"Trade Openness and Long Term Economic Growth:
Does Size or Level of Economic Development Matter?"

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Trade openness, or the degree to which a nation's policies are consistent with the free flow of goods and services into and out of the domestic economy, is a concept that has been modeled quite frequently in the growth (and economic freedom) literature but with little consensus regarding the suitability of any of the constructed metrics. Further, the trade openness and economic growth literature is rife with disagreement regarding the empirical linkage between a country's trade liberal policies and its long-term economic growth.[1] Though most economists would not argue that the freedom to trade internationally leads to slower long-term economic growth, the ability of economists to show concretely the existence of a positive relationship has been hampered by theoretically problematic and econometrically inconsistent measures of openness. This is not to say that there are no useful measures of relative trade liberalization in the literature – there are. But as descriptive and creative as they may be, economists have collected a range of questions regarding the theoretical foundation upon which these indicators are built and express concerns regarding the consistency of the estimated relationship that they deliver.

This study introduces a new measure of trade openness, a ***Trade Openness Index*** (***TOI***), to a long-run Barro-style economic growth equation similar in specification to that employed by Sachs and Warner in their seminal trade openness and long-run economic growth paper.[2,3] The ***TOI*** is a composite index of relative trade openness constructed from a set of carefully developed incidence and outcome measures of trade restrictiveness.[4] Three elements make up the ***TOI***: a 3-part tariff measure, an exchange rate control measure, and a proxy for the total extent of counter-openness policy present in the form of *actual-versus-expected* trade share differences from a carefully-specified econometric *trade-share-estimation* model. These three elements are combined using weights established using principal components analysis to form a continuous measure of relative trade openness for 123 countries from 1980-2002.

In order to assess the rigor of the trade openness and long-run economic growth relationship established in this study the analysis includes an examination of the relationship within the theoretically distinct small-population and

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[1] A set of key papers from both the measurement of trade openness and the trade openness and long-run economic growth literature would include the following: Baldwin, R. (2002) "Openness and growth: What's the empirical relationship?" Paper presented at the International Seminar on International Trade (ISIT): Challenges to Globalization, May 24-25, 2002; Greenway, D., Morgan, W. and Wright, P. (2002) "Trade liberalization and growth in developing economies." *Journal of Development Economics* 67: 229-244; Stockholm, Sweden; Rodríguez, F. and Rodrik, D. (2000) "Trade policy and economic growth: A skeptics guide to the cross-national evidence." In *Macroeconomics Annual 2000*, ed. B. Bernanke and K. Rogoff. Cambridge MA: MIT Press for National Bureau of Economic Research; Edwards, S. (1998) "Openness, productivity and growth: What do we really know?" *Economic Journal* 108: 383-398; Pritchett, L. (1996) "Measuring outward orientation in LDCs: Can it be done?" *Journal of Development Economics* 49: 307-35; and Lee, J. (1993) "International trade, distortions, and long-run economic growth." *IMF Staff Papers* 40: 299–328.

[2] Barro, R. (1991) "Economic Growth in a Cross Section of Countries." *Quarterly Journal of Economics* 106(2): 407-43.

[3] Sachs, J. and Warner, A. (1995) "Economic Reform and the Process of Global Integration" *Brookings Papers on Economic Activity*, (1); 1-118.

[4] The concept of separating the two basic approaches to openness measurement into incidence and effect categories was established by Baldwin, R. (1989) "Measuring Nontariff Trade Policies" NBER Working Paper no 2978. (May): 34-39, Cambridge, Massachusetts.

developing economy sub-sets of the data. Theory suggests that the openness and growth relationship should be more important for small-population economies and should be a significant factor in a developing economy's growth path. Analysis of these sub-samples of the data addresses these separate questions empirically.

Section I outlines the theoretical paths through which trade openness may potentially impact a nation's long-run economic growth path and identifies a handful of key concepts from the literature. *Section II* briefly discusses different theoretical approaches used in trade openness measurement. *Section III* briefly outlines the *trade-share-estimation* model which establishes the three components of the ***TOI*** and estimates the *actual-versus-expected* trade share differences used within it. *Section IV* explains how the ***TOI*** is constructed from its three parts and introduces the finished measures. *Section V* introduces the ***TOI*** to a Barro-type long-run economic growth model. *Section VI* tests the robustness of the established trade-openness and long-run economic growth relationship within the small-population and developing economy sub-sets of the data. *Section VII* summarizes the findings of this openness and long-run growth analysis.

I. The Basis for the Trade Openness and Long-run Economic Growth Argument

Pritchett defines *trade policy liberality* (*trade openness* here) as "that set of policies such that the level and pattern of trade (and prices) are near what they would be under free trade."[5,6] Trade openness represents the degree to which unfettered markets are used to coordinate trade across national boundaries and, hence, it indicates the extent to which such markets can allocate scarce resources where they are valued the most. Though trade openness may impact many different aspects of the economy, including investment, productivity, and perhaps even income distribution or environmental quality, its greatest influence is on long-run economic growth facilitated by specialization and trade according to the law of comparative advantage.

In a dynamic world, open markets can influence economic growth in many different specific ways. One path for greater economic growth through trade liberalization comes from expanding the opportunities of firms to realize more fully scale economies and greater efficiency in investment.[7] Further, increased competition through free trade limits the market power of imperfectly competitive markets, mandates efficiency, and delivers greater product variety to both consumers (in the form of final goods/services) and industry (in the form of intermediate goods/services).[8] A second path for greater economic growth through trade liberalization

[5] Pritchett, L. (1996) "Measuring outward orientation in LDCs: Can it be done?" *Journal of Development Economics* 49: 307-35.

[6] Pritchett also defines *trade openness* as synonymous with *trade intensity*, which varies for reasons unrelated to trade policy (like geographic size and population). The potential conflict, though, is simply a matter of semantics. *Trade intensity*, described as *trade share* in this paper, is an especially imprecise outcome based measure of both the non-policy characteristics of a state (such as its proximity to demand, size, population, etc) and its explicit counter-openness policies (such as tariffs, quotas, & exchange rate controls).

[7] Krueger, A. (1978) *Foreign Trade Regimes and Economic Development: Liberalization Attempts and Consequences.* Cambridge, MA: Ballinger Publishing Co. (for NBER).

[8] Where imperfectly competitive industries once operated below levels that exhaust economies of scale, trade liberalization brings increased efficiency through competition in both domestic and international markets. See Harris, R. and Cox, D. (1985) "Trade liberalization and industrial organisation: Some estimates for Canada." *Journal of Political Economy* 93(1): 115-145; and Bhagwati, J. (1988) "Export-promoting trade strategy: Issues and evidence." *The World Bank Research Observer* 3 (Washington: World Bank): 27-57.

stems from the transfer of ideas and methodologies among countries and the ability of domestic economies to utilize imported intermediate inputs that benefit from new techniques or technologies in the world economy. Repeated and sustained interaction through international trade facilitates the ability of domestic producers to adopt foreign technologies and knowledge in their own production.[9] A third path for greater economic growth through trade liberalization is derived through international competition in governance. Trade openness may constrain the choices of a nation's policy-makers as they consider the possibility that their actions may distort the opportunities facing their economy.[10] There are many different ways that trade openness may impact economic growth. These three channels are simply representative of the broad range of channels identified in the literature.

The impact of trade on long-run economic performance remains a contentious topic, but economic theory indicates that there is good reason to believe that relatively open economies will achieve higher income levels and grow more rapidly than those with substantial barriers that retard trade. Policies that limit potential gains from trade simultaneously limit the gains from division of labor, specialization, and the realization of gains from comparative advantage.

II. Theoretical Design of the Measurement of Trade Openness

The measurement of trade openness literature is built upon a broad range of index approaches and measurement techniques. Three such indicators that represent the breadth of index approaches include Sachs and Warner, Dollar, and simple trade share. Sachs and Warner use a laundry list of binary criteria to construct an open or closed categorical variable.[11] David Dollar compares the price of a basket of goods in one country to that in the United States to construct two measures – measuring both the degree and variability of distortion between economies. Higher prices, with Dollar's approach, represent the presence of counter openness policy.[12] Simple trade share is calculated simply as an economy's imports and exports as a share of GDP with higher ratios representative of more open economies.[13] Three different openness indicators that represent the breadth of measurement approaches include Leamer, Laird & Yeats, and Andriamananjara & Nash. Leamer builds an indicator of openness using predicted trade shares constructed using Heckscher-Ohlin-Vanek style factor endowments models.[14] Laird and Yeats base their measure on estimates of the incidence of non-tariff barriers.[15]

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[9] Edwards, S. (1992) "Trade orientation, distortions & growth in developing countries" *Journal of Development Economics* 39: 31-57.

[10] Wacziarg, R. (1998) "Measuring the Dynamic Gains from Trade" Policy Research Working Paper No. 2001. The World Bank, Washington DC.

