s growth can be raised from an immiserizing -0.2% to a positive 0.3%, if its trade goes up from 38% to 58% of *GDP* (a level similar to that of the Central African Republic or El Salvador).

The policy implications of the paper=s results are straightforward. Policies, national or global, which facilitate trade among countries, should also enhance growth rates. From successful trade rounds that reduce various forms of protection, to bilateral or multilateral agreements (such as NAFTA) that dismantle trade barriers, to the trade liberalization that is one of the characteristics of globalization, the effects on growth are positive and sizable.[7]

Furthermore, we should expect developing countries to benefit more from increased openness than developed ones, because our theoretical understanding of the mechanisms by which trade promotes long-run growth emphasizes the transfer of technology from developed to developing economies. This means that, in addition to accelerating growth, increased openness to trade will also have beneficial effects on the world income distribution.

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Table 1. Long-Run Effects of Openness on Growth: *b* in Model (1)

	Data Set I		*Data Set II*	
p	OLS	Fixed effects	OLS	Fixed Effects
1	0.003	0.028**	0.011**	0.028**
	(0.003)	(0.008)	(0.002)	(0.007)
2	0.003	0.028**	0.010**	0.026**
	(0.003)	(0.008)	(0.002)	(0.007)
3	0.002	0.026**	0.008**	0.023**
	(0.003)	(0.008)	(0.002)	(0.007)
4	0.001	0.025**	0.005*	0.020*
	(0.003)	(0.009)	(0.002)	(0.008)

Notes: Estimated standard errors in parentheses. *p* is the number of lags in the $C(L)$ and $B(L)$ polynomials in equation (1). ** and * denote statistical significance at the 1% and 5% significance levels.

Table 2.Adjusting with the Evans and Hamilton Procedures:
b in Models (2) and (3)

	Data Set I		*Data Set II*	
n	Evans adj.	Hamilton adj.	Evans adj.	Hamilton adj.
0	0.030**	0.031**	0.033**	0.028**
	(0.009)	(0.007)	(0.007)	(0.006)
1	0.034**	0.035**	0.031**	0.033**
	(0.010)	(0.007)	(0.007)	(0.006)
2	0.032**	0.031**	0.027**	0.034**
	(0.010)	(0.008)	(0.008)	(0.007)
3	0.019	0.021**	0.019	0.025**
	(0.013)	(0.008)	(0.010)	(0.008)

Notes: All models estimated with fixed effects. The Hamilton and Evans adjustments have been implemented as described in section 3. Estimated adjusted standard errors in parentheses. *n* is the number of lags and leads included in equations (2) and (3). An AR(5) process is estimated for *u* in all cases (*p*=5). ** and * denote statistical significance at the 1% and 5% significance levels. The critical values used are $N_{0.005}(0,1)=t_{0.005}(\square)=2.576$ and $N_{0.025}(0,1)=t_{0.025}(\square)=1.960$.

Table 3.Controlling for inv, pop, and gov: b_{inv}, b_{pop}, b_{gov}, and b_{open} in Model (4)

Data Set I

n	b_{inv}	b_{pop}	b_{gov}	b_{open}
0	0.073**	-0.118	-0.043	0.029**
	(0.022)	(0.181)	(0.022)	(0.006)
1	0.102**	0.148	-0.046*	0.032**
	(0.024)	(0.197)	(0.023)	(0.007)
2	0.115**	0.135	-0.036	0.030**
	(0.025)	(0.211)	(0.025)	(0.007)
3	0.104**	0.017	-0.028	0.020*
	(0.028)	(0.232)	(0.027)	(0.008)

Data Set II

n	b_{inv}	b_{pop}	b_{gov}	b_{open}
0	0.108**	-0.472**	-0.011	0.025**
	(0.020)	(0.137)	(0.017)	(0.006)
1	0.139**	-0.623**	-0.001	0.021**
	(0.022)	(0.162)	(0.018)	(0.006)
2	0.148**	-0.621**	0.001	0.021**
	(0.024)	(0.181)	(0.020)	(0.007)
3	0.147**	-0.965**	0.006	0.015*
	(0.027)	(0.213)	(0.022)	(0.008)

Notes: All models estimated with fixed effects and the Hamilton adjustment, as described in section 3. Estimated adjusted standard errors in parentheses. n is the number of lags and leads included, as in equation (2). An AR(5) process is estimated for u in all cases (p=5). ** and * denote statistical significance at the 1% and 5% significance levels. The critical values are as in Table 2.

