AN AUGMENTED NEOCLASSICAL GROWTH MODEL WITH HUMAN CAPITAL ACCUMULATION AND AGRICULTURAL AND NONAGRICULTURAL TRADE OPENNESS

By

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TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

CHAPTER I

INTRODUCTION

Over 200 years ago Adam Smith and David Ricardo elaborated on the role that international trade has on economic growth. Smith and Ricardo emphasized the important economic gains that trade specialization, according to comparative advantage, has on augmenting overall consumption possibilities and therefore overall social welfare. Consumption and production gains result from reallocating resources to their best alternative uses.

Implicitly, Ricardo and Smith stressed the importance that free trade, based on comparative advantage has on factors' productivity In this regard, the more a country specializes domestic production and participates in international trade the larger the gains derived from this process, but only if international trade is conducted according to a comparative advantage pattern. By specializing in the production of goods a country has the comparative advantage in producing and trading in international markets, resource productivity is maximized, economies of scale develop, unemployment is reduced, and overall production and consumption increases.

Perhaps one of the most important issues that relate to the process of economic policy is the determination of the sources of economic growth. Throughout history economists and policy makers have stressed the importance of setting economic instruments and goals to achieve higher levels of economic growth. This has been especially true in the last fifty years, where the emphasis of international trade and economic growth policy has focused on increasing the rate of growth of total output. Meier states "conditions were highly favorable during the 1950s and 1960s until the slowing down of growth in the world economy after 1973. The earlier two decades were unique for the high rate of growth in the more developed countries - a historical record period - and for the growth in world trade. The demand for imports was high and rising in the more developed countries (MDCs) and the high growth rate of the MDCs fostered trade liberalization and weakened the case for protection" (p. 408). Therefore the emphasis on commercial policy focused on the gains that trade liberalization brought about. Yet, a major concern for policy makers in developing countries stressed the fact that countries that specialized in the production and commercialization of industrial goods tended to out-perform those countries that specialized and traded primary products. According to Prebisch, countries that produced and exported primary commodities faced a deterioration in the terms of trade, resulting in lower rates of economic growth compared to developed countries. Prebisch argued that the center-periphery relationship occurred such that the terms of trade deteriorated in the periphery countries which specialize or produce primary goods. Meier added that "Prebisch suggested that these (periphery) countries should expand their manufacturing industries oriented toward domestic markets.

The purpose was to be served by industrial protection that was said to bring additional benefits through improvements in the terms of trade" (Meier, p. 395).

Nevertheless, as mentioned before, these rapid rates of growth in international trade started to slow down after a few years in the early 1970's. Among the reasons that caused this slow down in the rate of growth of international trade are higher priced oil products and changes in commercial policy in developing countries. Developing countries promoted different approaches that emphasized the use of tariffs and nontariff barriers to trade as the main strategy to achieve higher levels of income per capita growth. Indeed, the development and promotion of an industrial sector, as the engine of growth, was seen as the main goal of developing countries.

Within the context of international trade and economic growth policy import substitution was thought to be a feasible way to increase output growth. Import substitution focuses on substituting domestic production for imports of primary and manufactured goods. According to Meier, in the first stage developing countries substitute the consumption of imported primary goods with domestic production. Balassa called this stage the "easy" stage of import substitution. Meier states that "Second-stage import substitution involves the replacement of intermediate goods and producer and consumer durables by domestic production....[G]iven the relative scarcity of physical and human capital in developing countries that complete the first stage of import substitution, developing countries are at a disadvantage in the manufacture of highly physical capital-intensive intermediate goods and skill-intensive producer and consumer durables. In limiting the scope for the exploitation of economies of scale, the relatively small size of their national markets also contributes to high domestic costs. At the same time, net foreign exchange savings tend to be small because of the need for importing materials and machinery" (p. 396). Nevertheless, developing countries that promoted import substitution failed to consider the positive impact of trade expansion on economic growth, measured through the increase in factors' productivity resulting from the reallocation of resources to their best alternative use. In the framework of the two-gap model[1], export expansion releases the foreign exchange constraint, increasing the rate of capital formation, and enhancing the growth of factor productivity. Hence, determining the impact of factors of production on the level of economic growth is of great interest in terms of economic growth policy in developed and developing countries. This issue has been heavily addressed in the economic literature, yet few studies have focused on the decomposition of trade flows between agricultural and nonagricultural trade goods and the effect of each on factor accumulation and productivity growth.

In the last twenty years an increasing proportion of the General Agreement of Tariffs and Trade (GATT), have concentrated on the transformation, reduction and elimination of trade distortions. The formation of trade blocks such as the North American Free Trade Agreement (NAFTA), Mercado Común Suramericano (MERCOSUR), and others, have developed to eliminate trade distortions. These trade distortions are grouped within the categories of tariffs, quotas and nontariff barriers, that directly or indirectly affect the domestic production and consumption, and the domestic and international trade of agricultural and non-agricultural goods. To increase the importance of this trade liberalization and globalization process, agricultural trade has only recently been addressed

[1] Two-gap models assume that developing countries are constrained by the capacity to generate domestic savings to finance investment and by the availability of foreign exchange to obtain foreign goods and services that are complementary to those available at home (Gerald Meier).

in trade liberalization talks and agreements. The Uruguay Round of the GATT and the North American Free Trade Agreement establish the first steps for the mutual liberalization of primary and agricultural goods as well as services. The promotion of trade liberalization has reached even those commodities once considered too sensitive to be subject to negotiation.

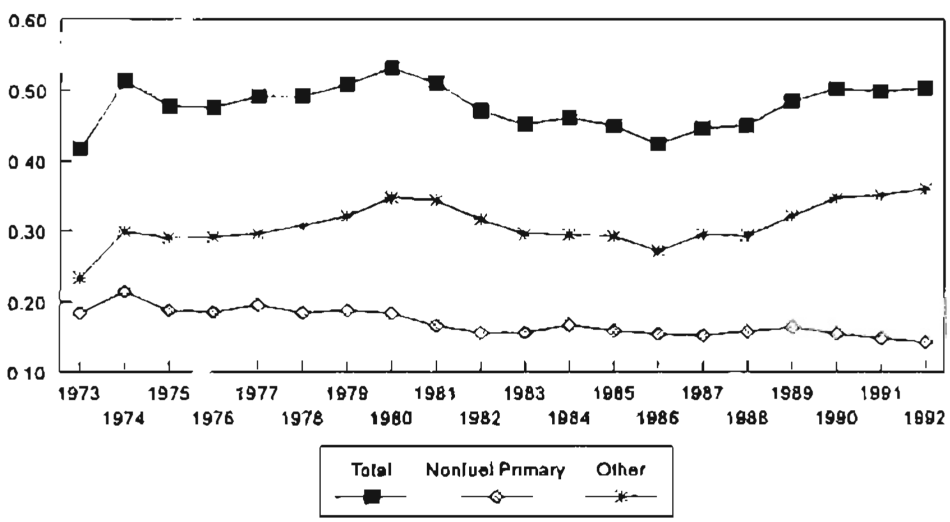
Economic research has studied the sources of economic growth. The most widely used economic growth model is the Solow Neoclassical Growth Model. The Solow Growth model focuses on the effect of labor growth and capital accumulation on the steady-state level of income per capita. Empirical estimations of growth for developing countries found that labor is abundant and capital is the single most important factor of production. Development economists have also studied the impact that export growth has on overall factor productivity and output growth. In most cases, empirical studies give support to the hypothesis that export promotion generates economic growth (Michaely; Balassa; Tyler; Kavoussi; Feder; Mbaku; Moran; Moschos; Ram; and Barboza). While export promotion may mean freer trade, it may also refer to the protection of any particular economic sector through the use of commercial policies such as tariff and nontariff barriers. Trade barriers find political support from the argument that developing industries need a certain protective period before they can be competitive in the international markets, i.e. it takes time before industries can develop a comparative advantage. Meier states "to the extent that the domestic production of these commodities generates external economies in the form of labor training, the development of enterpreneurship, and the spread of technology, there is an argument for moderate infant industry protection or promotion" (p. 395).

Yet, there is still a major gap when one wants to understand why countries achieve different steady-state levels of income per capita. New developments in economic theory such as the convergence hypothesis assume that countries that initially start off from lower levels of income per capita tend to grow faster than otherwise. In order to attempt to explain these observable differences in income per capita growth rates across developing and developed countries, human capital accumulation has been introduced as an important determinant (Mankiw, Romer and Weil). Technological transfer has also been considered as playing a major role in determining the long-run level of income per capita. (Edwards; Knight, Loayza and Villanueva).

The economic development literature has focused on determining the impact that trade openness has on output growth through the transfer of technology and through the learning by doing process (Edwards; and Knight, Loayza and Villanueva). Edwards; and Knight, Loayza and Villanueva assume that trade openness affects the long-run level of output growth through the transfer of technology but it does not have any effect on the steady-state level of physical and human capital accumulation and income per capita, because openness is considered only as a technological shifting factor. Trade openness is the measure that relates trade flows to output and is commonly defined as the ratio of exports to total output. The overall results of empirical studies support the hypothesis that the greater the trade openness, the greater the rate of growth of output. Levine and Renelt state that this result is not surprising since similar results can be obtained by using any other trade measure such as imports or total trade. Even though previous studies agree on the importance that trade openness has on output growth and hence on income per capita level, they do not differentiate between the trade flows of primary and manufactured goods, a major issue when trying to determine the sources of economic growth in developing countries.

The decomposition of trade flows between agricultural and non agricultural goods is important for at least three reasons; 1) to determine the sources of economic growth and to determine which countries are likely to be the gainers or losers of moving to a larger degree of trade openness; 2) to understand the effects of trade openness on factor productivity, and 3) to better understand the tradeoffs between international trade and economic growth in order to redirect overall economic policies.

Figure 1. Exports plus Imports to GDP Ratio by Category



Ratios are simple averages for a sample of 62 developing countries.

Figure 1 illustrates three alternative measures of trade openness. The first measure is the ratio of total exports plus total imports to Gross Domestic Product for a sample of

62 developing countries[2]. The second and third measures are a decomposition of the first measure by category of products. Hence, the second measure illustrates the relative importance of nonfuel primary trade as a ratio of Gross Domestic Product. Finally, the third measure indicates the importance of all other trade as a ratio of Gross Domestic Product.

International trade represents approximately 50 percent of the Gross Domestic Product for the sample of 62 developing countries under study. Thus, international trade is an important determinant of output growth and factor productivity in developing countries. The importance of international trade peaked in 1980, when trade represented approximately 56% of Gross Domestic Product for the sample of countries. International trade declined sharply in the first half of the 1980's to a level of 46% in 1986 in terms of Gross Domestic Product. This reduction in international trade coincides with the generalized balance of payments crisis of most developing countries on the early 1980's. In general, the decline in international trade resulted from a reduction in the level of trade of nonprimary goods. The decade of 1970's was characterized for an excess supply of financial resources in the international markets. Most of this excess supply can be attributed to the high oil prices of the early 1970's. The easy and large availability of financial resources made it easy for developing countries to borrow large amounts of foreign exchange at lower interest rates that financed the increasing trade of nonprimary goods.

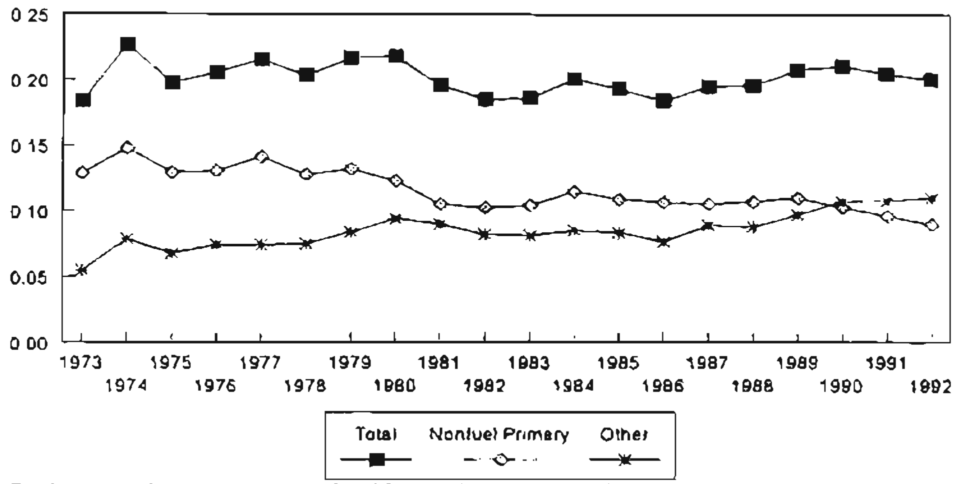
Developing countries were unable to continue financing the increasing amount of nonprimary imports which can be seen by the decrease in the relative importance of

[2] A complete list of the 62 developing countries is provided on Table 1 of the Appendix.

nonprimary trade as a proportion of Gross Domestic Product. At the same time, Figure 1 illustrates how the total amount of trade in nonfuel primary goods has decreased constantly during the last 20 years. This trend may be explained by two factors at least. First, developed countries have become less dependent in terms of nonfuel primary production and secondly developing countries have changed their economic growth strategy to the promotion of nonprimary good exports. Figure 1 provides a clear illustration that there has been a substantial change in the composition of international trade in developing countries. The question that remains unanswered is whether this change in the trend of international trade in developing countries has resulted in an enhancement of factors' productivity and increased real income per capita.