[11] Sachs, J. and Warner, A. (1995) "Economic Reform and the Process of Global Integration" *Brookings Papers on Economic Activity*, (1); 1-118.

[12] Dollar, D. (1992) "Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-85", *Economic Development and Cultural Change*, pp. 523-544.

[13] See ***footnote 6*** for additional discussion of the *simple trade share* measure (or as Pritchett called it – *trade intensity*).

[14] Leamer, E. (1988) "Measures of Openness" In Robert Baldwin, ed., *Trade Policy Issues and Empirical Analysis*, pp. 147-204. Chicago: University of Chicago Press.

Andriamananjara and Nash employ continuous import penetration data based on the imports of consumption goods as a share of total imports to build their measure.[16]

When attempting to measure the extent of counter-openness policy present there are two basic approaches: measurement of incidence and measurement of outcome.[17] Methods that concentrate on incidence examine either explicit measures of counter-openness policy or proxies for them; measures that concentrate on outcome infer the extent of counter-openness policy present by looking at macro outcomes hypothesized to be affected by such policy. Methods that concentrate on incidence must take care to select meaningful measures that are indicative of the entire trade policy regime. Methods that concentrate on outcome must select measures functionally related to the incidence of counter-openness policy, carefully model the relationship between the observed variables and the implied counter-openness policies, and must control for the multitude of contributing factors in an economy that may create the specific effect.

The *trade openness index* developed in this paper possess aspects of both the incidence and outcome approaches to openness measurement. The *actual-versus-expected* trade share differences element of the ***TOI*** (estimated by the *trade-share-estimation model*) represents a carefully designed outcome based measure. This econometric model estimates *natural* trade share levels that would exist in a world economy without policy distortion. Furher, the 3-part tariff and exchange rate control measures were each carefully selected to be incidence based indicators truly representative of the trade policy regime they depict.

III. The *Trade-share-estimation model*

At the heart of the *Trade Openness Index* analysis is an econometric study of the relationship between the extent of a state's imports and exports as a share of GDP (its trade share) and a set of its policy and non-policy characteristics. This econometric analysis, the *trade-share-estimation* model, serves two basic purposes: it establishes the set of explicit counter-openness policy measures which have a statistically significant impact on the size of a state's trade sector, and, assuming the model is well specified with both its policy and non-policy characteristics, it provides an estimate of the level of trade share *expected* in a state *in the absence of explicit counter-openness trade policy* from which trade share residuals may be constructed.

The pooled OLS trade-flow model employed in this study is based on the standard gravity model of international trade; in this model, trade share varies positively with demand proximity and negatively with size (both population and geographic), absence of access to coastline, and the presence of counter-openness policies like tariffs and exchange rate controls. The model is constructed such that zero levels on the policy measures signify the absence of counter-openness policy; hence, by zeroing out the policy measures (after the econometric

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[15] Laird, S. and Yeats, A. (1988) "Nontariff Barriers in Industrialized Countries: 1966-86," *Finance and Development* (March).

[16] Nash, J. & Andriamananjara, S. (1997) "Have Trade Policy Reforms Led to Greater Openness in Developing Countries?" Working Papers – International Economics (#1730), World Bank.

[17] Baldwin, R. (1989) "Measuring Non-tariff Trade Policies." NBER Working Paper #2978. (May): 34-39, Cambridge, Massachusetts.

model is run) estimates of *expected trade shares*, absent the presence of counter-openness policy, are possible. The difference between the actual and expected level of trade flows for an economy (its *actual-versus-expected* trade share) serves as a proxy for the total extent of counter-openness policy present in the state and is one of the three parts of the composite openness index constructed in this paper.

As for the set of consistently performing explicit counter-openness policy measures, what the *trade-share-estimation* model described below finds is that, of the many different measures available, a carefully balanced three-part tariff measure and a proxy for exchange rate controls (the ubiquitous black market exchange rate premium) are the two policy measures which perform most robustly. Examination of various non-tariff barrier measures and of capital controls revealed inconsistency in the composition of many and inconsistency in the econometric performance of others.[18] Together, the three-part tariff measure and exchange rate control proxy (described below) along with the *actual-versus-expected* trade share residuals (described above) make up the three parts to the composite trade openness scalar developed in this study, the ***TOI***.

The Specifics of the *Trade-Share-Estimation* Model

The formal specification of the *trade-share-estimation* model relates an economy's trade sector to:

- proximity to external demand (Distance Adjusted Demand Scalar – ***DADS***),
- working population,
- square kilometers of geographic size,
- kilometers of ocean coastline,
- a binary measure for whether or not a state is landlocked or not,
- a series of annual dummies for effects that vary by year (or through time) but are state invariant,
- a 3-part measure of tariffs, and,
- a measure of exchange rate controls.

Annual data from 123 economies during the 1980 to 2002 period are utilized.

The *Distance Adjusted Demand Scalar*, or ***DADS***, is an aggregated approach to the proximity idea developed by Skipton and Gwartney which includes within its construction more than 99% of the world's

[18] Non-tariff barriers (NTBs) cover a broad range of counter-openness policies that include quotas, administrative hurdles, sectoral subsidies, licensing, and quality or environmental standards (to name a few). NTBs often make a poor measure of counter-openness policy due to a weakness in their construction, which typically results in their explaining the coverage of restrictions and not the effective distortions they may create (see Edwards, S. (1992) "Trade orientation, distortions and growth in developing countries." *Journal of Development Economics* 39: 31-57; and Baldwin, R. (2002) "Openness and growth: What's the empirical relationship?" Paper presented at the International Seminar on International Trade (ISIT): Challenges to Globalization, May 24-25, 2002. Stockholm, Sweden). Consider, as an example, NTB measures that are based on the share of imports covered by at least one type of NTB. Such an indicator clearly under-measures NTB application by not accounting for the trade that is effectively eliminated through the distortions they impose. A second widely employed approach of NTB measurement counts the product categories for which NTB barriers exist. This approach is also not efficient as it does not convey the degree of distortion that the enumerated NTBs represent. Finally, NTB indices typically measure a group of vastly differing policy instruments such as quotas, import subsidies, and customs regulations together, each of which explains, may impact trade differently (see Pritchett, L. (1996) "Measuring outward orientation in LDCs: Can it be done?" *Journal of Development Economics* 49: 307-35). For these reasons, among others, it may not be reasonable to aggregate into one index measures that range from the use of heath standards to the complexity of bureaucratic hedge-rows.

measured GDP.[19] In the standard gravity model of international trade, bilateral trade shares are estimated pair-wise (bi-laterally) with the distance between them and their respective GDP measures introducing a 3-part measure of proximity to demand. After all pair-wise estimates are made, the bi-lateral estimates of trade flows for each state are aggregated to form estimates of international trade aggregates. The ***DADS*** measure represents a conceptual aggregation of this bilateral approach. The ***DADS*** measure for a country is calculated as the summation of rest of the world's economies' GDP, scaled by a mathematical transformation of their pair-wise big-circle distance, computed annually for the 23 years in the sample.[20] Countries closer to world concentrations of demand (like those in western Europe) have larger annual ***DADS*** measures than those more remote from concentrations of demand (like Argentina, New Zealand, or the United States). It is argued that greater proximity to demand, all else equal, leads to larger trade sectors.[21]

Working age population (15 to 65), geographic size, and 'absence of coastline" are each regularly included within the gravity model of international trade. *Extent of coastline* is a simple extension of the same concept. Theory suggests, all else equal, that countries with either large populations or substantial geographic size possess greater internal opportunities for realization of gains from economies of scale and specialization according to the law of comparative advantage. Further, as for states that are geographically large, if distance matters for trade, and it does with gravity models, then there is a certain propensity for a state to trade internally as more of its proximal demand prospects are located geographically within itself. As for "absence of coastline" or "extent of coastline," given the transactions cost involved with overland versus ocean-bound transport, countries with immediate access to the ocean may possess a natural advantage in many industries relative to those that are landlocked.

Both tariffs and exchange rate controls (often introduced in application with the black market exchange rate premium) are regular explicit counter-openness policy additions to attempts at quantifying cross-country differences in trade openness in the literature. The tariff measure employed in this paper is a careful weighted composite of 3 leading indicators of the existence and prominence of taxes on exports: mean tariff rates, taxes on international trade as a share of international trade, and the standard deviation of the tariff rate.[22] More

[19] See Skipton, C. and Gwartney, G., *Openness, Growth, and Trade Policy*, (Washington, DC: Joint Economic Committee Report, Congress of the United States, December 2000). This measure has been calculated for between 165 and 182 countries (depending on the year as countries come and go) from 1980 through 2002. The ***DADS*** is maintained by Dr. Skipton and is available upon request.