Appendix 1: *Data Set I.* Averages over 1951-1998

Country	*growth*	*open*	Country	*growth*	*open*
1 ARG	1.33%	14.34%	29 ITA	3.38%	36.14%
2 AUS	2.11	34.04	30 JPN	5.00	21.33
3 AUT	3.42	61.87	31 KEN	0.73	62.72
4 BEL	2.67	107.08	32 LKA	2.27	74.72
5 BOL	0.05	52.62	33 LUX	3.11	173.00
6 BRA	3.10	16.05	34 MAR	2.49	45.06
7 CAN	2.12	48.33	35 MEX	2.06	26.22
8 CHE	1.73	62.77	36 MUS	2.49	98.13
9 CHL	2.50	40.48	37 NGA	0.95	41.00
10 COL	2.06	29.56	38 NIC	0.22	63.11
11 CRI	1.79	66.44	39 NLD	2.70	95.40
12 DNK	2.54	65.04	40 NOR	3.07	73.96
13 DOM	2.93	52.79	41 PAK	1.69	31.45
14 ECU	1.68	45.32	42 PAN	2.71	81.49
15 EGY	2.00	48.03	43 PER	1.23	34.70
16 ESP	3.76	29.47	44 PHL	1.80	46.47
17 ETH	0.52	22.58	45 PRY	2.06	45.52
18 FIN	3.13	51.43	46 SLV	1.08	53.71
19 FRA	2.85	35.98	47 SWE	2.36	55.04
20 GBR	2.13	48.79	48 THA	4.03	50.19
21 GRC	3.66	31.93	49 TTO	3.05	95.40
22 GTM	1.26	36.45	50 TUR	2.73	20.31
23 GUY	1.15	135.17	51 TWN	6.30	69.44
24 HND	0.73	62.88	52 UGA	1.25	34.23
25 IND	2.59	13.59	53 URY	1.19	34.35
26 IRL	3.67	94.33	54 USA	2.13	14.80
27 ISL	2.92	68.87	55 VEN	0.78	46.60
28 ISR	2.85	69.48	56 ZAF	1.24	51.71

Note: *growth* is the average annual growth rate of *GDP* per capita, and *open* is the average openness (exports plus imports) as a fraction of *GDP*. Both averages are over 1951-1998.