The sources of growth in international trade are further decomposed between exports of nonfuel primary and other goods; and imports of nonfuel primary and others goods in figures 2 and 3, respectively. Figure 2 illustrates the ratios of exports as a proportion of Gross Domestic Product to provide more information on the sources of growth of international trade in developing countries. On the other hand, figure 3 illustrates imports as a proportion of Gross Domestic Product.

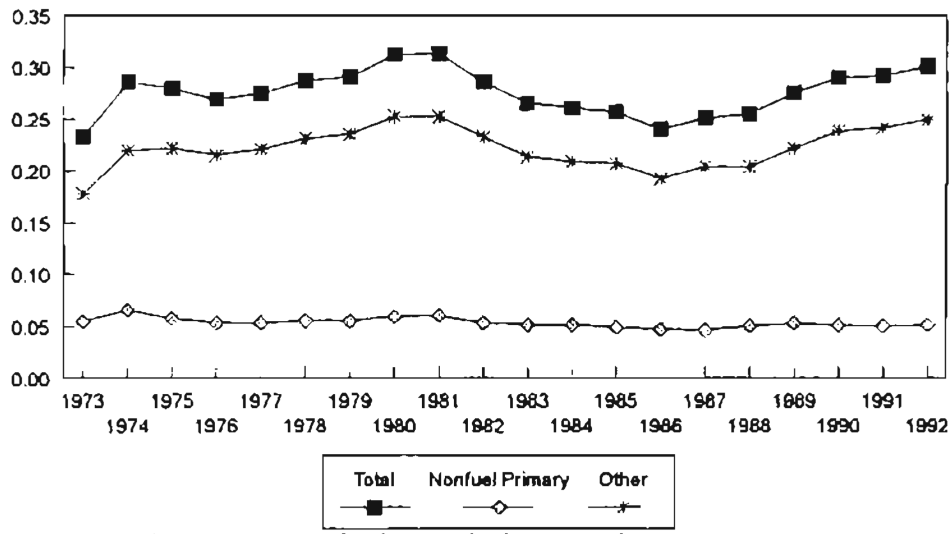
Figure 2. Exports to GDP Ratio by Category



Ratios are simple averages for 62 developing countries

Perhaps the most relevant fact of figure 2 is that developing countries have transformed their export structure in the last twenty years, toward a more industrialized system. Other exports have increased as a proportion of GDP throughout the period under study, but shows the sharpest increase over the last six to seven years. Furthermore, developing countries are still heavily dependent on the amount of imports of industrialized goods as illustrated in figure 3. Nonfuel primary goods, as a proportion of GDP, have remained roughly constant over the last twenty years. This result is not surprising since most developing countries tend to fulfill their own domestic demand with domestic production. The largest variability in imports, is due to the variability of other imports as shown in figure 3. After the economic crisis of the first half of the 1980s there has been a tendency to increase the amount of other imports. This seems to be the result of two complementary factors; reductions in the levels of tariffs and nontariffs barriers, and more stable economies growing at higher rates compared to the first half of the 1980s. Finally even though international trade has been growing since the mid 1980s, the total level of exports plus imports as a ratio of Gross Domestic Product is equal to those record levels of the late 1970s and early 1980s.

Figure 3. Imports to GDP Ratio by Category



Ratios are simple averages for 62 developing countries

The change in structure of international trade illustrated in Figures 1, 2, and 3 raises the question of whether international trade is important for developing countries or not. Empirical studies of the economic growth and economic development argue in favor of export promotion as a source of factor productivity and output growth. However, these studies do not determine the sources of growth by category of goods.

This study determines the sources of economic growth by using an augmented neoclassical growth model with human capital accumulation and trade flows between agricultural and nonagricultural goods. The research question is how can the degree of trade openness in agricultural and non-agricultural markets reduce resource misallocation, increase the productivity of factors of production, and increase the rate of growth of total output in developing countries?

The overall objective of this study is to determine the factors that affect the rate of growth of total output (economic growth) and reduce resource use misallocation in developing countries. The specific objectives are to:

1. Determine how trade openness (free trade) in agricultural and non-agricultural sectors affects the productivity of labor, physical capital, and human capital;
2. determine the contribution of agricultural and nonagricultural trade flows on overall economic growth; and
3. determine to what extent free trade (trade openness) in agricultural and non-agricultural markets promote economic development in developing countries.

This study is divided into six sections. The first section reviews the theoretical and empirical literature relating to economic growth. Next a conceptual framework is developed to support the development of the Augmented Solow Model with Trade Openness. The methods and procedures chapter provides the necessary information about data, model estimation, statistical testing, and expected results. The results chapter provide an extensive analysis of the empirical results first estimated by using OLS and later reestimated by using a POOLED model. This chapter also provides alternative estimation by region and by income group to determine more precisely the sources of growth in developing countries. Finally, the conclusion and recommendations chapter highlights the more important remarks of the study and provides the limitations and possible solutions in terms of future research. The overall results suggest that trade openness enhances output growth in developing countries. In addition, at initially low income per capita levels agricultural openness tends to be more important than nonagricultural openness. However, as income per capita rises this tendency reverses. No definite conclusion is found in terms of region significant effects in terms of income per capita growth.

CHAPTER II

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Literature Review

The literature on economic development is robust with studies focusing on the relationship between factors of production and total productivity. The Solow model of economic growth has been the main tool used by economists in the last three decades to determine the relationship between factors of production and output growth. Solow presents a decomposition of factors of production between physical capital accumulation and labor force. The rest of output growth is explained by total factor productivity and is considered a residual. Two different approaches have been used to measure factor contribution to output growth, the Neoclassical Accounting Growth method (NAG) and econometric based studies.

The NAG method assumes that the rate of growth of output can be decomposed as the rate of growth of inputs plus a residual that is considered total factor productivity (Chenery, Robinson and Syrquin). Assuming constant returns to scale the NAG method assumes that the sum of capital and labor shares must equal one (Solow). These factor shares are obtained from the data itself, and then by using the historical growth rates of inputs, the total factor productivity is obtained as a residual[3].

On the other hand, econometric based studies estimate the contribution of factors of production to economic growth by using a simple neoclassical production function. Totally differentiating the production function it is possible to express the rate of growth of output as a function of the rates of growth of inputs. Estimated parameters are the output elasticities with respect to factors of production. Following the formulation that previous studies have used[4] it is possible to express the factors' contribution to economic growth as follows:

$$Q_t = f(K_t, L_t, t) \tag{1}$$

where Q is the real Gross National Product, K is the capital stock, L is the labor force, and t is time.

Assuming that the elasticities of output with respect to the factors of production are constant and that technical change is Hicks-neutral with a constant rate, equation 1 can be rewritten in terms of rates of growth by total differentiating with respect to time (dividing through by equation 1). Then equation 2 is:

$$y = \alpha + \beta k + \delta l \tag{2}$$

[3] The neoclassical growth accounting methodology is used as a accounting method and it does not include any econometric estimating. Data is adjusted so the sum of the factor shares equals one. Econometrics application of this technique have been done allowing for the possibility of constant, decreasing, and increasing returns to scale. See Chenery et al (1986) p. 29.

[4] The approach followed here is the same as explained in Feder (1982), De Gregorio (1992), Mbaku (1989), Kavoussi (1984), Ram (1985), Moschos (1989), Knight et al (1993), Tyler (1981), and Moran (1983).

where y is the rate of growth of output, k is the rate of growth of capital stock, l is the rate of growth of the labor force, and β and δ are the elasticities of output with respect to capital and labor, respectively.

Measuring the rate of growth of the capital stock may not be possible for most developing and developed countries due to a lack of data. As an alternative Mbaku; Kavoussi; Tyler; De Gregorio; and Moschos have approximated the rate of growth of the capital stock by using the investment rate, under the assumption that this corresponds to the growth rate of capital[5]. A more appropriate approximation of the model can be obtained by further approximating the rate of growth of the capital stock by the investment-output ratio as done by Ram; Feder; and Mbaku:

$$y = \alpha + \left(\frac{\partial Q}{\partial K}\right)\left(\frac{K}{Q}\right)\left(\frac{dK}{K}\right) + \delta l \tag{3}$$

where $\partial Q/\partial K$ is the partial derivative of output with respect to the capital stock, K/Q is the capital stock-output ratio, and dK/K is the rate of growth of the capital stock. Then, replacing dK by I, where I is the level of investment, results in,

$$y = \alpha + \lambda\frac{I}{Q} + \delta l \tag{4}$$

where λ is the marginal physical output of capital.

More recent studies such as Michaely; Balassa; Ram; Moschos; Tyler; Kavoussi, Feder; Mbaku; Moschos have argued that economic growth may also depend on the rate of growth of total exports, assuming that exports can be considered a factor of production

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[5] Implicitly this approach assumes that the capital-output ratio is constant not only through time but also across countries. However, this approximation is not considered appropriate since the investment rate is the second derivative of the capital stock and only expresses the rate of change of the change in the capital stock.

that enhances the productivity of capital and labor by releasing the foreign exchange constraint, taking advantages of economies of scale, and reducing resource use misallocation by reallocating resources based on their comparative advantage. Michaely and Balassa used a Spearman rank correlation method and found that there is a positive relationship between export growth and economic growth.

To incorporate the rate of growth of exports as an explanatory variable of output growth, a new variable is included in equation 4. The resulting equation is

$$y = \alpha + \lambda \frac{I}{Q} + \delta l + \psi x \quad (5)$$

where x is the rate of growth of exports and the rate of technological change is assumed to be a linear function of the growth rate of exports expressed as ψ. Ram states that if the model specification is reasonable, ψ should indicate the direction and magnitude of the impact of export expansion on economic growth.

Empirical estimations of equation 5 for developing countries reveal that capital accumulation is the most important factor of production, labor force is considered to be abundant[6], and exports have a positive and statistically significant effect on the output growth. In the case of developing countries, export promotion is an appropriate tool to promote rapid economic growth. Feder states that the social marginal productivity is higher in the export sector than in the nonexport sector.

Studies by Kavoussi; Tyler; and Balassa, focus on the importance that export promotion, both of primary and manufactured goods, have on output growth. Kavoussi; and Tyler argue that the promotion of exports can be decomposed between primary goods and manufactured goods. Furthermore, at initial or low levels of economic development the promotion of both primary and manufactured goods increase economic growth. Beyond a threshold income level export promotion of primary goods does not contribute much more to economic growth, whereas the promotion of manufactured goods increases the rate of growth of income per capita. (Balassa; Tyler; and Kavoussi).

Conceptual Framework

Neoclassical and Structural Growth Models

In the second half of the current century, economic development discussions have been focused on analyzing alternative approaches that attempt to determine the sources of economic growth. The discussions have attempted to discover why there are different levels of income per capita between developed and developing countries and explain why similar countries achieve different levels of income per capita in the long run. The analysis used to lay the ground work for the discussions use models that study the difference between open and closed economy models, developed and developing countries, growth and equity, export promotion and import substitution. In this sense there has been a substantial use of alternative techniques and/or procedures to accurately estimate those sources of growth. In turn, development economists are concerned with finding explanations that define how developing countries may increase income per capita and at the same time assure macroeconomic stability.

The most common techniques used by economists to evaluate the process of economic development are multisector models such as the input-output model, project

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[6] Labor force is abundant in terms of marginal productivity. Marginal productivity is either close to zero

evaluation, linear and nonlinear programming models, and computable general equilibrium models. Among the major concerns of policy makers and economic development specialists are the tradeoffs among economic growth, income distribution (equity), balance of payments stability, exchange rate parity, inflation, unemployment, capital accumulation, and population growth. In some particular cases the debate seems to become even more complicated when alternative economic variables can be defined and/or used either as policy tools (instruments) or macroeconomic goals (target)[7].

Numerous perspectives exist on how to address the problem of underdevelopment and how to determine the sources of growth to elaborate alternative policy scenarios to stimulate a sustainable process of economic growth in developing countries. However, despite the emphasis on alternative estimation tools and alternative economic approaches, a vast majority of economic research related to economic growth has been circumscribed to the analysis of either neoclassical growth models or structural growth models.