[20] The cross-sectional, time-series data used to build the ***DADS*** are *real* GDP figures that have been further "de-trended" to make the data *stationary* (eliminating the growth of the world's economy through time). An earlier iteration of the ***DADS*** employed data that was both longitudinally and cross-sectionally real. It was found, though, that the data (sourced primarily from both the World Bank and CIA data group) was filled with difficult to fill gaps and created ***DADS*** that were very highly correlated (pair-wise correlation was greater than 0.99 with DADS figures constructed without the PPP aspect).

[21] For more detailed information on the ***DADS*** measure, including specifics regarding its construction and a complete listing of the individual annual measures, see Skipton, C. (June 2002) "The Measurement of Trade Openness: A Selection Cropped from Forthcoming Dissertation." This working paper and other sections of the completed dissertation are available upon request.

[22] The weighted tariff measure is relatively unique in the trade openness literature. It comes from the cross-country economic freedom measurement work done by Gwartney and Lawson in their *Economic Freedom of the World: 2001 Annual Report*, (Vancouver: Fraser Institute, 2001).

distortionary tariff policy leads, all else equal, to smaller trade shares. As is found regularly in the literature, in this study the black market exchange rate premium is used as a proxy for exchange rate controls.[23] Theory suggests that policies that increase the cost of international exchange will diminish its existence. Greater exchange rate controls, all else equal, lead to smaller trade sectors.

The *trade-share-estimation* model was run as a pooled OLS equation using annual data from 1980 through 2002 for the 123 economies in the sample.[24] The dependent variable for this analysis is the sum of imports and exports as a share of GDP. The independent variables are divided into two general groups: policy and non-policy. Of the non-policy variables, the ***DADS*** proximity measure is continually developed and maintained by the author of this study, and the data related to extent of coastline, geographic size, and population size were each sourced from either the World Bank (*World Development Indicators*) or CIA (*World Fact Book* – online). The 3-part tariff and black market exchange rate premium measures each come from Gwartney and Lawson's *Economic Freedom of the World Index*.[25] The author of this study worked with Gwartney and Lawson to update, maintain, and develop the set of data employed in the freedom index during the 1998 to 2003 period and has a solid understanding of its composition. Both of the tariff and exchange rate control policy measures are 0 to 10 transformations of the actual data where a 0 represents the absence of measured trade restriction.[26]

The *Actual-versus-Expected* Trade Share Estimates

If the *trade-share-estimation* model is as fully specified as is practical and if the model has controls for variations related to year-specific (state-invariant) global events and the growth of international trade through time (resulting, perhaps, from the IT and communication revolution of the late 1980s and early 1990s, the fall of the iron curtain, and further exploitation and evolution of container ship technology) then the majority of the error (which is not random noise) should be made up of difficult to specify and measure aspects of counter-

[23] For just a few examples from the trade openness (and economic freedom) literature where the black market exchange rate premium as employed as a proxy for the extent of exchange rate controls present in an economy see the following: Lundberg, M., and Squire, L. (2003) "The simultaneous evolution of growth and inequality." *Economic Journal*113: 326-344; Easterly, W., and Levine, R. (1997) "Africa's growth tragedy: Policies and ethnic divisions." *The Quarterly Journal of Economics* 112(4): 1203-1250; Edwards, S (1992) "Trade orientation, distortions and growth in developing countries." *Journal of Development Economics* 39: 31-57.

[24] In an earlier working paper (Skipton, C. (2003) *Trade Openness and Long-run Economic Growth: 1980-1999*) which employed a smaller sample of countries (81 instead of the 123 in this paper) over a shorter time period (20 years instead of 23) a couple different precautions were taken in an effort to address some of the potential weaknesses of using OLS estimation with pooled cross-sectional & time-series data. First, a second series of *actual-versus-expected* trade share differences was constructed using individual OLS runs of the annual cross-sections of data. When this second set of residuals was introduced into a parallel (test) *TOI*, the correlation coefficient between it and the *TOI* developed within this paper was nearly 0.99. Further, when this parallel (test) *TOI* was introduced to a series of Barro-style growth equations similar to those employed in this paper, the parallel (test) *TOI* performed almost identically. The second precaution involved the use of a 2-way fixed effect model to estimate the trade shares instead of either pooled OLS or the series of annual OLS runs described above. Here the actual-versus-expected residuals differed from the pooled OLS series modestly (notably more than the series of annual OLS runs), and while this second parallel (test) *TOI* did not perform as robustly as the model in this paper, it performed similarly.

[25] See Gwartney, J. and Lawson, R. (2004) *Economic Freedom of the World: 2004 Annual Report*, (Vancouver: Fraser Institute, 2004).

[26] For more information regarding the specific methodology used by Gwartney and Lawson in the construction of their 3-part tariff and black market exchange rate premium measures, see Gwartney, J. and Lawson, R. (2004) *Economic Freedom of the World: 2004 Annual Report*, (Vancouver: Fraser Institute, 2004).

openness policy (such as the ever-so-elusive non-tariff barriers).[27] By taking the carefully specified model and zeroing out the policy coefficients, the resulting predicted trade shares represent *trade sector estimates in the absence of counter-openness policy* or, in essence, *natural* trade share levels. The degree to which actual trade shares deviate from that predicted by the model serves as a proxy for the total extent of counter-openness policies present.[28] The magnitude of this difference contains the effect of both policy constraints explicitly specified in the model and those omitted due to data constraints – like for non-tariff barriers. Theoretically the relative magnitude of the 'actual versus expected' differences serves as a raw measure of limits to trade openness; in application, no empirical technique is without its potential weaknesses.[29]

IV. Construction of the *TOI*

The three parts of the ***TOI*** – the three part tariff measure, the exchange rate controls measure, and the *actual-versus-expected* trade share measure – are integrated together into a scalar measure of openness using a system of weights estimated using principal components analysis. This process is employed in order to construct a measure of openness that avoids any potential distortion from the specific econometric approach used to estimate the *actual-versus-expected* trade share differences and in order to maximize the descriptive capacity of the measure (in an effort to delineate as many of the differences between the economies as is possible).

Principal component analysis (***PCA***) is a statistical technique often used to reduce an n-dimensional space down to an m-dimensional space (where $m < n$) by combining correlated variables in such a fashion as to maximize the share of the variability explained by each newly constructed composite component. The ***PCA*** methodology offers a powerful technique to reduce n-factors to $m < n$ components while maintaining as much of the variability in the original data-space as possible. In other words, by the ***PCA*** methodology, a weighting system was constructed that distills the descriptive power of the three elements of the ***TOI*** down to a scalar while maintaining much of the degree of variability found within the 3 original variables as is possible.[30]

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[27] The trade-share-estimation model includes a series of annual dummies to control for year specific changes or changes that build, irrespective of state, through time. As expected, the dummy variables are insignificant in the first few years of the data and become more and more significant (with larger and larger coefficients) as the years progress to the end. This result supports the predictions related to growth in the general level of trade share outlined in the paragraph above.

[28] The *actual-versus-expected* differences that are employed within the ***TOI*** are actually 0 to 10 transformations of the trade share differences between the predicted and actual values that come from the *trade-share-estimation* model. The data is linearly transformed with an upper and lower cap. Data points that exceed two standard deviations above the full sample mean are assigned a measure of 10; *actual-versus-expected* differences that exceed two standard deviations below the sample mean are assigned a measure of 0. This four standard deviation range that the 'actual versus expected' differences are mapped into diminishes the distortionary effect of outliers from either the top or bottom end of the range.

[29] The specific econometric results for the *trade-share-estimation model* are not presented in this study. These details, along with a 2-way random effects and 2-way fixed effects alternate analysis are presented (at length) in Skipton, C. (June 2002) "The Measurement of Trade Openness: A Selection Cropped from Forthcoming Dissertation." This paper, and sections from the completed dissertation, is available upon request from Dr. Skipton at cskipton@ut.edu.

[30] The specific weights generated by the PCA methodology for the 2 policy variables are 30 to 50% larger than for the *actual-versus-expected* trade share differences element.

The ***TOI*** were constructed annually for 123 economies. Some states do not have ***TOI*** measures for the entire period due to either the presence of inconsistent / conflicting data or because the state either appeared (like with the post-soviet economies at the end of the 1980s) or disappeared (like with Rwanda in 2000/01).[31] *Table 1* (next page) shows the states with complete period ***TOI*** (1980-2002) which are used in the growth model that follows in order of ***TOI*** rank. *Table 2* (following Table 1) shows blended 3-year ***TOI*** for the complete sample of 123 economies, sorted alphabetically. The ***TOI*** are available annually, but the 3-year smoothed observations make it easier to view the data at a glance (for the whole period) and eliminate the year-to-year variations that would be present if a single year was shown (for every 5 years).