Appendix 2: *Data Set II* .Averages over 1960-1997

Country	growth	open	Country	growth	open	Country	growth	open
1 ARG	1.37	14.68	36 GIN	-0.00	47.51	71 NIC	-0.61	4.22
2 AUS	2.19	34.19	37 GMB	-0.13	101.57	72 NLD	2.47	6.42
3 AUT	2.90	65.94	38 GNB	1.39	44.22	73 NOR	3.24	74.07
4 BDI	0.68	30.22	39 GRC	3.54	34.89	74 NPL	1.62	28.45
5 BEL	2.75	114.43	40 GTM	1.26	38.56	75 NZL	1.12	53.89
6 BEN	0.23	52.77	41 GUY	1.47	143.9	76 PAK	2.38	32.82
7 BFA	0.82	33.83	42 HKG	6.12	203.4	77 PAN	2.64	82.71
8 BGD	1.25	19.90	43 HND	0.80	65.22	78 PER	1.28	33.40
9 BOL	0.49	56.05	44 IDN	4.61	40.85	79 PHL	1.38	50.25
10 BRA	3.04	16.25	45 IND	2.65	13.78	80 PNG	0.81	82.26
11 BWA	5.12	87.30	46 IRL	4.02	99.37	81 PRT	4.23	58.85
12 CAF	-2.08	56.53	47 IRN	2.50	38.07	82 PRY	2.72	47.78
13 CAN	2.31	50.04	48 ISL	2.83	71.59	83 ROM	4.27	1.46
14 CHE	1.09	64.77	49 ISR	3.05	80.85	84 RWA	0.36	9.81
15 CHL	2.69	43.96	50 ITA	3.01	39.13	85 SEN	-0.53	2.73
16 CHN	4.23	16.01	51 JAM	1.07	92.25	86 SGP	7.51	9.52
17 CIV	0.49	69.10	52 JOR	1.67	98.83	87 SLV	0.91	5.52
18 CMR	0.64	47.80	53 JPN	4.74	21.29	88 SWE	2.19	6.75
19 COG	1.68	102.30	54 KEN	1.25	60.78	89 SYC	3.63	7.58
20 COL	2.30	29.69	55 KOR	6.51	53.65	90 SYR	3.57	8.58
21 COM	-0.54	58.42	56 LKA	2.45	69.26	91 TCD	-0.00	40.10
22 CPV	3.34	59.23	57 LSO	3.06	117.66	92 TGO	0.50	84.59
23 CRI	1.12	69.23	58 LUX	3.26	177.16	93 THA	5.03	2.36
24 DNK	2.46	64.60	59 MAR	3.13	44.84	94 TTO	2.33	87.99
25 DOM	3.10	53.29	60 MDG	-1.39	38.22	95 TUR	2.78	22.59
26 DZA	1.46	54.13	61 MEX	1.90	27.07	96 TWN	6.81	79.50
27 ECU	1.64	47.26	62 MLI	-0.18	42.81	97 TZA	0.72	35.72
28 EGY	2.53	49.63	63 MOZ	-1.52	40.31	98 UGA	1.68	30.45
29 ESP	3.66	33.30	64 MRT	1.07	84.08	99 URY	1.45	36.18
30 ETH	0.45	24.16	65 MUS	3.50	103.22	100 USA	2.35	6.05
31 FIN	2.92	53.50	66 MWI	1.22	59.56	101 VEN	0.52	46.69
32 FRA	2.65	38.06	67 MYS	4.22	110.73	102 ZAF	1.26	50.01
33 GAB	3.18	98.05	68 NAM	0.66	91.34	103 ZAR	-2.89	39.27
34 GBR	2.10	49.96	69 NER	-1.32	39.26	104 ZMB	-1.58	80.51
35 GHA	-0.21	37.91	70 NGA	0.51	44.35	105 ZWE	1.33	52.30

Note: *growth* is the average annual growth rate of *GDP* per capita, and *open* is the average openness (exports plus imports) as a fraction of *GDP*. Both averages are over 1960-1997.

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[1] For three widely cited examples of theoretical modeling along these lines, see Grossman and Helpman (1991), Barro and Sala-i-Martin (1995), and Obstfeld and Rogoff (1996). Romer (1992) makes a similar argument.

[2] Because of the obvious importance of the topic, the empirical literature is vast. Recent examples include Fischer (1991, 1993), Dollar (1992), Sachs and Warner (1995), Rodriguez and Rodrik (1999), and Irwin and Terviö (2002). For an extensive literature review, see World Bank (2002). Balwin (2002) also offers an authoritative survey of the literature.

[3] Country selection is dictated by data availability only. Sample means for the rest of the variables (*inv*, *pop*, and *gov*) are not reported in the Appendices in order to preserve space, but are available on request.

[4] In all the empirical specifications that follow, the *w*=s and *v*=s are modeled as country and time fixed effects, respectively.

[5] All models were estimated with and without fixed effects. As the fixed effects were jointly statistically significant in each case, the models without fixed effects are not reported to preserve space.

[6] None of the other versions of equation (4) (i.e., the Evans adjustment with or without fixed effects, no adjustment with or without fixed effects, or the Hamilton adjustment without fixed effects) gave appreciably different results, but all results are available on request.

[7] It is worth noting that this is broadly consistent with the assessment of the evidence and policy recommendation in World Bank=s *Globalization, Growth, and Poverty* report (World Bank, 2002).