Within the framework of neoclassical growth models the main source of economic growth comes about through physical capital accumulation. In the context of the single neoclassical growth model, the steady-state income per capita is achieved when the rate of growth of physical capital is equal to output growth. The conclusions derived from the neoclassical framework were very useful in explaining why developing countries achieve lower levels of income per capita compared to developed countries. In this regard, empirical evidence shows that physical capital is scarce in developing countries, and labor

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or equal to zero.

[7] Some example of economic variable that may be defined either as policy tools or macroeconomic goals are the exchange rate, the inflation rate, government spending, and so on.

has a very low marginal productivity in developing countries[8]. Criticisms of neoclassical growth models emphasize the fact that within the context of the neoclassical models the remaining or the unexplained variability of output growth is a residual. Meier states that "the residual was initially thought of as a coefficient of technical advance, but it was quickly recognized to be a composite of the effects of many different sources." As mentioned in the previous chapter some of these sources of output growth came about through the improvement in the quality of labor, exploitation of economies of scale, reallocation of resources to best alternative uses, and economic gains derived from the international trade process.

Complementary to the analysis of neoclassical growth models, the structural approach to economic growth assumes that economic growth is the result of a transformation of the production structure that takes advantage of technological changes. In the structural approach, technological change is not assumed exogenous, rather it is endogenized as a function of other factors of production. Structural economists consider as neoclassical economists do, that physical capital accumulation is an important factor to achieve economic growth. However, structural economists stress the importance that the technological component of the production function has through the process of learning by doing and technology transfer. In the structural approach it is also possible for an economy not to be at equilibrium, meaning that factors of production are not necessarily paid their corresponding marginal productivity. The out-off equilibrium condition allows economies to reallocate resources and generate economies of scale, thus increasing

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[8] According to Meier, labor is abundant in developing countries because its productivity does not add to overall output growth. In the extreme case, labor is said to be abundant when marginal product is equal to zero.

factors' productivity, per capita output, and the rate of growth of income per capita. Hence, the emphasis is on the possibility for resource reallocation, and technology transfer. To overcome the apparent limitations of neoclassical growth models, the structural approach assumes that there is a possibility for labor and capital to shift from activity to activity given the disequilibrium nature of the economy. Indeed, resource reallocation becomes a major issue in the framework of the structural models. This resource reallocation is even more important in the case of developing countries where there is a larger possibility for such a process to occur, as Meier points out. The following table taken from Meier, presents and summarizes the main difference between the neoclassical and structural models of economic growth.

Table 1. Alternative Views of Growth

Neoclassical Approach	Structural Approach
Assumptions	
Factor returns equal marginal productivity in all uses	Income related changes in internal demand
No economies of scale	Constrained external markets and lags in adjustment
Perfect foresight and continuos equilibrium in all markets	Transformation of productive structure producing disequilibria in factor markets
Empirical Implications	
Relatively high elasticities of substitution in demand and trade	Low price elasticities and lags in adjustment
Limited need for sector desegregation	Segmented factor markets
	Lags in adopting new technology
Sources of Growth	
Capital accumulation	Neoclassical sources plus:
Increase in labor quantity and quality	Reallocation of resources to higher-productivity sectors
Increase in intermediate inputs	Economies of scale and learning by doing
Total factor productivity growth within sectors	Reduction of internal and external bottlenecks

Source: Meier, Gerald. *Leading Issues in Economic Development* ,Fifth Edition, Oxford University Press, 1989, p. 98.

Endogenous and Exogenous Growth Models

The economic discussion on how to determine the sources of growth and why countries achieve different levels of income per capita has recently moved to explain the differences between exogenous and endogenous growth models. The underlying assumptions of exogenous growth models are that the rate of population growth, capital accumulation, and technological change are given exogenously, i.e. they are determined outside the framework of neoclassical models.

Renelt argued that endogenous growth models are characterized by removing the fixed factor constraint of neoclassical growth models by allowing constant returns to reproducible factors or by endogenizing technological change. In the same regard, Mankiw, Romer and Weil state that "Endogenous-growth models are characterized by the assumption of non decreasing returns to the set of reproducible factors of production. Among the implications of this assumption are that countries that save more grow faster indefinitely and that countries need not converge in income per capita, even if they have the same preferences and technology" (p. 421). The same authors add that implications of endogenous growth models compared to neoclassical growth models are that in the former there is no steady-state level of income per capita and differences in income per capita across countries can persist indefinitely even if countries have different saving and population growth rates.

This dissertation uses the neoclassical growth model framework but allows for technological change to occur through the degree of trade openness herein assumed to be a factor of production. Technological change is explicitly modeled as a function of trade openness in primary and nonprimary goods. The advantage of using the neoclassical framework is that it allows for a determination of how trade openness affects physical capital accumulation, human capital accumulation, and income per capita growth. The neoclassical framework also accounts for the possibility that countries with different rates of saving and initial income per capita levels achieve different levels of income per capita in the long run. The framework also maintains the assumptions of constant returns to scale to all factors common to neoclassical growth models, while considering the possible gains derived from the international trade process of specialization and transfer of technology.

To better understand the implications of introducing trade openness as a factor of production within the context of the Solow neoclassical growth model, this dissertation provides a complete derivation of the steady-state levels of physical capital, human capital and trade openness. The outline of the matemathical derivation is presented in steps by first deriving the Solow model, then the Augmented Solow model with Human Capital, and finally the Augmented Solow model with Human Capital and Trade Openness.

The Solow Model

As mentioned before, the Solow model of economic growth uses a standard neoclassical production function with decreasing returns to capital and constant returns to scale for all inputs. The fundamental assumptions of the Solow model are that the rates of saving, population growth and technological progress are exogenous. Assuming a Cobb-Douglas production function with two inputs, capital and labor, the model is expressed as follows;

(6) $$Y(t) = K(t)^{\alpha}\left(A(t)L(t)\right)^{1-\alpha} \qquad 0<\alpha<1$$

where Y is output, K is physical capital, L is labor and A is the level of technology. In addition, L and A are assumed to grow exogenously at rates n and g

(7) $$L(t) = L(0)e^{nt}$$

(8) $$A(t) = A(0)e^{gt}$$

The Solow model also assumes that a constant fraction of output, s, is invested in physical capital. Defining k as the stock of capital per effective unit of labor, $k = K/AL$, and y as the level of output per effective unit of labor, $y = Y/AL$, the evolution of k is governed by

(9) $$\dot{k}(t) = sy(t) - (n + g + \delta)k(t)$$

(10) $$\dot{k}(t) = sk(t)^{\alpha} - (n + g + \delta)k(t)$$

where $0 < \delta < 1$, is the rate of depreciation and $\dot{k}$ is the derivative of k with respect to time. It implies that k converges to a steady-state value k^* defined by:

(11) $$k^* = \left[s / (n + g + \delta)\right]^{1/(1-\alpha)}$$

The steady-state capital-labor ratio (k^*) is related positively to the rate of savings and negatively to the rate of population growth. Therefore, substituting (11) into (6) and taking logarithms the steady-state level of income per capita is given by

(12) $$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n + g + \delta)$$

Furthermore, the model assumes that $\ln A(0) = a + \varepsilon$, where a is a constant and ε is a country-specific shock. Thus, log income per capita at a given time -time 0 for simplicity- is

$$(13) \qquad \ln\left(\frac{Y}{L}\right) = a + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \varepsilon$$

Knight, Loayza and Villanueva argue that "the Solow-Swan growth model predicts that in the steady-state equilibrium the level of income per capita will be determined by the prevailing technology, as embodied in the production function, and by the rates of saving, population growth, and technical progress, all three of which are assumed exogenous. Since these rates differ across countries, the Solow-Swan model yields testable predictions about how differing saving rates and population growth rates, for example, might affect different countries' steady-state levels of income per capita. Other things being equal, countries that have higher savings rates tend to have higher levels of income per capita, and countries with higher population growth rates tend to have lower levels of income per capita" (p. 513).

More recently, research has focused on determining whether the Solow model supports the hypotheses of conditional and unconditional convergence of income per capita across countries (Mankiw, Romer, and Weil; Knight, Loayza and Villanueva; and Edwards). The convergence hypothesis states that those countries that initially have a lower level of income per capita tend to grow faster than the ones that initially have higher levels of income per capita. The difference between conditional and unconditional convergence is that conditional convergence assumes that income per capita across countries converges after controlling for the factors of production. Empirically, the explanatory variables of the rate of growth of income per capita are the rate of growth of the labor force, the rate of growth of the capital stock, and the initial level of income per capita. Expansions of this model have considered inflation rate, government's share of total output, a financial variable and a freedom variable as important determinants of income per capita growth. Unconditional convergence means that the only explanatory variable of the rate of growth of income per capita is the initial level of income per capita. For the convergence hypothesis to hold the expected sign of the estimated parameter is negative for the initial level of income per capita. This means that countries that start off from lower income per capita levels tend to grow faster than those that initially have higher levels of income per capita. The Solow model predicts that countries having different saving and population growth rates tend to converge to different income per capita levels.

Adding Human-Capital Accumulation to the Solow Model

The new convergence approach focuses also on the inclusion of human capital accumulation as an explanatory variable of output growth. Mankiw, Romer and Weil emphasize that the accumulation of human as well as physical capital is important for economic growth, especially for those countries in which labor is not considered abundant.

Mankiw, Romer and Weil argue that "to understand the relationship between savings, population growth, and income, one must go beyond the textbook Solow model" (p. 408). They argue that including human capital can potentially alter either the theoretical modeling or the empirical analysis of economic growth. At the theoretical level, properly accounting for human capital may change one's view of the nature of the growth process. Mankiw, Romer and Weil noted that, "for any given rate of human capital accumulation, higher saving or lower population growth leads to a higher level of income and thus a higher level of human capital; hence, accumulation of physical capital and population growth have greater impacts on income when accumulation of human capital is taken into account. Further, human-capital accumulation may be correlated with saving rates and population growth rates; this would imply that omitting human-capital accumulation would bias the estimated coefficients on saving and population growth" (p. 408).

The Augmented Solow model of economic growth presented by Mankiw, Romer and Weil uses the same standard specification as the model developed in equation 6.

(14) $$Y(t) = K(t)^{\alpha} H(t)^{\beta} \left(A(t)L(t)\right)^{1-\alpha-\beta}$$

where $\alpha > 0$, $\beta > 0$ and $0 < \alpha+\beta < 1$. In addition, H is the stock of human capital and $h = H/AL$, is a unit of human capital per effective unit of labor. All other variables are defined as before. Letting s_k be the fraction of income invested in physical capital and s_h the fraction invested in human capital. The evolution of the economy around k and h is now determined by

(15) $$\dot{k}(t) = s_k y(t) - (n + g + \delta)k(t)$$

(16) $$\dot{h}(t) = s_h y(t) - (n + g + \delta)h(t)$$

Mankiw, Romer and Weil assume that $\alpha + \beta < 1$, which implies that there are decreasing returns to all capital. (If $\alpha + \beta = 1$, then there are constant returns to scale in the reproducible factors. In this case, there is no steady-state for this model). In addition, $0 < \delta < 1$, is the rate of depreciation and it is assumed, for simplicity, to be equal for physical and human capital.

The steady-state levels of the stock of physical and human capital per effective unit of labor are determined by

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n + g + \delta} \right)^{1/(1-\alpha-\beta)} \tag{17}$$

$$h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n + g + \delta} \right)^{1/(1-\alpha-\beta)} \tag{18}$$

Substituting (17) and (18) into (14) and taking the natural log yields the steady-state level of income per capita

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha-\beta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta}\ln(s_h) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) \tag{19}$$

Like the textbook Solow model, the augmented model predicts coefficients that are functions of the factor shares. In addition, the steady-state level of income per capita also depends on the rate of human capital accumulation. Mankiw, Romer and Weil argue that the empirical estimation of the augmented Solow model yields better results because it shows that by adding human capital the accumulation of physical capital has a larger impact on income per capita than the textbook Solow model. A higher saving rate leads to higher income per capita at the steady-state. In addition, population growth has a larger negative impact on income per capita compared to the initial Solow model.

Trade Openness and Technological Transfer in the Solow Model Framework

Other considerations on economic growth theory focus on the importance that international trade has on overall output growth through the transfer of technology. Two different approaches are presented, one by Knight, Loayza and Villanueva and the other by Edwards

In the first instance, Edwards argues that a country's trade policy can affect the speed at which technological improvements take place. He uses a set of new indicators on trade intervention and trade distortions to empirically investigate the role of commercial policy in explaining cross-country growth differentials. Edwards assumes that a country's ability to appropriate technological innovations depends on the degree of openness of the economy. More open should be interpreted as referring to a less distorted or more market oriented foreign trade sector.