The change in the openness that occurs during the 22 year sample is part of the growth model presented in this paper. Change can be calculated in one of a number of ways. One way would be to simply look at the raw change in the level of the measured ***TOI***. This approach, though, would not convey any information related to how large a change was achieved by the state. Alternatively, one could look at the relative change in the openness measure. *Table 3* (following Table 2) shows the economies with the greatest change throughout the period using both methodologies. Note that when relative change is calculated that it is calculated as the change in the ***TOI*** measure from (1980-82) to (2000-02) relative to the difference between the beginning-of-period level (1980-82) and 10 (the highest rating possible).[32] The largest changes occur with states for which the change measure does not matter. The change measure employed in the economic growth model in this study is the relative change measure.

V. Trade Openness and Long-Run Economic Growth

The main question addressed in this study is whether or not trade openness, or the absence of explicit policy limitations to exchange goods internationally, has any measurable impact on the long-term economic growth of a state, and how (and whether) the measured relationship is any different within the small country and developing economy subsets of the data. With the construction and logic of the ***TOI*** carefully outlined, the question of openness and long-run economic growth may proceed.

It is important to note, though, that the existence of the relationship in question is being searched for over the relatively long-term (over 20 years). The greatest impact of trade openness policy on economic growth is in the long-run. Though the reduction of counter-openness policy may lead to fairly immediate changes in trade flows (as they are often anticipated) the full impact of liberalization on income is likely to take more time. It takes time for institutional changes to lead to capital inflows and resource decisions to be made to reflect now profitable

[31] Special care was taken with Germany. The economy listed in the sample is actually West Germany before 1989 and unified Germany thereafter. The population, geographic size, extent of coastlines, and proximity to demand variables were each specifically tuned to account for the change.

[32] If the change was negative during the period the relative change is calculated as the change relative to the difference between the end-of-period rating (2000-02) and 10 (the highest rating possible).

Table 1: The Trade Openness Index (TOI) 1980-2002

Rank	Economy	Rating	Rank	Economy	Rating	Rank	Economy	Rating
1	Hong Kong	9.96	33	Thailand	7.12	65	Venezuela	5.62
2	Singapore	9.92	34	Congo, Republic of.	7.08	66	Nepal	5.60
3	Bahrain	8.60	35	Panama	7.02	67	Malawi	5.57
4	Belgium	8.59	36	South Africa	7.01	68	China	5.43
5	Malaysia	8.57	37	Jordan	6.92	69	Ecuador	5.42
6	Luxembourg	8.54	38	Greece	6.88	70	Paraguay	5.37
7	Netherlands	8.36	39	Cyprus	6.76	71	Zambia	5.29
8	Taiwan	8.35	40	Bolivia	6.64	72	Nicaragua	5.26
9	Ireland	8.06	40	Botswana	6.64	73	Congo, Democratic Republic	5.24
10	Austria	7.93	42	Mali	6.58	74	Guatemala	5.09
11	Canada	7.91	43	Fiji	6.56	75	Trinidad and Tobago	5.08
12	Switzerland	7.81	44	Iceland	6.53	76	Argentina	5.06
13	Germany	7.80	45	Gabon	6.42	77	El Salvador	5.04
14	United Kingdom	7.79	46	Barbados	6.40	78	Dominican Republic	5.03
15	Indonesia	7.78	46	Turkey	6.40	79	Brazil	4.98
16	Sweden	7.73	48	Uruguay	6.30	80	Madagascar	4.63
17	Italy	7.70	49	Mexico	6.28	81	Ghana	4.59
18	Portugal	7.66	50	Jamaica	6.17	81	Peru	4.59
19	Israel	7.62	51	Cote d'Ivoire	6.11	83	Uganda	4.51
20	Denmark	7.55	52	Cameroon	6.04	84	Nigeria	4.50
21	France	7.52	53	Kenya	6.02	85	Belize *	4.26
22	United States	7.50	54	Mauritius	6.00	86	India	4.25
23	South Korea	7.49	55	Tunisia	5.96	87	Tanzania *	4.12
24	Malta	7.48	56	Hungary	5.95	88	Egypt	4.10
25	Norway	7.47	57	Sri Lanka	5.87	89	Pakistan	3.91
26	Finland	7.43	58	Morocco	5.82	90	Syria	3.84
27	Spain	7.41	59	Costa Rica	5.79	91	Algeria	3.41
28	Philippines	7.27	60	Niger	5.74	92	Sierra Leone	3.39
29	New Zealand	7.22	61	Colombia	5.72	93	Burundi	2.98
30	Chile	7.19	62	Senegal	5.68	94	Iran	2.87
31	Australia	7.15	63	Central African Republic	5.65	95	Bangladesh	2.48
32	Japan	7.14	64	Zimbabwe	5.64			

Note: Annual TOI have been constructed for 123 countries from 1980-2002. Sufficient full period data exist for these 95. Annual data are available upon request.

* Insufficient macro growth data exist for these two economies to be run in the growth equations summarized in Tables 4,5, and 6.

Table 2: The TOI from 1980-82 to 2000-02

1980-2002 Rank	Economy	1980-82 Rating	1985-87 Rating	1990-92 Rating	1995-97 Rating	2000-02 Rating	*1980-2002 Rating*
**	Albania	.	.	.	6.13	6.38	.
91	Algeria	3.80	2.79	2.77	3.13	5.66	*3.41*
76	Argentina	4.55	2.78	5.25	6.68	6.69	*5.06*
31	Australia	6.89	7.06	6.81	7.38	7.65	*7.15*
10	Austria	7.74	7.81	7.66	8.01	8.56	*7.93*
**	Bahamas	4.78	5.06	4.75	5.30	.	.
3	Bahrain	9.11	8.73	8.76	8.37	8.22	*8.60*
95	Bangladesh	0.90	0.80	1.18	3.56	6.39	*2.48*
46	Barbados	6.58	6.24	5.99	6.72	6.54	*6.40*
4	Belgium	8.35	8.54	8.38	8.58	9.11	*8.59*
85	Belize *	3.38	2.85	4.07	5.31	6.30	*4.26*
**	Benin	5.19	5.21	.	.	6.83	.
40	Bolivia	4.93	6.03	7.08	7.61	7.47	*6.64*
40	Botswana	6.24	6.49	6.67	6.54	7.32	*6.64*
79	Brazil	3.64	2.41	5.47	6.62	7.03	*4.98*
**	Bulgaria	.	3.86	4.86	7.27	8.16	.
93	Burundi	1.34	3.10	3.76	2.32	4.53	*2.98*
52	Cameroon	5.64	6.38	6.00	5.74	6.46	*6.04*
11	Canada	7.66	7.86	7.52	7.80	8.79	*7.91*
63	Central African Rep.	5.42	5.43	5.14	6.33	5.90	*5.65*
**	Chad	.	.	6.65	7.30	6.80	.
30	Chile	6.72	6.02	7.78	7.77	8.06	*7.19*
68	China	3.95	4.80	3.97	7.25	8.21	*5.43*
61	Colombia	4.56	5.03	5.43	6.77	7.22	*5.72*
73	Congo Dem. Rep.	2.89	5.99	5.44	7.05	3.46	*5.24*
34	Congo Rep. of	7.45	6.10	6.31	7.83	8.03	*7.08*
59	Costa Rica	2.58	4.02	6.69	7.40	7.84	*5.79*
51	Cote d'Ivoire	5.85	6.03	5.55	6.55	6.84	*6.11*
**	Croatia	.	.	.	6.88	7.81	.
39	Cyprus	6.80	6.68	6.33	6.98	7.30	*6.76*
**	Czech Rep.	.	.	.	8.51	8.50	.
20	Denmark	7.44	7.56	7.40	7.53	7.88	*7.55*
78	Dominican Rep.	3.30	5.07	3.70	6.44	6.88	*5.03*
69	Ecuador	4.68	3.20	5.96	6.64	7.40	*5.42*
88	Egypt	4.46	1.81	3.28	5.65	5.78	*4.10*
77	El Salvador	2.21	3.15	5.28	7.06	7.47	*5.04*
**	Estonia	.	.	6.20	8.79	9.14	.
43	Fiji	5.65	5.83	6.84	7.26	7.57	*6.56*
26	Finland	7.40	7.40	7.03	7.60	7.77	*7.43*
21	France	7.35	7.37	7.42	7.60	7.92	*7.52*
45	Gabon	5.77	6.45	6.53	6.66	6.63	*6.42*
13	Germany	7.60	7.68	7.64	7.83	8.38	*7.80*
81	Ghana	0.34	2.21	5.61	7.13	8.51	*4.59*
38	Greece	6.49	6.03	7.05	7.33	7.64	*6.88*
74	Guatemala	4.02	2.26	5.96	6.86	7.11	*5.09*

Table 2: The TOI from 1980-82 to 2000-02 *continued*

1980-2002 Rank	Economy	1980-82 Rating	1985-87 Rating	1990-92 Rating	1995-97 Rating	2000-02 Rating	*1980-2002 Rating*
**	Guinea Bissau	.	3.95	.	.	7.37	.
**	Guyana	4.81	3.79	.	.	7.91	.
**	Haiti	4.02	2.85	2.59	.	7.09	.
**	Honduras	4.57	.	6.82	7.77	7.82	.
1	Hong Kong	9.94	9.94	9.97	9.98	9.98	*9.96*
56	Hungary	3.89	4.52	5.62	7.45	8.38	*5.95*
44	Iceland	5.78	5.97	6.82	7.08	6.95	*6.53*
86	India	3.72	3.24	3.79	4.87	6.44	*4.25*
15	Indonesia	7.45	7.29	7.50	7.92	9.01	*7.78*
94	Iran	1.75	1.62	3.31	3.70	4.16	*2.87*
9	Ireland	7.53	7.58	7.68	8.45	9.08	*8.06*
19	Israel	7.22	7.48	7.64	7.59	8.23	*7.62*
17	Italy	7.75	7.64	7.39	7.78	8.03	*7.70*
50	Jamaica	4.60	6.19	5.77	7.04	7.43	*6.17*
32	Japan	7.52	7.29	6.96	6.94	7.06	*7.14*
37	Jordan	7.04	6.66	6.60	7.41	6.99	*6.92*
53	Kenya	5.53	5.63	5.51	6.72	6.91	*6.02*
23	Korea, South	6.83	6.96	7.49	7.86	8.32	*7.49*
**	Kuwait	.	7.98	8.25	7.98	7.92	.
**	Latvia	.	.	.	7.98	7.74	.
**	Lithuania	.	.	.	8.08	7.97	.
6	Luxembourg	8.22	8.55	8.31	8.47	9.24	*8.54*
80	Madagascar	2.49	3.89	4.73	5.90	5.88	*4.63*
67	Malawi	3.57	4.76	6.16	6.48	6.69	*5.57*
5	Malaysia	8.14	8.32	8.87	8.84	8.51	*8.57*
42	Mali	5.85	6.31	6.43	6.99	7.64	*6.58*
24	Malta	6.62	6.97	7.56	8.26	8.08	*7.48*
54	Mauritius	3.78	6.02	6.03	6.78	7.07	*6.00*
49	Mexico	2.00	5.26	7.35	8.20	7.94	*6.28*
58	Morocco	5.08	5.91	5.63	6.37	5.98	*5.82*
**	Myanmar	0.72	0.27	0.11	0.04	.	*0.24*
**	Namibia	.	6.69	6.85	6.56	7.24	.
66	Nepal	5.77	5.21	4.93	5.84	6.46	*5.60*
7	Netherlands	8.27	8.32	8.11	8.41	8.76	*8.36*
29	New Zealand	7.23	6.91	6.87	7.31	7.86	*7.22*
72	Nicaragua	1.62	2.18	6.18	7.54	8.41	*5.26*
60	Niger	5.99	5.58	5.10	5.60	7.03	*5.74*
84	Nigeria	2.74	3.15	5.12	4.83	6.94	*4.50*
25	Norway	7.65	7.74	7.48	7.32	7.15	*7.47*
**	Oman	.	7.78	7.78	7.59	7.91	.
89	Pakistan	2.91	4.10	3.85	4.63	3.84	*3.91*
35	Panama	7.48	6.89	6.56	7.25	7.13	*7.02*
**	Papua New Guinea	.	7.39	7.02	6.99	.	.
70	Paraguay	4.19	3.14	5.65	7.13	7.31	*5.37*
81	Peru	3.18	2.00	4.69	6.76	7.01	*4.59*

Table 2: The TOI from 1980-82 to 2000-02 *continued*

1980-2002 Rank	Economy	1980-82 Rating	1985-87 Rating	1990-92 Rating	1995-97 Rating	2000-02 Rating	*1980-2002 Rating*
28	Philippines	6.01	6.23	6.83	8.32	8.98	*7.27*
**	Poland	.	3.47	6.32	6.93	7.60	.
18	Portugal	7.44	7.65	7.42	7.76	7.95	*7.66*
**	Romania	.	.	4.90	7.11	7.30	.
**	Russia	.	.	.	7.92	8.57	.
**	Rwanda	1.20	.	2.55	4.46	5.21	.
62	Senegal	5.55	5.56	5.08	5.81	6.68	*5.68*
92	Sierra Leone	1.94	2.11	3.80	5.21	3.93	*3.39*
2	Singapore	9.94	9.94	9.89	9.88	9.97	*9.92*
**	Slovakia	.	.	.	8.55	9.24	.
**	Slovenia	.	.	.	7.50	7.70	.
36	South Africa	7.37	6.51	6.84	6.90	7.82	*7.01*
27	Spain	7.08	7.10	7.09	7.70	8.10	*7.41*
57	Sri Lanka	5.22	4.65	4.79	7.04	7.97	*5.87*
16	Sweden	7.35	7.77	7.50	7.81	8.12	*7.73*
12	Switzerland	7.65	7.81	7.75	7.51	8.39	*7.81*
90	Syria	3.11	2.57	2.90	4.53	7.36	*3.84*
8	Taiwan	8.30	8.36	8.31	8.42	8.35	*8.35*
87	Tanzania *	2.45	2.41	3.52	6.49	6.16	*4.12*
33	Thailand	6.15	6.34	6.89	7.79	8.83	*7.12*
**	Togo	5.65	6.38	5.76	.	7.44	.
75	Trinidad and Tobago	3.92	3.87	4.41	6.95	6.69	*5.08*
55	Tunisia	5.05	5.02	6.09	6.61	6.99	*5.96*
46	Turkey	4.44	6.17	5.94	7.52	7.72	*6.40*
83	Uganda	3.67	3.32	3.27	6.20	7.12	*4.51*
**	Ukraine	.	.	.	.	8.15	.
**	United Arab Emirates	8.27	8.11	8.45	.	.	.
14	United Kingdom	7.72	7.85	7.54	7.89	7.99	*7.79*
22	United States	7.54	7.42	7.40	7.62	7.56	*7.50*
48	Uruguay	5.47	6.02	6.33	6.85	6.80	*6.30*
65	Venezuela	6.65	4.35	5.93	5.12	7.13	*5.62*
71	Zambia	4.42	4.12	4.47	7.12	7.08	*5.29*
64	Zimbabwe	3.93	4.23	5.96	7.53	6.21	*5.64*

** There is insufficient ***TOI*** data for these economies to have a full 1980-2002 period rating.

* Insufficient macro growth data exist for these two economies to be run in the growth equations in Tables 4,5, and 6.

transactions. It takes time for financial institutions to become convinced of the likelihood of trade policy persistence – facilitating the reorganization of resources necessary for the full-impact of a liberal trade regime to be realized. It takes time for economies, once impeded by the strong arm of exchange regulation , to operate in industries where their true comparative advantage lay and where wealth may be created without inhibition. Finally, it takes time for all resources, whether human or physical, to be reallocated to where they are valued the most, making the largest measurable impact on the growth rate of the economy, the long-run growth rate, possible.

Table 3: Economies with the Largest Change in Openness [*,**]

Economy	% change	Economy	Raw change
Ghana	84.6%	Ghana	8.17
Nicaragua	81.0%	Nicaragua	6.79
Philippines	74.6%	Mexico	5.94
Mexico	74.3%	Bangladesh	5.50
Hungary	73.4%	Costa Rica	5.27
Costa Rica	70.9%	El Salvador	5.26
China	70.4%	Hungary	4.49
Thailand	69.7%	China	4.26
El Salvador	67.6%	Syria	4.25
Ireland	62.7%	Nigeria	4.20
Syria	61.7%	Rwanda	4.01
Indonesia	61.1%	Peru	3.83
Bangladesh	60.4%	Tanzania	3.70
Honduras	59.9%	Dominican Republic	3.59
Guyana	59.7%	Uganda	3.45

*** Figures are calculated using the 3-year smoothed period TOI from 1980-82 to TOI 2000-02.**
**** Percent change figures calculated as the % change relative to the difference between the original value and 10.**

The choice of growth model for this study is an applied Barro methodology – one very similar, in fact, to the specific methodology employed by Sachs and Warner in their landmark trade openness paper from 1995.[33, 34] The dependent variable in this growth environment is the average annual compounding growth of PPP GDP per capita for the period (1980-2002). There are two measures of human capital formation in the form of primary and secondary enrollment rates. There are two measures related to physical capital formation in the form of gross capital formation and a measure for the start of period relative price of investment capital.[35] There is a convergence indicator in the form of the log of GDP per capita at the start of the period.[36] Gone are two social and political stability indicators present in the Sachs and Warner analysis as well as the standard Barro model (assassinations per million and revolutions / coups per million); an earlier working paper employing the ***TOI*** using a growth model very close to the *precise* Sachs and Warner specification showed these two political and social

[33] Barro, R. (1991) "Economic Growth in a Cross Section of Countries," *The Quarterly Journal of Economics*, Volume 106, Issue 2 (May, 1991), p. 407-442.