The overall finding is that there is very strong evidence supporting the hypothesis that, with other things given, more open countries will tend to grow faster. Countries with a greater degree of openness will not only exhibit a higher level of income than countries with trade distortions but they will also have a higher long run steady state rate of growth. Edwards continues, saying that "the model implies that the out of steady-state rate of growth of aggregate output in a small country will depend positively on capital accumulation, positively on labor force growth, positively on the knowledge (or technological) gap between the country in question and the advanced nations, and negatively on the degree of trade distortions. Additionally, trade policy will also affect long-run growth, with more open countries growing faster than otherwise identical countries" (p. 37). In addition, Edwards states that "The coefficient of the openness indicators provides strong support to the hypothesis that countries with a more open trade regime have, with other things given, tended to grow faster" (p. 42).

On the other hand, Knight, Loayza and Villanueva propose an extension of the Augmented Solow Model developed by Mankiw, Romer, and Weil. The new model includes trade policy and the stock of public infrastructure as factors that affect labor augmenting technological change. Knight, Loayza and Weil state "policies that foster more openness in a country's international trade regime help to stimulate labor-augmenting technological change in two ways. First, the import-export sector serves as a vehicle for technology transfer through the importation of technologically advanced capital goods, as elucidated by Barhan and Lewis (1970), Chen (1979) and Khang (1987), and as a channel for intersectoral external economies through the development of efficient and internationally competitive management, the training of skilled workers, and the spillover consequences of scale expansion (Keesing (1967) and Feder (1983)). Second, rising exports help to relieve the foreign exchange constraint -- that is, a country's ability to import technologically superior capital goods is augmented directly by rising exports receipts and indirectly by the higher flows of foreign credits and direct investment caused by the country's increased ability to service debt and equity held by foreigners" (p. 515).

The main difference between the Knight, Loayza and Villanueva model and the Mankiw, Romer and Weil model is the specification of the technological factor A. The factor, A, is redefined in the KLV model as

$$A_t = A_0 e^{gt} F^{\theta_f} P^{\theta_p} \tag{20}$$

where g is the exogenous rate of technological progress, F is the degree of openness of the domestic economy to foreign trade (with elasticity θ_f), and P is the level of government fixed investment in the economy (with elasticity θ_p). Knight, Loayza and Villanueva state "this modification is particularly relevant to the empirical study of economic growth in developing countries, where technological improvement tends to be absorbed domestically through imports of capital goods and where the productive sector's efficiency may depend heavily on the level of fixed investment undertaken by the government" (p. 516).

Hence, given that the degree of trade openness (F) and the stock of government fixed investment (P) are included in equation 20 as part of a technological shifting factor, the determination of the steady-state level of physical and human capital per effective unit of labor remains invariable compared to the estimates of the steady-state levels in Mankiw, Romer and Weil model. Nevertheless, Knight, Loayza and Villanueva conclude that overall economic efficiency is influenced significantly and positively by the extent of openness to international trade and by the level of government fixed investment in the domestic economy. In their words "when openness and the level of public infrastructure are taken into account, physical investment becomes quantitatively more important in the growth process, implying that a better quality of investment is encouraged by a more liberal international trade regime and by more government fixed investment" (p. 536).

An important finding in Knight, Loayza and Villanueva is that there are two channels through which the negative impact on growth of a restrictive trade system (proxied by the weighted average of tariffs on intermediate and capital goods) may be transmitted, through the rate of investment and through the effect on production efficiency. A high tariff structure discourages imports of capital goods and leads to less technology transfer, and thus to less technological improvement. Outward-oriented development strategies have a positive impact on economic growth.

Edwards; and Knight, Loayza and Villanueva argue in favor of a positive effect that trade openness has on the productivity of physical and human capital, and also in total output growth. They argue that this positive effect comes about through the transfer of technology and the learning by doing process. Yet, at the theoretical level both approaches fail to address how trade openness affects human and physical capital productivity and therefore capital accumulation because the approaches consider trade openness as a technological shifting factor as opposed to a production factor. This effect is shown in equations 17 and 18 since k^* and h^* are assumed to be the steady-state levels of physical and human capital per effective unit of labor. Hence, the impact of technology changes as mentioned in Edwards; and Knight, Loayza and Villanueva is not explicitly incorporated in the steady-state levels of k and h, nor is the impact explicitly accounted for on the estimated parameters and coefficients.

CHAPTER III

THEORETICAL MODEL

Solow Model with Human Capital Accumulation and Trade Openness

To determine in a direct and precise manner how trade openness affects factor productivity, human and physical capital accumulation, and per capita output growth, this dissertation proposes an alternative Neoclassical approach that incorporates human capital and trade openness. The main difference of the approach this study follows is that the model incorporates the degree of trade openness promotion as a factor of production and not as a component of the technological shifting factor A as in previous studies. This is a key assumption in deriving the steady-state conditions in order to be able to measure the effects of trade openness on economic growth. In this regard, the model incorporates trade openness as a factor of production assuming that; i) it promotes the reallocation of resources according to comparative advantage, ii) allows for greater capacity utilization, iii) permits the exploitation of economies of scale, iv) generates technological improvements in response to competition abroad and, v) in labor surplus countries contributes to increased employment and labor productivity. To account for the differences in its impact on sectoral production between agricultural and nonagricultural goods, the model further demonstrates the importance of trade openness by category of goods through its decomposition between agricultural and nonagricultural.

The decomposition of trade openness between agricultural and nonagricultural goods is relevant to the process of economic growth and economic development because differences may be determined in terms of factor productivity, resources allocation, and economies of scale between two different sectors with different structural and heterogeneous characteristics. Traditionally, it has been argued that agriculture provided surplus labor to the development of the industrial sector. Kavoussi; Tyler; and Balassa argue that the contribution of primary and manufactured export goods to output growth and capital productivity depends on the initial level of income per capita and on the composition of exports. Renelt argues that those results can be obtained using any trade openness measure, however trade openness as measured in this study includes the gains derived from international trade not only through export promotion but also by allowing greater competition through importing capital and primary goods. Technology transfer and development of economies of scale are the result of overall openness to trade and not only the outcome of a process of export promotion. Trade openness optimizes resource allocation by promoting those production activities that face international competition. Thus, this study assumes that trade openness is better understood when incorporating the investment process associated to the promotion of both exports and imports of agricultural and nonagricultural goods[9].

[9] The concern of developing countries on whether they should promote exports and restrict imports is an issue that relates usually to structural balance of payments problems and/or domestic production policies oriented to protect domestic producers. However, the truthness of this argument does not relate or attempt to explain the gains a country receives by participating on international trade.

The Augmented Neoclassical Growth Model developed herein adheres to the Mankiw, Romer and Weil specification of human capital from the previous chapter and includes two more factors of production, agricultural and non-agricultural trade openness promotion. A simple production function can be expressed as follows. Let

$$Y = f(K, H, Xa, Xna, L) \tag{21}$$

where Y is total output, K is physical capital, H is human capital, Xa is a trade openness promotion measure in the agricultural sector, Xna is a trade openness promotion measure in the non-agricultural sector, and L is the labor force. Assuming a Cobb-Douglas production function with decreasing returns to scale to all reproducible factors, the Augmented Neoclassical Solow model is expressed as follows. Let,

$$Y(t) = K^{\alpha}(t)H^{\beta}(t)Xa^{\theta}(t)Xna^{\pi}(t)(AL)^{1-\alpha-\beta-\theta-\pi} \tag{22}$$

where $\alpha > 0$, $\beta > 0$, $\theta > 0$ and $\pi > 0$; and $0 < \alpha+\beta+\theta+\pi < 1$. In addition, the model assumes that $K > 0$, $H > 0$, $Xa > 0$, $Xna > 0$ and $L > 0$. Special cases of the model arise when any of the variables assumes a value equal to zero. These cases are particularly interesting when either $Xa = 0$ and/or $Xna = 0$.[10] As stated, A is the technological factor, and A and L follow the same specification as before

$$L(t) = L(0)e^{nt} \tag{23}$$

$$A(t) = A(0)e^{gt} \tag{24}$$

therefore the number of effective units of labor grows at $n+g$ like in the Solow model. The model also defines $k = K/AL$, $h = H/AL$, $xa = Xa/AL$, $xna = Xna/AL$, and $y = Y/AL$, as

[10] A complete explanation of the theoretical implications are provided later in this chapter.

the physical capital, human capital, agricultural trade openness, non-agricultural trade openness and total output per effective unit of labor, respectively.

Non-negativity of *Xa* and *Xna*

Before proceeding with the actual derivation of the steady-state levels of income per capita, physical capital, human capital, agricultural trade openness, and nonagricultural trade openness, some discussion of the assumed non-negative nature of *Xa* and *Xna* is warranted. By definition the model assumes that $Xa > 0$ and $Xna > 0$. This assumption implies that countries take part in the international trade process either as exporters/importers of agricultural goods or/and exporters/importers of nonagricultural goods. However, it is possible to consider the hypothetical case where a country does not participate in international trade either because of self-sufficiency reasons[11] or any other macroeconomic reason.

Let us assume first that a country does not have any commercial relationship with any other country in agricultural goods, i.e. *Xa* is equal to zero. If $Xa = 0$ then the country is defined as been self-sufficient in agricultural goods and therefore there are no trade gains or technological improvements derived from *Xa*. Under this case the term *Xa* must be eliminated from the specification of the Augmented Solow model of equation 22. In this regard agricultural trade openness does not have any impact on the steady-state levels of physical capital, human capital, and income per capita. The second condition refers to the non-negativity of *Xna*. This condition refers to the assumption that a country may be defined as being self-sufficient in the production and consumption of nonagricultural

[11] Self-sufficiency does not mean that a country has comparative advantage in the production of a specific good, nor does it mean that a country can not benefit from the trade promotion process.

goods if *Xna* = 0. As in the case of self-sufficiency in agricultural goods, self-sufficiency in nonagricultural goods means to eliminate the *Xna* term from the specification of equation 22. The implications in terms of steady-state level determinations are the same as before. Even though it is less likely for these theoretical scenarios to occur in the real world, it is convenient to keep them in mind to have a better understanding of the associated gains in productivity and consumption that international trade brings about. Having explored these possible theoretical scenarios, this study proceeds to derive the steady-state levels of income per capita, physical capital accumulation, human capital accumulation, agricultural trade openness, and nonagricultural trade openness for the Augmented Solow Model. The results of the newly developed steady-state conditions will then be used to specify the differences among growth models and to develop the growth equation for empirical estimations.

Steady-states

Before proceeding with the derivations of the steady-state conditions, it is convenient to remember some considerations about the Solow and MRW growth models. First, the Solow Growth Model assumes that the rate of savings of any economy is equal to the rate of investment in physical capital, where physical capital is expressed in terms of effective units of labor. Therefore, the Solow model only derives one steady-state level for the physical capital. In the same context and following the Solow model specification mentioned above, Mankiw, Romer and Weil argue that savings can be used not only in the formation of physical capital but also in the formation of human capital. Thus, MRW assume that the overall savings level can be decomposed between s_k and s_h, where s_k is the fraction of income invested in physical capital, and s_h is the fraction of income invested in human capital. Therefore, in MRW there are now two steady-state conditions, one for physical capital and the other for human capital accumulation.

Using the Solow neoclassical framework and the correspondent MRW extension to it, this study further assumes that a fraction of Gross Domestic Product, s_{xa}, is invested in the promotion of agricultural trade, and that a fraction of Gross Domestic Product s_{xna} is invested in the promotion of non-agricultural trade[12]. The model further assumes, that the rate of depreciation for physical capital accumulation, human capital accumulation, agricultural trade openness, and non-agricultural trade openness is equal to δ, where $0 < \delta < 1$[13]. Therefore, by combining the rate of depreciation δ, and the rate of savings invested in each factor of production (s_i, where $i = k$, h, xa, and xna), it is possible to define the correspondent rates of net investment for each factor as follows;

(25) $$\frac{\partial K}{\partial t} = s_k Y - \delta K$$

(26) $$\frac{\partial H}{\partial t} = s_h Y - \delta H$$

(27) $$\frac{\partial Xa}{\partial t} = s_{xa} Y - \delta Xa$$

(28) $$\frac{\partial Xna}{\partial t} = s_{xna} Y - \delta Xna$$

where net investment is defined as the gross investment rate ($s_i Y$ where $i=k$, h, xa, and xna), minus the rate of depreciation of the correspondent i^{th} factor in time t. Recalling the

[12] Investment in the promotion of agricultural and nonagricultural trade is associated with the development of economies of scale, capacity of response to foreign competition, development of comparative advantage, and promotion of technological transfer.

definitions of k, h, xa and xna (effective units of factors of production) it is possible to rearrange terms as to determine the total differentials of K, H, Xa and Xna with respect to (wrt) time, i.e., $\frac{\partial K}{\partial t}, \frac{\partial H}{\partial t}, \frac{\partial Xa}{\partial t}, and \frac{\partial Xna}{\partial t}$. The partial derivatives of K, H, Xa, and Xna wrt time will then be equated to equations 25, 26, 27, and 28 respectively to determine the correspondent steady-state conditions for each factor of production. The results and procedures of the mathematical derivation are shown from equations 29 through 40.