[34] Sachs, J. and Warner, A. (1995) "Economic Reform and the Process of Global Integration" *Brookings Papers on Economic Activity*, (1); 1-118.

[35] PPI80DEV measures the relative price of investment goods for a state in 1980 (the start of the period studied). Quite literally it is the deviation of the log of the price level of investment for a state relative to the sample mean as calculated by Barro and Lee in Barro, R. and J-W. Lee (1994) "Dataset for a Panel of 138 Countries," *Mimeo*, Harvard University. In a handful of cases where observations were not available for 1980, observations for 1985 were used in their place. There is data available using this methodology and this data source for 109 of the 123 countries measured by the ***TOI***.

[36] The log of GDP per capita is regularly used as a convergence indicator in Barro style growth models. Income convergence would be shown, in a model like this, with a significant and negative sign on the beginning of the period per capita GDP measure (Ln GDP Per Cap 1980) – implying that high-income economies grew slower, during the span of the sample, than low-income economies thereby converging.

stability series as regularly insignificant – perhaps a function of the difference in political stability for the two periods studied (the 70s and 80s with Sachs and Warner and the relatively more sedate 80s and 90s with the ***TOI***).[37] In place of the binary openness indicator from the Sachs and Warner study is the continuous ***TOI*** measure (developed above) and a measure of its change during the period (discussed earlier). In place of real government consumption spending as a share of GDP (a fairly cumbersome series of data from the Barro growth analysis which measures government spending outside of the military and education) this study considers a new series for private and public investment from Gwartney, Holcombe, and Lawson which separates national inversment as a share of GDP between that originating from the government and private sector.[38] This new series is substituted in for gross capital formation for half of the growth model runs. This more detailed measure of capital formation is examined in order to test whether or not there is some nuance in the growth relationship present in the classic Barro growth model but absent in most of the openness and growth literature and, specifically, whether or not it has any impact on the relationship between trade openness and long-run economic growth as measured in this study. Finally, a measure of sound monetary policy is included in the form of period inflation variability.[39]

The full-sample for the long-run economic growth analysis is made up of 93 economies. The difference between these 93 and the 123 in the full sample is comprised mostly of states that were not present in the data for the entire 23 year span. There are, though, a few states which were in existence for the entire period but for which ***TOI*** data are not available for long-periods in the sample due to data availability issues for those particular economies (for instance the Bahamas has very poor macroeconomic data over the past 6 or 8 years). Eliminating the states without ***TOI*** data spanning the breadth of the 23 year growth period (for whichever reason) reduces the full sample of 123 to 95. There are two states, Belize and Tanzania, with ***TOI*** data spanning the entire growth regression period which were eliminated from the full-sample for the growth run due to inconsistency in other data necessary for the growth analysis.

The main full-sample growth regression is presented in *Table 4* (EQ-1). This run of the model includes an income convergence indicator, primary and secondary enrollment rates, a measure of monetary policy stability, a measure of the relative price of capital investment, gross capital formation, and the ***TOI***. The convergence

[37] To see the impact of assassinations per million and revolutions / coups per million on the ***TOI*** within the long-run economic growth environment see Skipton, C., "Measuring Trade Openness, 1980-2000," paper presentation at the 2003 annual meetings of the Association of Private Enterprise Education, (April 2003). This paper is available upon request from Dr. Skipton at cskipton@ut.edu.

[38] Gwartney, J., Holcombe, R., and Lawson, R. (2004) "Institutions and the Impact of Investments on Growth" A working paper presented at the Association of Private Enterprise Education 2004 annual meetings (April 2004). This paper is available for download from the Gus Stavros Center for the Advancement of Free Enterprise and Economic Education at Florida State University webpage.

[39] Data for the standard elements of the Barro growth regressions came from a variety of sources. GDP and gross capital formation figures were collected from the World Bank, *World Development Index 2003 CD-ROM*; Penn World Table (v. 5.6a); International Monetary Fund, *International Financial Statistics Yearbook* (various editions); OECD, *Economic Outlook* (various issues); Central Intelligence Agency, *World Fact Book* (online – various years), and Central Intelligence Agency, *Handbook of International Economic Statistics* (1998). Enrollment, Assassinations, and Revolutions/Coups figures are from William Easterly and Mirvat Sewadeh's online *Global Development Network Database* (#4 – Social Indicators and fixed factor time series). Enrollment figures were updated using the World Bank's *World Development Index 2003 CD-ROM*. Relative price of investment goods data were gathered from Barro, R. and J-W. Lee (1994) "Dataset for a Panel of 138 Countries," *Mimeo*, Harvard University.

measure is significant and possesses the expected negative sign (as it is for each of the full sample runs).[40] The primary enrollment rate is not significant while the secondary enrollment rate is. These two human capital measures deliver a proxy for the extent of human capital formation occurring at the beginning of the 23 year period of the sample.[41,42] This particular finding was present in earlier work employing the ***TOI*** in similar Barro style growth equations. While puzzling, this mixed result is not overtly contradictory. The coefficient on the inflation variability measure, which captures the *soundness* of monetary policy (to be stable and predictable), is significant and possesses the expected negative sign. Where the annual rate of change in the general level of prices in the economy is volatile (as measured with larger standard deviations) there is a slower rate of economic growth – when the level of prices cannot be predicted it is hard for banks, firms, and consumers to plan forward very far. The "relative price of investment goods" measure (PPI80DEV) introduces the relative cost of capital investment into an economy. This measure is both significant and possesses the expected positive sign. In economies where the general price level for investment was higher, slower long-term economic growth followed. The coefficient on gross capital formation as a share of the economy is also both significant and positive (as expected). This measure gives the model an idea of the extent of both domestic net capital formation and net capital inflow from abroad. Relatively small levels of capital formation (and net flows) – all else equal – are indicative of an economy limited in its own capacity to grow.[43] Last, the ***TOI*** (the openness indicator developed in this study) enters the growth equation significant at the 95th percentile and with the expected positive sign. This suggests that, even from within an established long-run economic growth equation, trade openness matters for long-run economic growth. The adjusted r-squared for this specification of the model (EQ-1) is 0.61.

Equation 2 (EQ-2) in *Table 4* is the same *main full sample growth regression* but with the Gwartney, Holcombe, and Lawson investment figures divided up between their government and private parts. The interesting thing here is that even after the addition of this far more specific measure of the *kind of* investment being pursued in the economy the ***TOI*** remains significant (and still at the 95th percentile). It is also interesting to note that the coefficient on private investment is twice that of the one on public investment. With the addition of the more detailed investment data the adjusted r-squared for this model (EQ-2) climbs modestly to 0.62.

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[40] The ***convergence*** of income levels through faster growth rates exhibited by less developed economies (after controlling for the other macro aspects of the economy) is identified using a beginning of period GDP per capita measure. Using this technique, a negative and significant coefficient on the beginning of period GDP measure suggests economies with smaller beginning of period per capita incomes (all else equal) grew faster than their larger per capital income equivalents – suggesting convergence (see Edwards, S. (1992) "Trade orientation, distortions and growth in developing countries." *Journal of Development Economics* 39: 31-57; and Levine, R., and Renelt, D. (1992) "A sensitivity analysis of cross-country growth regressions." *American Economic Review* 82: 942–63).

[41] Note that the primary enrollment measure is insignificant in every equation of each sample throughout the analysis presented except for EQ-3 of the full sample analysis where it enters the equation as marginally significant (possessing an unexpected negative sign). The unexpected performance of this human capital measure may be due to multi-colinearity between the two human capital measures.

[42] The coefficient on secondary enrollment is consistently statistically significant for all of the full sample (at the 99th percentile) and all of the states within the developing economy sub-sample (at the 95th percentile) but is only marginally significant within the small population sub-sample (at the 90th percentile, and only when the two-part capital measure is employed). Further, where significant, each secondary enrollment coefficient possesses the expected positive sign.

[43] Both the relative price of investment goods and gross capital formation are each strongly statistically significant and possess the expected sign throughout the various growth regressions (in all of the samples and sub-samples).

Table 4: Trade Openness and Long-Run Economic Growth

Dependent Variable: Average Annual Compounding Growth of PPP GDP Per Capita 1980-2000
(t-statistic is in parenthesis)

Independent Variable	Eq-1	Eq-2	Eq-3	Eq-4
Constant	- 0.008 *(0.70)*	0.001 *(0.52)*	- 0.015 *(1.22)*	- 0.005 *(0.39)*
LN GDP Per Cap 1980	- 0.004 *(2.31)***	- 0.006 *(2.92)****	- 0.004 *(2.07)***	- 0.005 *(2.63)****
Enroll P [a]	- 1.3E-04 *(1.60)*	- 9.5E-05 *(1.23)*	- 1.5E-04 *(1.88)**	- 1.1E-04 *(1.43)*
Enroll S [b]	2.6E-04 *(2.88)****	2.6E-04 *(2.90)****	2.7E-04 *(2.94)****	2.6E-04 *(2.93)****
Std Dev Infla Rate [c]	- 9.2E-06 *(4.82)****	- 8.6E-06 *(4.52)****	- 9.1E-06 *(4.86)****	- 8.6E-06 *(4.53)****
PPI80DEV [d]	- 0.013 *(4.06)****	- 0.013 *(4.10)****	- 0.011 *(3.58)****	- 0.012 *(3.74)****
Gross Capital Form [e]	0.002 *(4.92)****		0.002 *(5.04)****	
Priv Invest % GDP [f]		0.002 *(5.01)****		0.002 *(4.83)****
Govt Invest % GDP [g]		0.001 *(2.27)***		0.001 *(2.43)***
TOI [h]	0.003 *(2.47)***	0.003 *(2.01)***	0.003 (2.66)****	0.003 (2.16)***
Change in TOI 80-02 [i]			0.010 (1.78)*	*0.007* (1.27)
Adjusted R-squared	.61	.62	.62	.62
Sample size	93	93	93	93

**** significant at the 1% level ** significant at the 5% level * significant at the 10% level

a. Enroll P 80: Primary school enrollment rate in 1980

b. Enroll S 80: Secondary school enrollment rate in 1980

c. Standard deviation of change in GDP deflator (inflation) from 1980 to 1999

d. PPI80DEV: Relative price of investment goods in 1980

e. Gross Cap Form: Gross capital formation as a share of GDP1980-1999

f. Priv Invest % of GDP: Private investment as a share of GDP (period average, 1980-2000)

g. Govt Invest % of GDP: Government investment as a share of GDP (period average, 1980-2000)

h. TOI: *Trade Openness Index*, period average 1980-2002

i. Change in TOI: Change in the *Trade Openness Index* from 1980-82 to 2000-02

Equations 3 and 4 (EQ-3 & 4) of *Table 4* add the change in openness during the period to the main full sample growth regression. While only significant in EQ-3 (with gross capital formation instead of the more detailed government versus private investment data), the addition of the change in openness measure is significant at the 90th percentile and possesses the expected positive sign. In EQ-3 both the level of and change in trade openness are statistically significant and possess the expected positive sign. This suggests that it is not only the average *level* of openness that an economy achieves over the long-term which contributes positively to economic growth but the degree to which a state becomes more liberal (in its trade policy) as well. The adjusted r-squared in EQ-3 was slightly higher than Equation 1 at 0.62. The change in openness measure is insignificant in EQ-4, which uses the private versus public investment data, and so its adjusted r-squared remained at its level in Equation 2 (0.62).

Conclusions from the Introduction of Openness to the Barro Growth Regression

Does trade openness matter for long-run economic growth? The answer from within a carefully specified, mainstream Barro-style economic growth equation which includes two measures for human capital formation, two measures related to physical capital formation, a measure of the relative price of physical capital formation, a measure for sound monetary policy, and a convergence indicator is a resounding yes. Further, not only does the level of openness appear to lead to greater long-term economic growth, but the change in its level appears to have a measureable impact on growth as well (at least in the models that used gross capital formation instead of the Gwartney, Holcombe, and Lawson breakdown of private and public investment as a share of GDP).

Does the size or level of economic development matter when it comes to the trade openness and economic growth relationship? To test the robustness of the estimated trade openness and long-run economic growth relationship, the growth equation is run within the two notable sub-samples of the data which economic theory suggests should possess different structural relationships between trade openness and long-term economic growth (specifically the small population and developing economy sub-sets).

VI. Openness & Long-Run Economic Growth w/in the Small Population and Developing Economy Subsets

In order to test the robustness of the relationship estimated above, the Barro-style growth model was re-estimated using the small population and developing economy subsets. Compared to full sample, the structural relationship between trade openness and economic growth may be different for both small population and developing countries. Hence, analysis within these two sub-samples provides additional information regarding the strength and consistency of the trade openness and long-run economic growth relationship.

Opernness and Long-run Economic Growth Within the Small Population Economies

72 of the 93 economies within the full-sample for the growth analysis possessed fewer than 20 million working age (aged 15 to 65) persons in 1980. The main small-population sub-sample growth regression is presented in *Table 5* (EQ-1). The convergence variable becomes insignificant within most of the small-population sample runs. The secondary enrollment rate becomes insignificant in both of the growth runs that include gross capital formation (and are only marginally significant for the two runs which include the more detailed private versus public investment data). While the rest of the model performs as in the full-sample, the TOI enters the regression with both a greater coefficient value and t-statistic (entering in the small-population series at the 99th percentile instead of the 95th). The adjusted r-squared for this growth equation (EQ-1) is 0.63.

When the alternate specification of capital formation is employed, in EQ-2 of *Table 5*, the model performs very similarly to the same specification with the full-sample. Unlike with EQ-1, the convergence indicator remains significant, with the expected sign. Also, unlike with the same specification using the full-sample, the government investment as a share of GDP variable enters the equation as completely insignificant. Despite this, private investment as a share of GDP continues to enter as significant with the expected sign. As for the ***TOI***, it enters EQ-2 stronger than it did with the full-sample but with a slightly lower coefficient (and t-statistic) than Equation 1. The overall descriptive power of this run of the growth equation (EQ-2) comes to 0.66.

The *change in trade openness* indicator is added to EQ-1 and EQ-2 to form EQ-3 and EQ-4. The convergence indicator which was marginally significant in EQ-2 slips just enough to become statistically insignificant in EQ-4. The change in openness measure enters each regression as significant and possessing the expected sign. The adjusted r-squared for each regression climbs to 0.66 and 0.67 respectively.

Opernness and Long-run Economic Growth Within the Developing Economies

72 of the 93 economies within the full-sample for the growth analysis were not classified as "high income industrial" by the World Bank in 1980 (the start of the sample). The developing-economy sub-sample growth regressions are presented in *Table 6* (EQ-1 thru EQ-4). Within each run of the growth model using the developing economy sub-sample the convergence variable remained significant (as it was within the full-sample) and maintains its expected negative sign. Apparently, even within the developing country sub-set of economies, convergence among the states can be observed. Further, within each run of the growth model within the developing economy sub-set, the secondary enrollment rate remained significant (at the 95th percentile) and retained the expected positive sign.

In both EQ-1 and EQ-3, where the investment variable employed is gross capital formation, the ***TOI*** enters the analysis on the developing-economy sub-sample at a weaker 90th percentile (while maintaining its expected positive sign). In both EQ-2 and EQ-4, where the Gwartney, Holcombe, and Lawson private versus public investment data is employed instead of gross-capital formation, the ***TOI*** measure becomes insignificant (with the

Table 5: Trade Openness and Long-Run Economic Growth Within Small Population[l] Economies

Dependent Variable: Average Annual Compounding Growth of PPP GDP Per Capita 1980-2000
(t-statistic is in parenthesis)

Independent Variable	Eq-1	Eq-2	Eq-3	Eq-4
Constant	- 0.026 *(2.11)***	- 0.015 *(1.13)*	- 0.036 *(2.85)****	- 0.025 *(1.78)**
LN GDP Per Cap 1980	- 0.002 *(1.04)*	- 0.004 *(1.76)**	- 0.002 *(0.99)*	- 0.003 *(1.58)*
Enroll P [a]	- 3.6E-05 *(0.44)*	- 2.6E-05 *(0.34)*	- 4.1E-05 *(0.53)*	- 2.9E-05 *(0.38)*
Enroll S [b]	1.6E-04 *(1.64)*	1.6E-04 *(1.71)**	1.5E-04 *(1.64)*	1.5E-04 *(1.68)**
Std Dev Infla Rate [c]	- 8.8E-06 *(4.87)****	- 8.4E-06 *(4.73)****	- 8.9E-06 *(5.08)****	- 8.5E-06 *(4.87)****
PPI80DEV [d]	- 0.013 *(3.82)****	- 0.013 *(3.98)****	- 0.011 *(3.38)****	- 0.011 *(3.61)****
Gross Capital Form [e]	0.001 *(2.41)* **		0.001 *(2.54)****	
Priv Invest % GDP [f]		0.002 *(3.47)****		0.001 *(3.17)****
Govt Invest % GDP [g]		2.7E-04 *(0.54)*		3.7E-04 *(0.78)*
TOI [h]	0.005 *(3.44)****	0.004 *(2.93)****	0.006 (3.99)***	0.005 (3.38)***
Change in TOI 80-02 [i]			0.013 (2.44)**	0.010 (1.91)*
Adjusted R-squared	.63	.66	.66	.67
Sample size	72	72	72	72

*** significant at the 1% level ** significant at the 5% level * significant at the 10% level

a. Enroll P 80: Primary school enrollment rate in 1980

b. Enroll S 80: Secondary school enrollment rate in 1980

c. Standard deviation of change in GDP deflator (inflation) from 1980 to 1999

d. PPI80DEV: Relative price of investment goods in 1980

e. Gross Cap Form: Gross capital formation as a share of GDP1980-1999

f. Priv Invest % of GDP: Private investment as a share of GDP (period average, 1980-2000)

g. Govt Invest % of GDP: Government investment as a share of GDP (period average, 1980-2000)

h. TOI: *Trade Openness Index*, period average 1980-2002

i. Change in TOI: Change in the *Trade Openness Index* from 1980-82 to 2000-02

l. A *small population economy* is defined as an economy with a population < 20 million persons (aged 15-64) in 1980.