Physical Capital

Let us first start with the derivation of the steady-state level for the physical capital. Thus, the first step to determine the physical capital steady-state level is to rearrange $k = K/AL$ as $K = kAL$ and then take the total differential of K wrt time which results in,

$$\frac{\partial K}{\partial t} = AL\frac{\partial k}{\partial t} + kA\frac{\partial L}{\partial t} + kL\frac{\partial A}{\partial t}$$

(29) $$\frac{\partial K}{\partial t} = AL\frac{\partial k}{\partial t} + nkAL + gkAL$$

where, the rate of change of the capital stock wrt time $\frac{\partial K}{\partial t}$ is equal to the sum of three components. The first term at the right-hand-side of equation 29 refers to the change of the capital stock per effective unit of labor wrt time multiplied by the number of effective

[13] This assumption simplifies the mathematical derivation of the steady-state levels of K, H, Xa, and Xna.

units of labor (AL). The second term is the change in the capital stock due to changes in the rate of growth of the labor force; and the third term indicates the change in the capital stock due to changes in the rate of technology growth.

To solve for the steady-state level, equate equations 25 and 29 which are equivalent specifications of the change in the level of physical capital wrt time. Thus, it is possible to substitute 29 into 25, and solve for the rate of change of the level of physical capital per effective unit of labor wrt time as follows;

$$s_k Y - \delta K = AL\frac{\partial k}{\partial t} + nkAL + gkAL$$

$$AL\frac{\partial k}{\partial t} = s_k Y - \delta K - nkAL - gkAL$$

$$\frac{\partial k}{\partial t} = \frac{s_k Y}{AL} - \frac{\delta K}{AL} - \frac{nkAL}{AL} - \frac{gkAL}{AL}$$

$$\frac{\partial k}{\partial t} = s_k y - k(g + n + \delta)$$

however, to solve for the steady-state level of physical capital, it is required to use the definition of output per effective unit of labor $y = k^{\alpha} h^{\beta} xa^{\theta} xna^{\pi}$ and substitute it into the previous equation resulting in

(30)
$$\frac{\partial k}{\partial t} = s_k k^{\alpha} h^{\beta} xa^{\theta} xna^{\pi} - k(g + n + \delta)$$

where the net change in the level of physical capital accumulation per effective unit of labor wrt time is equal to the proportion of income invested in physical capital

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Changes in the assumption do not affect the overall results of this study.

accumulation per effective unit of labor minus the change in the level of physical capital accumulation associated with the rates of change of technology and labor force, and the depreciation rate.

To solve for k from equation 30 it is further assumed that at the steady-state level the condition 30a holds. Where, (30a) refers to $\frac{k}{s_k} = \frac{h}{s_h} = \frac{xa}{s_{xa}} = \frac{xna}{s_{xna}}$, and identifies the producer maximizing behavior that allows any economy to assign scarce resources to their best alternative uses until the last unit of savings per effective unit of labor has been allocated equally among alternative investment opportunities. This condition implicitly assumes that at the steady-state level the marginal productivity of the last dollar invested in the i^{th} factor is equal to the marginal productivity of the last dollar invested in the j^{th} factor, under the condition that $i \neq j$.

Therefore, using condition 30a, it is possible to mathematically identify the following equalities that are then used to solve for the steady-state level of physical capital $\dot{k}$ in equation 30. Thus, the model identifies that if at the steady-state level the marginal productivity of the last dollar invested in factors i^{th} and j^{th} is equal, then it is possible to raise any pair of all these resulting equalities to the same power without altering the implications of this condition. This mathematical procedure then allows the model to substitute and solve for k. This is then shown as follows;

i) $$\left(\frac{k}{s_k}\right)^{\beta} = \left(\frac{h}{s_h}\right)^{\beta},$$

ii) $$\left(\frac{k}{s_k}\right)^{\theta} = \left(\frac{xa}{s_{xa}}\right)^{\theta} \text{ and}$$

iii) $$\left(\frac{k}{s_k}\right)^{\pi} = \left(\frac{xna}{s_{xna}}\right)^{\pi},$$

solving i, ii, and iii in terms of h^{β}, xa^{θ}, and xna^{π} respectively gives the following results,

i*) $$h^{\beta} = \frac{k^{\beta} s_h^{\ \beta}}{s_k^{\ \beta}},$$

ii*) $$xa^{\theta} = \frac{k^{\theta} s_{xa}^{\ \theta}}{s_k^{\ \theta}}, \text{ and}$$

iii*) $$xna^{\pi} = \frac{k^{\pi} s_{xna}^{\ \pi}}{s_k^{\ \pi}}.$$

Results from i*, ii*, and iii* are then substituted into equation 30, and then solved at the steady-state for k, where $\frac{\partial k}{\partial t} = 0$. The remaining of the mathematical derivation is an algebraic procedure as shown below;

$$0 = s_k k^{\alpha} \left(\frac{k^{\beta} s_h^{\ \beta}}{s_k^{\ \beta}}\right)\left(\frac{k^{\theta} s_{xa}^{\ \theta}}{s_k^{\ \theta}}\right)\left(\frac{k^{\pi} s_{xna}^{\ \pi}}{s_k^{\ \pi}}\right) - k(g + n + \delta)$$

$$s_k^{\ 1-\beta-\theta-\pi} k^{\alpha+\beta+\theta+\pi} s_h^{\ \beta} s_{xa}^{\ \theta} s_{xna}^{\ \pi} = k(g + n + \delta)$$

$$\frac{s_k^{\ 1-\beta-\theta-\pi} s_h^{\ \beta} s_{xa}^{\ \theta} s_{xna}^{\ \pi}}{n + g + \delta} = k^{*\,1-\alpha-\beta-\theta-\pi}$$

$$\dot{k} = \left(\frac{s_k^{1-\beta-\theta-\pi} s_h^{\beta} s_{xa}^{\theta} s_{xna}^{\pi}}{n+g+\delta} \right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}} \tag{31}$$

where $\dot{k}$ is the steady-state level of physical capital accumulation. Some considerations are important to address. The first and foremost important element to point out is that the result in equation 31 differs from those previous derivations of the steady-state level of physical capital accumulation in the Solow model of equation 11 and in the Augmented Solow model of equation 17.

In the basic neoclassical Solow model the steady-state level of physical capital accumulation is positively related to the savings rate and negatively related to the rate of population growth. In the Mankiw, Romer and Weil augmented model of equation 17, the steady-state level of physical capital accumulation is determined as in the Solow model. However, equation 17 predicts a larger steady-state level of physical capital, because it incorporates the positive effect human capital accumulation has on physical capital. Not surprisingly the same results are found in equation 31. However, the Augmented Solow model with Human Capital Accumulation and Trade Openness predicts that the steady-state level of physical capital per effective unit of labor also depends positively on the income proportions invested in agricultural and nonagricultural trade openness promotion. If the model specification is correct then physical capital accumulation is positively affected by investment in trade openness because it helps to reallocate resources in a more efficient way, allowing for greater capacity utilization, exploitation of economies of scale, and generating technological improvements in response to competition abroad and, in labor surplus countries contributes to increased employment, as mentioned before.

A second difference between the model developed in this study and previous determinations of growth models relates to the study by Knight, Loayza and Villanueva. Following MRW approach, Knight, Loayza and Villanueva define that the degree of trade openness affects the steady-state level of physical capital accumulation and output growth only through exogenous changes in the level of technological transfer. Knight, Loayza and Villanueva assume that trade openness is an indirect determinant of output growth which only has effects on it through exogenous changes in the level of technology. Thus, trade openness does not have any direct effect on the steady-state level of physical capital accumulation. On the other hand, theoretical results from equation 31 indicate that endogenous technological change through the degree of trade openness has a positive and direct effect on the steady-state level of physical capital accumulation. This particular difference is a major shortcoming of previous theoretical growth models that will be discussed in more detail when determining both the direct and indirect effects of trade openness on overall per capita output growth.

Finally an empirical question that remains unanswered is whether the steady-state level of physical capital accumulation is larger in the augmented Solow model with trade openness than in the model estimated by Mankiw, Romer and Weil. The answer to this particular question depends directly on the relative magnitudes of Sxa, $Sxna$, θ and π, other things being equal.

Human Capital

The second steady-state condition to derive corresponds to human capital accumulation As for the physical capital, this section follows the same steps as before. It is relevant to notice that even though some of the material herein presented may be repetitive with respect to the previous section, it is still necessary to understand the derivation process for the steady-state level of human capital. Thus, using the definition of human capital per effective unit of labor $h=H/AL$, let us rearrange it as $H=hAL$, and then take the total differential wrt time. This in turn yields,

$$\frac{\partial H}{\partial t} = AL\frac{\partial h}{\partial t} + hA\frac{\partial L}{\partial t} + hL\frac{\partial A}{\partial t}$$

(32) $$\frac{\partial H}{\partial t} = AL\frac{\partial h}{\partial t} + nhAL + ghAL$$

where, the rate of change of the human capital stock wrt time $\frac{\partial H}{\partial t}$ is equal to the sum of three components. The first term at the right-hand-side of equation 32 refers to the change of the human capital stock per effective unit of labor wrt time multiplied by the number of effective units of labor (AL). The second term is the change in the human capital stock due to changes in the rate of growth of the labor force; and the third term indicates the change in the human capital stock due to changes in the rate of technology growth.

To solve for the steady-state level we proceed to equate equations 32 and 26 which are equivalent specifications of the change in the level of human capital wrt time.

Thus, it is possible to substitute 32 into 26, and solve for the rate of change of the level of human capital per effective unit of labor wrt time as follows;

$$s_h Y - \delta H = AL\frac{\partial h}{\partial t} + nhAL + ghAL$$

$$AL\frac{\partial h}{\partial t} = s_h Y - \delta H - nhAL - ghAL$$

$$\frac{\partial h}{\partial t} = \frac{s_h Y}{AL} - \frac{\delta H}{AL} - \frac{nhAL}{AL} - \frac{ghAL}{AL}$$

$$\frac{\partial h}{\partial t} = s_h y - h(g + n + \delta)$$

however, to solve for human capital, it is required to use the definition of output per effective unit of labor $y = k^{\alpha} h^{\beta} xa^{\theta} xna^{\kappa}$ and substitute it into the previous equation resulting in

$$\frac{\partial h}{\partial t} = s_h k^{\alpha} h^{\beta} xa^{\theta} xna^{\kappa} - h(g + n + \delta) \tag{33}$$

where the net change in the level of human capital accumulation per effective unit of labor wrt time is equal to the proportion of income invested in human capital accumulation per effective unit of labor minus the change in the level of human capital accumulation associated with the rates of change of technology and labor force, and the depreciation rate.

To solve for h from equation 33 the model makes use of the condition 30a, as before. Where, (30a) refers to $\frac{k}{s_k} = \frac{h}{s_h} = \frac{xa}{s_{xa}} = \frac{xna}{s_{xna}}$, and identifies the producer maximizing behavior that allows any economy to assign scarce resources to their best alternative uses until the last unit of savings per effective unit of labor has been allocated equally among alternative i^{th} investment opportunities.

Hence, using condition 30a, it is possible to identify the following equalities which are then used to solve for the steady-state level of physical capital $\dot{h}$ in equation 33. The model also assumes that at the steady-state level the marginal productivity of the last dollar invested in factors i^{th} and j^{th} is equal, which in turn allows to manipulate the equalities as follows. This is then shown as;

i) $$\left(\frac{k}{s_k}\right)^{\alpha} = \left(\frac{h}{s_h}\right)^{\alpha},$$

ii) $$\left(\frac{h}{s_h}\right)^{\theta} = \left(\frac{xa}{s_{xa}}\right)^{\theta}, \text{ and}$$

iii) $$\left(\frac{h}{s_h}\right)^{\pi} = \left(\frac{xna}{s_{xna}}\right)^{\pi},$$

solving i, ii, and iii in terms of k^{α}, xa^{θ}, and xna^{π} respectively gives

i*) $$k^{\alpha} = \frac{h^{\alpha} s_k{}^{\alpha}}{s_h{}^{\alpha}},$$

ii*) $$xa^{\theta} = \frac{h^{\theta} s_{xa}{}^{\theta}}{s_h{}^{\theta}}, \text{ and}$$

iii*) $$xna^{\pi} = \frac{h^{\pi} s_{xna}^{\pi}}{s_h^{\pi}}.$$

Results from i*, ii*, and iii* are then substituted into equation 33, and then solved at the steady-state for h, where $\frac{\partial h}{\partial t} = 0$. The remaining of the mathematical derivation is an algebraic procedure as shown below;

$$0 = s_h h^{\beta}\left(\frac{h^{\alpha} s_k^{\alpha}}{s_h^{\alpha}}\right)\left(\frac{h^{\theta} s_{xa}^{\theta}}{s_h^{\theta}}\right)\left(\frac{h^{\pi} s_{xna}^{\pi}}{s_h^{\pi}}\right) - h(g+n+\delta)$$

$$s_h^{1-\alpha-\theta-\pi} h^{\alpha+\beta+\theta+\pi} s_k^{\alpha} s_{xa}^{\theta} s_{xna}^{\pi} = h(g+n+\delta)$$

$$\frac{s_h^{1-\alpha-\theta-\pi} s_k^{\alpha} s_{xa}^{\theta} s_{xna}^{\pi}}{n+g+\delta} = \dot{h}^{1-\alpha-\beta-\theta-\pi}$$

(34) $$\dot{h} = \left(\frac{s_h^{1-\alpha-\theta-\pi} s_k^{\alpha} s_{xa}^{\theta} s_{xna}^{\pi}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$$

where $\dot{h}$ represents the steady-state level of human capital accumulation. The result in equation 34 differs from that derived in Mankiw, Romer and Weil in equation 18. Mankiw, Romer and Weil predict that the steady-state level of human capital relates positively to the rate of savings invested in physical and human capital and relates negatively to the rate of population growth. Equation 34 presents similar results as those implied by equation 18, however, the augmented Solow model with human capital accumulation and trade openness predicts that the steady-state level of human capital per effective unit of labor is also affected by the degree of openness both in agricultural and nonagricultural goods. The degree of trade openness provides for the exploitation of economies of scale that technology transfer and learning-by-doing processes have on the formation of human capital. Trade openness increases the process of technology transfer and learning-by-doing, increasing overall labor productivity. In turn, reallocation of labor among economic sectors increases overall marginal productivity that will not occur in economies that do not trade. Furthermore, industries and sectors which take part in the process of international trade usually have labor skill requirements higher than those industries dedicated to the production of goods for the domestic market. International trade competition results therefore in enhancement of labor quality, easing the process of technology transfer and physical capital accumulation. Hence, human capital accumulation is positively affected by the degree of openness because it reallocates resources in a more efficient way, allows for greater capacity utilization, enables the exploitation of economies of scale, and generates technological improvements in response to competition abroad and, in labor surplus countries contributes to increased employment. At the empirical level, whether the estimated magnitude of the steady-state level of human capital accumulation is larger than the one estimated by Mankiw, Romer and Weil is an empirical question that depends on the absolute magnitudes of Sxa, $Sxna$, θ and π, other things equal.

A second difference between the model developed in this study and previous determinations of growth models relates to the study by Knight, Loayza and Villanueva.

Following MRW approach, Knight, Loayza and Villanueva define that the degree of trade openness affects the steady-state level of human capital accumulation and output growth only through exogenous changes in the level of technological transfer. Knight, Loayza and Villanueva assume that trade openness is an indirect determinant of output growth which only has effects on it through exogenous changes in the level of technology. Thus, trade openness does not have any direct effect on the steady-state level of human capital accumulation. On the other hand, theoretical results from equation 34 indicate that endogenous technological change through the promotion of trade openness has a positive and direct effect on the steady-state level of human capital accumulation. Perhaps, the two most relevant considerations drawn out of these steady-state conditions are; trade openness results in higher labor quality, and thus resources shift from domestic uncompetitive activities to trade related highly competitive production processes. This result derives directly from the producer maximizing behavior assumption that indicates that at the steady-state level (marginal condition) the marginal productivity of the last unit of savings has to be equal among alternative investment opportunities. This particular difference is a major shortcoming of previous theoretical growth models that will be discussed in more detail when determining both the direct and indirect effects of trade openness on overall per capita output growth.

In this regard, the difference between the closed and open economy models is that in the closed economy model the economy is not maximizing either production nor social welfare. This is because the closed economy does not exploit the benefits associated with maximizing resource use allocation directly derived from the process of international trade. On the other hand, the open economy model differentiates between those economies that trade accordingly to their comparative advantage and those that are not involved in international trade.

Agricultural Trade Openness

The Augmented Growth Model with Trade Openness proposes the derivation of two new steady-state conditions. The first condition refers to the degree of trade openness promotion in agriculture, whereas the second condition refers to the degree of trade openness promotion in the non-agriculture sectors. The model first determines the steady-state level for the agricultural trade openness promotion as follows. Using the same specification as before, let $xa = Xa/AL$ and $Xa = xaAL$. Taking the derivative of Xa with respect to time.

$$\frac{\partial Xa}{\partial t} = AL\frac{\partial xa}{\partial t} + xaA\frac{\partial L}{\partial t} + xaL\frac{\partial A}{\partial t}$$

(35) $$\frac{\partial Xa}{\partial t} = AL\frac{\partial xa}{\partial t} + nxaAL + gxaAL$$

where, the rate of change of agricultural of trade openness promotion wrt time $\frac{\partial Xa}{\partial t}$ is equal to the sum of three components. The first term at the right-hand-side of equation 35 refers to the change in agricultural trade openness promotion per effective unit of labor wrt time multiplied by the number of effective units of labor (AL). The second term is the change in agricultural trade openness promotion due to changes in the rate of growth of the labor force; and the third term indicates the change in agricultural trade openness promotion due to changes in the rate of technology growth.

To solve for the steady-state level we proceed to equate equations 27 and 35 which are equivalent specifications of the change in agricultural trade openness promotion wrt time. Thus, it is possible to substitute 27 into 35, and solve for the rate of change in agricultural trade openness promotion per effective unit of labor wrt time as follows;

$$s_{xa}Y - \delta Xa = AL\frac{\partial xa}{\partial t} + nxaAL + gxaAL$$

$$AL\frac{\partial xa}{\partial t} = s_{xa}Y - \delta Xa - nxaAL - gxaAL$$

$$\frac{\partial xa}{\partial t} = \frac{s_{xa}Y}{AL} - \frac{\delta Xa}{AL} - \frac{nxaAL}{AL} - \frac{gxaAL}{AL}$$

$$\frac{\partial xa}{\partial t} = s_{xa}y - xa(g + n + \delta)$$

however, to solve for the steady-state level of agricultural trade openness promotion, it is required to use the definition of output per effective unit of labor $y = k^{\alpha}h^{\beta}xa^{\theta}xna^{\kappa}$ and substitute it into the previous equation resulting in

(36) $$\frac{\partial xa}{\partial t} = s_{xa}k^{\alpha}h^{\beta}xa^{\theta}xna^{\kappa} - xa(g + n + \delta)$$

where the net change in agricultural trade openness promotion per effective unit of labor wrt time is equal to the proportion of income invested in agricultural trade openness promotion per effective unit of labor minus the change in the level of agricultural trade openness promotion associated with the rates of change of technology and labor force, and the depreciation rate.

To solve for *xa* from equation 36 it is further assumed that at the steady-state level the condition 30a holds. As before, the model assumes that at the steady-state level the marginal productivity of the last dollar invested in the i^{th} factor is equal to the marginal productivity of the last dollar invested in the j^{th} factor, under the condition that $i \neq j$.

Therefore, using condition 30a, it is possible to identify the following equalities which are then used to solve for the steady-state level of agricultural trade openness promotion in equation 36. This is then shown as follows;

i) $$\left(\frac{k}{s_k}\right)^{\alpha} = \left(\frac{xa}{s_{xa}}\right)^{\alpha},$$

ii) $$\left(\frac{h}{s_h}\right)^{\beta} = \left(\frac{xa}{s_{xa}}\right)^{\beta} \text{ and}$$

iii) $$\left(\frac{xa}{s_{xa}}\right)^{\pi} = \left(\frac{xna}{s_{xna}}\right)^{\pi},$$

solving i, ii, and iii for k^{α}, h^{β}, and xna^{π} respectively gives

i*) $$k^{\alpha} = \frac{xa^{\alpha} s_k^{\ \alpha}}{s_{xa}^{\ \alpha}},$$

ii*) $$h^{\beta} = \frac{xa^{\beta} s_h^{\ \beta}}{s_{xa}^{\ \beta}}, \text{ and}$$

iii*) $$xna^{\pi} = \frac{xa^{\pi} s_{xna}^{\ \pi}}{s_h^{\ \pi}}.$$

Results from i*, ii*, and iii* are then substituted into equation 36, and then solved at the steady-state for xa, where $\frac{\partial xa}{\partial t} = 0$. The results is then,

$$0 = s_{xa} xa^{\theta}\left(\frac{xa^{\alpha} s_k^{\alpha}}{s_{xa}^{\alpha}}\right)\left(\frac{xa^{\beta} s_h^{\beta}}{s_{xa}^{\beta}}\right)\left(\frac{xa^{\pi} s_{xna}^{\pi}}{s_{xa}^{\pi}}\right) - xa(g+n+\delta)$$

$$s_{xa}^{1-\alpha-\beta-\pi} xa^{\alpha+\beta+\theta+\pi} s_k^{\alpha} s_h^{\beta} s_{xna}^{\pi} = xa(g+n+\delta)$$

$$\frac{s_{xa}^{1-\alpha-\beta-\pi} s_k^{\alpha} s_h^{\beta} s_{xna}^{\pi}}{n+g+\delta} = \dot{xa}^{1-\alpha-\beta-\theta-\pi}$$

(37)
$$\dot{xa} = \left(\frac{s_{xa}^{1-\alpha-\beta-\pi} s_k^{\alpha} s_h^{\beta} s_{xna}^{\pi}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$$

where $\dot{xa}$ is the steady-state level of agricultural trade openness per effective unit of labor. The model predicts that $\dot{xa}$ depends positively on the rate of savings invested in physical and human capital, and on the proportion of income invested on agricultural and nonagricultural trade; and negatively on the rate of population growth. According to equation 37, physical and human capital positively affects agriculture by allocating to the production and trade of agricultural goods, only those resources that are productive in such activity. The relative size of agricultural trade openness compared to nonagricultural trade openness depends finally on the levels of s_{xa}, s_{xna}, s_h, and s_k. Nevertheless, for a country with a large agricultural base $\dot{xa}$ is expected to be larger than otherwise. In most cases as countries move their production structure from agricultural to nonagricultural industries, a reversal in the relative sizes of the steady-state levels might be expected, becoming nonagriculture more important than before. In this regard, countries that start off having a comparative advantage in the production and therefore, trade of agricultural goods may reflect larger relative sizes of agricultural trade as ratio of the specific sectoral production. At the empirical level countries which have a comparative advantage in the production and trade of agricultural goods would, other things given, reflect a positive sign related to income per capita.

It is convenient to remember that the positive effect of trade openness promotion comes about because the model assumes that countries' production and trade behavior follow a pattern directly associated with their comparative advantage. On the other hand, if a country becomes involved in international trade not accordingly to its inherent or current comparative advantage, then there would be a resource use misallocation that contradicts the basic assumption of producer maximizing behavior. This in turn would be reflected in general loss of social welfare, which would be reflected as well, in a negative sign of empirical estimates for agricultural and nonagricultural trade openness promotion. Furthermore, this resource use misallocation would reduce the marginal productivity of all factors of production, driving countries away their long-run steady-state level of income per capita.

Nonagricultural Trade Openness

Finally, the steady-state level for the nonagricultural trade openness is determined as follows. Given $xna=Xna/AL$, let $Xna=xnaAL$, and take the derivative of Xna with respect to time.

$$\frac{\partial Xna}{\partial t} = AL\frac{\partial xna}{\partial t} + xnaA\frac{\partial L}{\partial t} + xnaL\frac{\partial A}{\partial t}$$

(38)
$$\frac{\partial Xna}{\partial t} = AL\frac{\partial xna}{\partial t} + nxnaAL + gxnaAL$$

where, the rate of change of non-agricultural of trade openness promotion wrt time $\frac{\partial Xna}{\partial t}$ is equal to the sum of three components. The first term at the right-hand-side of equation 38 refers to the change in non-agricultural trade openness promotion per effective unit of labor wrt time multiplied by the number of effective units of labor (AL). The second term is the change in non-agricultural trade openness promotion due to changes in the rate of growth of the labor force; and the third term indicates the change in non-agricultural trade openness promotion due to changes in the rate of technology growth.