Table 6: Trade Openness and Long-Run Economic Growth Within Developing[l] Economies

Dependent Variable: Average Annual Compounding Growth of PPP GDP Per Capita 1980-2000
(t-statistic is in parenthesis)

Independent Variable	Eq-1	Eq-2	Eq-3	Eq-4
Constant	- 0.007 *(0.53)*	- 0.003 *(0.25)*	- 0.011 *(0.86)*	2.6E-04 *(0.17)*
LN GDP Per Cap 1980	- 0.004 *(2.21)***	- 0.006 *(2.83)****	- 0.004 *(2.04)***	- 0.006 *(2.63)****
Enroll P [a]	- 1.2E-04 *(1.29)*	- 8.0E-05 *(0.92)*	- 1.3E-04 *(1.48)*	- 9.0E-05 *(1.01)*
Enroll S [b]	2.3E-04 *(2.07)***	2.3E-04 *(2.15)***	2.3E-04 *(2.13)***	2.3E-04 *(2.16)***
Std Dev Infla Rate [c]	- 8.9E-06 *(4.42)****	- 8.3E-06 *(4.11)****	- 8.9E-06 *(4.42)****	- 8.3E-06 *(4.10)****
PPI80DEV [d]	- 0.013 *(3.83)****	- 0.013 *(3.91)****	- 0.012 *(3.43)****	- 0.013 *(3.64)****
Gross Capital Form [e]	0.002 *(4.96)****		0.002 *(4.91)****	
Priv Invest % GDP [f]		0.002 *(5.06)****		0.002 *(4.82)****
Govt Invest % GDP [g]		0.001 *(2.32)***		0.001 *(2.53)***
TOI [h]	0.003 *(1.77)**	0.002 *(1.30)*	0.003 (1.94)*	0.002 (1.39)
Change in TOI 80-02 [i]			0.007 (1.09)	0.004 (0.56)
Adjusted R-squared	.63	.64	.63	.64
Sample size	73	73	73	73

*** significant at the 1% level ** significant at the 5% level * significant at the 10% level

a. Enroll P 80: Primary school enrollment rate in 1980

b. Enroll S 80: Secondary school enrollment rate in 1980

c. Standard deviation of change in GDP deflator (inflation) from 1980 to 1999

d. PPI80DEV: Relative price of investment goods in 1980

e. Gross Cap Form: Gross capital formation as a share of GDP1980-1999

f. Priv Invest % of GDP: Private investment as a share of GDP (period average, 1980-2000)

g. Govt Invest % of GDP: Government investment as a share of GDP (period average, 1980-2000)

h. TOI: *Trade Openness Index*, period average 1980-2002

i. Change in TOI: Change in the *Trade Openness Index* from 1980-82 to 2000-02

l. A *developing economy* is defined as an economy not classified as "high-income / industrial" by World Bank in 1980.

t-statistics falling to 1.30 and 1.40 respectively). Last, in EQ-3 and EQ-4, where the change in openness measure is added to the growth regression, as is expected after reviewing the ***TOI*** measure in EQ-1 and EQ-2, the change measures also enter the growth equation as insignificant. Where the private versus public investment data is employed, both measures enter the equation as significant and, like in the full sample analysis, the private investment coefficient is larger than the public investment coefficient. The adjusted r-squared for both EQ-1 and EQ-3 (with gross capital formation) are 0.63 each. The adjusted r-squared for EQ-2 and EQ-4 (where the private versus public investment data are employed) are 0.64 each.

A Summary of the Openness and Growth Analysis within the Small Population and Developing Economies

The ***TOI*** performs robustly within the *small-population* sub-sample. Further, the coefficients for the trade openness *level* and *change* variables were significantly higher in the small-population subset than in the analysis of the full sample. This result was expected considering the importance of external trade to economies which do not possess the internal capacity to enjoy economies of scale (to the same extent as larger population economies). Further, small population economies do not possess the same range of human capital as larger population states. Hence, economic reasoning suggests that the importance of openness on long-term economic growth stemming from prolonged institutions of free trade should be greater within the smaller population economy subset. It is reassuring that this result is statistically present.

The ***TOI*** only performs marginally within the *developing-economy* sub-sample. Specifically, when gross-capital formation is used instead of the Gwartney, Holcombe, and Lawson private versus public investment data, the ***TOI*** enters the model significantly (at the 90^{th} percentile) and with the expected sign; when the Gwartney, Holcombe, and Lawson private versus public series is employed within this sub-set of the data, though, the ***TOI*** does not enter significantly at all. While this is a mixed result, it does leave one to wonder what the specific nature of the relationship is within the group of developing economies within the sample studied in this paper. Trade openness does appear to matter, but, perhaps, in a more complex fashion. Further study of the developing economy sub-set is needed.

In all, the sub-set analysis showed that trade openness *is* important for long-term economic growth, even within the theoretically distinct sub-samples of the data. It is both interesting to see and conclusive to observe that the positive relationship between trade openness and long-run economic growth persists even after controlling for income convergence, differences in human and physical capital, the differential breakdown of government and private investment, the relative price of capital investment, the wide range of monetary policy, and vast differences in both population and economic development. This crucial point – that openness matters for all sorts of economies, regardless of population, geographic locale, per capita income, or otherwise – is both a reasonable and powerful result.

VII. Conclusion

The question addressed in this study is whether or not trade openness matters in the context of an economy's long-run economic growth path. To better understand the estimated relationship, the question of whether or not it holds (whether or not it is robust) within the theoretically distinct small-population and developing economy sub-sets is also addressed. To facilitate the question, a new measure of trade openness (the *trade openness index*) was carefully developed, data was collected, and the measure estimated.

This study constructs a new measure of trade openness, a ***Trade Openness Index*** (***TOI***), from a set of carefully developed incidence and outcome measures of trade restrictiveness. A *trade-share-estimation* model, based on the gravity model of international trade, is developed to both identify and estimate the individual elements of the ***TOI***. This empirical model includes the dynamic spatial characteristics of global concentrations of demand in its estimation of individual trade shares. *Natural* (or *expected*) trade shares, which represent the level of imports & exports as a share of GDP that would exist for a given economy in a given year in the absence of trade restriction, are estimated by country and year. Both policy and non-policy data from a panel of 123 economies from 1980 to 2003 are employed.

The three elements that make up the ***TOI*** are a 3-part tariff measure that is consistently statistically significant within the *trade-share-estimation* model, an exchange rate controls proxy that is also consistently statistically significant as a predictor of cross-country differences in trade flows, and the *actual-versus-expected* trade share differences (residuals) as derived from the carefully specified *trade-share-estimation* model. Each of these three parts is normalized between 0 and 10 and then combined using weights established using principal components analysis to form the *Trade Openness Index* (***TOI***). The result is a continuous, cross-sectionally and longitudinally relative measure of trade liberalization.

When the ***TOI*** is introduced into a Barro-type long-run growth equation, the results are robust.[44] When examining the 93 economies within the sample examined in this study over the 1980-2002 time period, relatively free trade economies are found, all else equal, to grow faster than those more closed. Further, those economies which underwent change (liberalized their trade policy regime), all else equal, grew more rapidly than those that maintained the same general level of trade freedom.

While examining the two notable sub-samples of the data, however, the results were found to be somewhat mixed. While the relationship within the small-population sub-sample of the data was found to be stronger than from within the general sample (as economic theory would suggest), the relationship within the sub-sample of 73 developing economies was more tenuous. In all, the sub-sample analysis showed that the importance of trade-openness on long-run economic growth is both strong and robust – regardless of size or level of economic development.

[44] Barro, R. (1991) "Economic Growth in a Cross Section of Countries." *Quarterly Journal of Economics* 106(2): 407-43.