To solve for the steady-state level we proceed to equate equations 28 and 38 which are equivalent specifications of the change in non-agricultural trade openness promotion wrt time. Thus, it is possible to substitute 28 into 38, and solve for the rate of change in non-agricultural trade openness promotion per effective unit of labor wrt time as follows,

$$s_{xna}Y - \delta Xna = AL\frac{\partial xna}{\partial t} + nxnaAL + gxnaAL$$

$$AL\frac{\partial xna}{\partial t} = s_{xna}Y - \delta Xna - nxnaAL - gxnaAL$$

$$\frac{\partial xna}{\partial t} = \frac{s_{xna}Y}{AL} - \frac{\delta Xna}{AL} - \frac{nxnaAL}{AL} - \frac{gxnaAL}{AL}$$

$$\frac{\partial xna}{\partial t} = s_{xna}y - xna(g + n + \delta)$$

however, to solve for the steady-state level of non-agricultural trade openness promotion, it is required to use the definition of output per effective unit of labor $y = k^{\alpha}h^{\beta}xa^{\theta}xna^{\pi}$ and substitute it into the previous equation resulting in

(39) $$\frac{\partial xna}{\partial t} = s_{xna}k^{\alpha}h^{\beta}xa^{\theta}xna^{\pi} - xna(g + n + \delta)$$

where the net change in non-agricultural trade openness promotion per effective unit of labor wrt time is equal to the proportion of income invested in non-agricultural trade openness promotion per effective unit of labor minus the change in the level of non-agricultural trade openness promotion associated with the rates of change of technology and labor force, and the depreciation rate.

To solve for *xna* from equation 39 this study makes use of condition 30a. Therefore, using condition 30a, it is possible to mathematically identify the following equalities which are then used to solve for the steady-state level of non-agricultural trade openness promotion in equation 39. This is then shown as follows;

i) $$\left(\frac{k}{s_k}\right)^{\alpha} = \left(\frac{xna}{s_{xna}}\right)^{\alpha},$$

ii) $$\left(\frac{h}{s_h}\right)^{\beta} = \left(\frac{xna}{s_{xna}}\right)^{\beta} \text{ and}$$

iii) $$\left(\frac{xa}{s_{xa}}\right)^{\theta} = \left(\frac{xna}{s_{xna}}\right)^{\theta},$$

solving i, ii, and iii for k^{α}, h^{β}, and xa^{θ} respectively gives the following results.

i*) $$k^{\alpha} = \frac{xna^{\alpha} s_k^{\alpha}}{s_{xna}^{\alpha}},$$

ii*) $$h^{\beta} = \frac{xna^{\beta} s_h^{\beta}}{s_{xna}^{\beta}}, \text{ and}$$

iii*) $$xa^{\theta} = \frac{xna^{\theta} s_{xa}^{\theta}}{s_{xa}^{\theta}}.$$

Results from i*, ii*, and iii* are then substituted into equation 39, and then solved at the steady-state for *xna*, where $\frac{\partial xna}{\partial t} = 0$. The results is then,

$$0 = s_{xna} xna^{\pi} \left(\frac{xna^{\alpha} s_k^{\alpha}}{s_{xna}^{\alpha}}\right)\left(\frac{xna^{\beta} s_h^{\beta}}{s_{xna}^{\beta}}\right)\left(\frac{xna^{\theta} s_{xa}^{\theta}}{s_{xna}^{\theta}}\right) - xna(g + n + \delta)$$

$$s_{xna}^{1-\alpha-\beta-\theta} xna^{\alpha+\beta+\theta+\pi} s_k^{\alpha} s_h^{\beta} s_{xa}^{\theta} = xna(g+n+\delta)$$

$$\frac{s_{xna}^{1-\alpha-\beta-\theta} s_k^{\alpha} s_h^{\beta} s_{xa}^{\theta}}{n+g+\delta} = \dot{xna}^{1-\alpha-\beta-\theta-\pi}$$

(40) $$\dot{xna} = \left(\frac{s_{xna}^{1-\alpha-\beta-\theta} s_k^{\alpha} s_h^{\beta} s_{xa}^{\theta}}{n+g+\delta} \right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$$

where $\dot{xna}$ is the steady-state level of non-agricultural trade openness per effective unit of labor. The model predicts that $\dot{xna}$ depends positively on the rates of saving invested in physical and human capital, and on the proportion of income spent on agricultural and nonagricultural trade; and negatively on the rate of population growth. According to equation 40, physical and human capital positively affects nonagriculture by allocating to the production and trade of nonagricultural goods, only those resources that are productive in such activity. For a country with a large nonagricultural base $\dot{xna}$ is expected to be larger than otherwise. Countries that have comparative advantage in the production of nonagricultural goods may reflect larger relative sizes of nonagricultural trade as ratio to the specific sectoral production. At the empirical level countries which have comparative advantage in the production and trade of nonagricultural goods would, other things given, reflect a positive sign related to income per capita. In general, how much a country participates on international trade depends positively on how much the country invests on physical capital, human capital, trade openness in agriculture and trade openness in nonagriculture promotion. The more a country dedicates resources to the enhancement of physical capital accumulation and to increase the level of labor education (training), the more competitive this economy becomes.

Income Per Capita

The procedure to determine the effects that *K*, *H*, *Xa*, and *Xna* have on income per capita, and to find the steady-state level of income per capita, is to substitute equations 31, 34, 37, and 40 into the initial production function, equation 22. To empirically estimate the resulting production function, this study proceeds to transform the original Cobb-Douglas type of production function into a linear function, by taking the natural logarithm. This transformation allows the use of econometric techniques to empirical estimate the coefficient. It is important to mention that empirical estimations of the model can only be performed if the coefficients of the model are expressed in linear form. Therefore, the equation to be estimated is

$$\frac{Y}{L} = A\left(\frac{s_k^{1-\beta-\theta-\pi} s_h^{\beta} s_{xa}^{\theta} s_{xna}^{\pi}}{n+g+\delta}\right)^{\frac{\alpha}{1-\alpha-\beta-\theta-\pi}} \left(\frac{s_h^{1-\alpha-\theta-\pi} s_k^{\alpha} s_{xa}^{\theta} s_{xna}^{\pi}}{n+g+\delta}\right)^{\frac{\beta}{1-\alpha-\beta-\theta-\pi}}$$

$$\left(\frac{s_{xa}^{1-\alpha-\beta-\pi} s_k^{\alpha} s_h^{\beta} s_{xna}^{\pi}}{n+g+\delta}\right)^{\frac{\theta}{1-\alpha-\beta-\theta-\pi}} \left(\frac{s_{xna}^{1-\alpha-\beta-\theta} s_k^{\alpha} s_h^{\beta} s_{xa}^{\theta}}{n+g+\delta}\right)^{\frac{\pi}{1-\alpha-\beta-\theta-\pi}}$$

$$\ln\left(\frac{Yt}{Lt}\right) = \ln A(0) + gt + \frac{\alpha}{1-\alpha-\beta-\theta-\pi}\ln\left(s_k^{1-\beta-\theta-\pi} s_h^{\beta} s_{xa}^{\theta} s_{xna}^{\pi}\right) - \frac{\alpha+\beta+\theta+\pi}{1-\alpha-\beta-\theta-\pi}\ln(n+g+\delta)$$

$$+\frac{\beta}{1-\alpha-\beta-\theta-\pi}\ln\left(s_h^{1-\alpha-\theta-\pi}s_k^{\alpha}s_{xa}^{\theta}s_{xna}^{\pi}\right)+\frac{\theta}{1-\alpha-\beta-\theta-\pi}\ln\left(s_{xa}^{1-\alpha-\beta-\pi}s_k^{\alpha}s_h^{\beta}s_{xna}^{\pi}\right)$$

$$+\frac{\pi}{1-\alpha-\beta-\theta-\pi}\ln\left(s_{xna}^{1-\alpha-\beta-\theta}s_k^{\alpha}s_h^{\beta}s_{xa}^{\theta}\right)$$

The final result is:

$$(41)\qquad \ln\left(\frac{Yt}{Lt}\right)=\ln A(0)+gt-\frac{\alpha+\beta+\theta+\pi}{1-\alpha-\beta-\theta-\pi}\ln(n+g+\delta)+\frac{\alpha}{1-\alpha-\beta-\theta-\pi}\ln s_k$$

$$+\frac{\beta}{1-\alpha-\beta-\theta-\pi}\ln s_h+\frac{\theta}{1-\alpha-\beta-\theta-\pi}\ln s_{xa}+\frac{\pi}{1-\alpha-\beta-\theta-\pi}\ln s_{xna}$$

Equation 41 predicts that the long-run steady-state level of income per capita depends positively on the degree of trade openness promotion in agricultural (s_{xa}) and nonagricultural (s_{xna}). It also predicts, as expected, that population growth (n)[14] affects negatively the long-run steady-state level of income per capita and that physical capital (s_k) accumulation and human capital (s_h) accumulation positively affect the long-run steady-state level of income per capita growth. In addition, the long-run steady-state income per capita coefficients in equation 41 are a function of the factor share parameters α, β, θ, and π.

The main difference with the approaches followed by Edwards; and Knight, Loayza and Villanueva is that trade openness affects both the steady state of physical and human capital accumulation and the steady-state level of income per capita. If the specification of the model is correct, the introduction of openness in agricultural and nonagricultural markets as factors of production, on the grounds mentioned throughout the dissertation, has changed the traditional view that exports and imports affect physical capital, human capital, and output growth only through the exogenous transfer of technology. The new specification of the Solow model predicts difference in magnitude on the empirical estimates as it will be mentioned in the next section. The model predicts that the estimated coefficients of physical and human capital are affected by the introduction of trade openness. Considering trade openness as a component of the technological factor (A) implies that estimated coefficients remained unchanged when comparing the closed and open economy growth models. This assumption implies that there is no difference in the steady-state levels of physical and human capital accumulation between the closed and open economy models. A result that seems unplausible.

Indeed, one would expect that trade openness would affect the productive and steady-state levels of both physical and human capital. Whether the final steady-state levels of physical and human capital accumulation are larger or smaller after trade compared to the before trade situation is an empirical question that depends on the relative magnitudes of the production coefficients. Nevertheless, one expects that trade openness results in a positive effect on overall income per capita through the reallocation of resources, economies of scale, and transfer of technology of the trading process.

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[14] The model assumes that the rate of change of technology transfer g and the rate of depreciation δ remain constant.

Summary

Tables 2 and 3 provide a comparative analysis of the alternative growth models discussed in Chapter III. These tables clearly state the differences among models. Table 2 illustrates the differences in terms of mathematical derivations for the steady-state levels of the correspondent factors of production. Table 3 provides the conceptual analysis that relates to the derivations outlined in table 2, below. The main differences and their correspondent implications are explained as follow.

The summary presented on tables 2 and 3 indicate that by endogenizing technological change as a function of the degree of trade openness, one can explain the effect that trade openness has on output growth, factor accumulation and overall factor productivity in the context of the Solow model. The Barboza-Dicks proposed model specification also allows the determination of both the direct and indirect effects that trade openness promotion has on the long-run rate of growth of income per capita and on the correspondent steady-state level.

Table 2. Comparison of Steady-State Conditions under Alternative Growth Models

	Solow [a]	Mankiw et al [a]	Edwards; and Knight et al [b]	Proposed Barboza-Dicks [c]
Physical Capital	$\left[s/(n+g+\delta)\right]^{\frac{1}{1-\alpha}}$	$\left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right)^{1/(1-\alpha-\beta)}$	$\left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right)^{1/(1-\alpha-\beta)}$	$\left(\frac{s_k^{1-\beta-\theta-\pi} s_h^{\beta} s_{ao}^{\theta} s_{nao}^{\pi}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$
Human Capital		$\left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n+g+\delta}\right)^{1/(1-\alpha-\beta)}$	$\left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n+g+\delta}\right)^{1/(1-\alpha-\beta)}$	$\left(\frac{s_h^{1-\alpha-\theta-\pi} s_k^{\alpha} s_{ao}^{\theta} s_{nao}^{\pi}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$
Agric. Openness				$\left(\frac{s_{ao}^{1-\alpha-\beta-\pi} s_k^{\alpha} s_h^{\beta} s_{nao}^{\pi}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$
Nonagric. Openness				$\left(\frac{s_{nao}^{1-\alpha-\beta-\theta} s_k^{\alpha} s_h^{\beta} s_{ao}^{\theta}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta-\theta-\pi}}$

[a] Closed economy growth models
[b] Open economy growth model with trade openness as a component of technological change factor A
[c] Open economy growth model with endogenous technological change through trade openness

Table 3. Conceptual Comparison of Alternative Growth Models

	Solow	Mankiw et al	Edwards; and Knight et al	Proposed Barboza-Dicks
Functional Form	$y = k^{\alpha}(AL)^{1-\alpha}$	$y = k^{\alpha}h^{\beta}(AL)^{1-\alpha-\beta}$	$y = k^{\alpha}h^{\beta}(AL)^{1-\alpha-\beta}$	$y = k^{\alpha}h^{\beta}x_{a}^{\theta}x_{na}^{\pi}(AL)^{1-\alpha-\beta-\theta-\pi}$
Inputs	Capital and Labor. Labor grows exogenously at rate *n*.	Physical capital, human capital and labor. Labor grows exogenously at rate *n*	Physical capital, human capital and labor. Labor grows exogenously at rate *n*.	Physical capital, human capital, trade openness in agriculture and nonagriculture. Labor grows exogenously at rate *n*.
Technology Factor *A*	Exogenously given with growth rate *g*. Residual component.	Exogenously given with growth rate *g*. Residual component.	Exogenously given with growth rate *g*, and depends positive on trade openness and government infrastructure.	Partially endogenized as linear function of trade openness in agriculture and nonagriculture goods. Remaining portion grows at rate *g*
Steady-states				
Inputs	Positive on savings rate, negative on labor growth (*n*) and negative on exogenous technological change.	Positive on investment in physical and human capital, negative on labor force growth, and negative on exogenous technological change	Positive on investment in physical and human capital, negative on labor force growth, and negative on exogenous technological change.	Positive on investment in physical and human capital, negative on labor force growth, and negative on exogenous technological change. Positive on the degree of trade openness in agriculture and nonagriculture goods. In addition, steady-state levels of physical and human capital accumulation depend upon the degree of trade openness
Per Capita Income	Positive on physical capital, negative on labor, and positive on exogenous technology change	Positive on physical and human capital, negative on labor, and positive on exogenous technology change.	Positive on physical capital, human capital, and trade openness; negative on labor, and positive on exogenous technology change. Open economies grow faster toward given steady-state.	Positive on physical capital, human capital, agriculture and nonagriculture trade openness; negative on labor, and positive on exogenous technology change. Open economies tend to grow faster toward steady-state, and open economies achieve different steady-states as trade openness factors vary Lower savings rate required to achieve same growth level compared to the closed economy scenario.

The indirect impact is reflected in the effect that trade openness has on the steady-state levels of physical and human accumulation (as indicated in table 2), and hence on the parameter coefficients for the physical and human capital accumulation. On the other hand, the direct impact of trade openness on the long-run level of income per capita is indicated by the parameter coefficients of the degree of trade openness for agriculture and non-agriculture trade activities; where open economies tend to grow faster than closed economies other things given[15]. In addition, as technology change is endogenized through the promotion of trade openness, open economies are able to achieve different long-run steady-state level of income per capita as trade openness factor vary. This particular feature of endogenous technological change differentiates the Proposed Barboza-Dicks model from the closed economy Solow model the MRW model and the KLV open economy growth model with exogenous technological change.

To stress the importance of the last paragraph's theoretical implications Tables 2 and 3 outline three relevant differences between the closed and open economy specification of the Neoclassical Growth Models. In this regard, the first difference is that the long-run steady-state level of income per capita is always larger in the open economy model. Thus, allowing open economies to achieve larger steady-state levels of income per capita and greater long-run rates of growth of income per capita toward a given steady-state level. This result is particularly interesting because it suggests that a lower level of capital accumulation (human and physical) is needed in the open economy compared to the closed economy to achieve the same level of long-run per capita output.

[15] Other things given refer to the same level of domestic savings, same rate of depreciation, and same level of technological transfer.

The second implication is that in the open economy model lower levels of domestic saving are associated with larger levels of per capita output growth. This is possible, because the productivity of physical and human capital is enhanced as a result of the process of technology transfer associated with the promotion of international trade openness according to a comparative advantage behavior.

Thirdly, as trade factors vary, endogenized technological change allows economies to achieve different steady-state levels of income per capita and physical and human capital. This particular implication of the expanded model is not possible in the closed economy model with exogenous technological change. Therefore, this study argues that by endogenizing technological change through the degree of trade openness promotion, the model provides evidence to close the gap to allow for endogenous changes in steady-state levels of income per capita which is not possible in the closed economy Solow model.

CHAPTER IV

METHODS AND PROCEDURES

Expected Results

This study estimates equation 41, by using a cross-section time-series model. The model determines the effects of human and physical capital accumulation and agricultural and nonagricultural trade openness on income per capita. Easterly et al. point out that combining time-series with cross-section data is necessary because the growth performance of LDCs shows substantial variation over time. Moreover, it is possible to capture any country-specific effects. Second, it allows us to expand the sample size.

Further, to appropriately estimate the model in equation 41, the model assumes $\ln A(0) = a + \varepsilon$, where a is a constant and ε is a country-specific shock. In addition t is assumed to be equal to zero. In terms of the empirical estimation, this redefines the model of equation 41 as

$$(42) \qquad \ln GNPPC = a_0 + a_1 \ln L + a_2 \ln \frac{I}{Q} + a_3 \ln School + a_4 \ln \frac{Xa}{Q} + a_5 \ln \frac{Xna}{Q} + \varepsilon$$

where a_0 is a constant and a_1, a_2, a_3, a_4, a_5 are the parameters to be estimated. The dependent variable in equation 43 $\ln\left(\frac{Y}{L}\right)$ is approximated by the natural logarithm of the per capita Gross Domestic Product and it is defined as ln*GNPPC*. Per capita income is defined as the Gross Domestic Product in constant 1987 US $ divided by total population. This allows to have a relative comparable unit of measure for income per capita across all countries[16].

To approximate the natural logarithm of the rate of population growth, $\ln(n)$ in equation 43, (assuming that $g+\delta$ are constant) this study uses the natural logarithm of the labor force, ln*L*. Labor force is defined as the "economically active" proportion of total population that is classified from 14 to 65 years of age. The natural logarithm of the savings invested in physical capital, $\ln(s_k)$, is approximated by natural logarithm of the ratio of gross domestic investment to total output, $\ln\left(\frac{I}{Q}\right)$. Investment corresponds to total gross investment[17] and output is defined as the Gross Domestic Product. Gross investment and Gross Domestic Product are defined in domestic currency for each country and then a ratio is calculated to make data across countries comparable. The natural logarithm of the savings invested in human capital, $\ln(s_h)$, is approximated by the secondary enrollment ratio, ln*School*. The secondary enrollment ratio is defined as the

[16] The author recognizes that per capita income as defined in this study presents significant problems to correctly compared to actual purchasing power of individuals across nations. However, per capita income is the only available cross section time series data useful to conduct this study. Some of the major problems while comparing per capita income across countries are that "informal" sectors and other relevant economic activities in developing countries are not recorded in the traditional definition of Gross Domestic Product. In addition, differences in real exchange rates are not considered when transforming data from domestic currency to constant US $.

ratio of gross enrollment of all ages at secondary level as a percentage of children in the country's secondary school age group, including pupils enrolled in vocational or teacher-training secondary schools The natural logarithm of the income proportion spent on agricultural trade openness, $\ln(s_{xa})$, is approximated by the natural logarithm of the ratio of nonfuel primary exports and imports to total output, $\ln\left(\frac{Xa}{Q}\right)$. According to the World Bank Database (Stars) the classification corresponding to nonfuel primary exports plus imports include commodities in SITC revision 1, Section 0, 1, 2, 4, and Division 68 (food and live animals, beverages and tabacco, inedible crude materials, oils, fats, waxes and nonferrous metals). Finally, the natural logarithm of the income proportion spent on nonagricultural trade openness, $\ln(s_{xna})$, is approximated by the natural logarithm of the ratio of all other exports and imports[18] to total output, $\ln\left(\frac{Xna}{Q}\right)$. All other exports plus imports include fuel and manufactured goods. The fuel category includes SITC revision 1 Section 3 which incorporates mineral fuels and lubricants and related materials. While manufactured goods cover SITC revision 1, Sections 5 through 9 (chemicals and related products, basic manufactures, machinery and transportation equipment, other manufactured articles and goods not elsewhere classified, excluding Division 68).

The a_1 coefficient in equation 42 corresponds to $\frac{\alpha + \beta + \theta + \pi}{1 - \alpha - \beta - \theta - \pi}$ in equation 41, and it represents the effect of population growth on per capita output. As the Solow

[17] Gross Domestic Investment is defined as the sum of gross domestic fixed investment and the change in capital stocks.

[18] All other exports and imports are calculated as total exports plus imports minus exports plus imports of nonfuel primary goods.

model predicts per capita output growth depends negatively on the rate of growth of population. The magnitude of a_1 is expected to be larger in absolute terms than the one estimated by Mankiw, Romer and Weil, because it incorporates the effects that trade openness on agriculture and nonagriculture has on population growth. In practical terms, the numerator is larger and the denominator is smaller than the one presented by Mankiw, Romer and Weil in equation 19.

The second coefficient a_2 corresponds to $\frac{\alpha}{1-\alpha-\beta-\theta-\pi}$ in equation 41 and it represents the effect that physical capital has on overall output growth. This coefficient is expected to be positive in sign. This dissertation supports the idea that by including trade openness as a factor of production, the estimated impact of physical capital on output growth should be larger than the one reported in previous studies. At the practical level the numerator α remains invariant compared to previous estimations of the Solow model, however, the denominator incorporates the factor coefficients for trade openness in agriculture (θ) and nonagriculture (π), resulting in a smaller value for the denominator and therefore a larger overall coefficient. The hypothesis to be tested is whether empirically this coefficient is larger once trade is included. Feder argues that factor productivity on the export sector is higher than productivity in the nonexport sector. If this is true then trade has a positive effect on physical capital productivity and therefore it should be reflected in the coefficient a_2 as the model of equation 41 suggests.

Empirical studies that determine the impact of export on per capita output growth report that there is a positive and statistically significant relationship between export growth and per capita output growth (Michaely; Balassa; Tyler; Kavoussi; Feder; Mbaku;

Moran; Moschos; Ram; and Barboza). In addition, these studies support the hypothesis that export growth enhances factor productivity, which is reflected in large values for estimated coefficients on physical and human capital as suggested in equation 41. This study provides an alternative theoretical approach to the exogenous neoclassical theory of economic growth with a feasible explanation why these empirical estimates may have larger values once export growth (or any trade measure as Renelt and Levine argue) is included as an explanatory variable of per capita output growth. One important result of this model is that even though the estimated parameters for the physical and human capital may be larger than the ones reported by Mankiw, Romer and Weil, there is still a possibility that the absolute value of the steady-state level of physical and human capital accumulation may be smaller if certain conditions on S_{xa}, S_{xma}, θ and π are met.

Edwards; and Knight, Loayza and Villanueva considers trade openness as a component of the technological factor (A) that only has affect on long-run output growth. This means that in the models of equations 19 and 20, empirical estimates of the coefficients for physical and human capital are not affected by the inclusion of trade openness, i.e. the factor-input elasticities remain invariant when comparing the closed and open economy models. On the other hand, the model developed in this study shows that trade openness has a positive affect on the magnitude of the parameters for physical and human capital, and a negative effect on the labor force growth parameter estimate. These theoretical implications are for the most part in accordance with the empirical evidence found in Michaely; Balassa; Tyler; Kavoussi; Feder; Mbaku; Moran; Moschos; Ram; and Barboza.

The third coefficient a_3 corresponds to $\frac{\beta}{1-\alpha-\beta-\theta-\pi}$ in equation 41 and it represents the effect that human capital has on overall output growth. Likewise, the coefficient for human capital is expected to be positive in sign. This study supports the idea that by including trade openness as a factor of production, the estimated impact of human capital on output growth is larger than the one reported in previous studies. The variation in the magnitude of the coefficient comes because of the reduction in the value of the denominator, where the value of the factor share of a labor augmented unit of technology, $(1-\alpha-\beta-\theta-\pi)$, is now smaller than in previous studies, $(1-\alpha-\beta)$, resulting in a larger a_3 coefficient. The hypothesis to be tested is whether empirically this coefficient is indeed larger once trade is included.

The coefficient a_4 is equal to $\frac{\theta}{1-\alpha-\beta-\theta-\pi}$ in equation 41 and it measures the effect that agricultural trade openness has on per capita output growth. According to Balassa; Kavoussi; Levine and Renelt; and Tyler, this coefficient should be positive. Furthermore, a_4 should be larger, positive and statistically significant for low income developing countries whereas it should be either small or not statistically significant for middle and high income developing countries. The overall expected sign for a_4 is positive.

Finally, the coefficient a_5 is defined as $\frac{\pi}{1-\alpha-\beta-\theta-\pi}$ in equation 41 and it measures the contribution of nonagricultural trade openness on output growth. For middle to high income developing countries a_5 should be statistically significant and positively related to per capita output growth. The magnitude of a_5 is expected to be larger than the one for a_4. Technology transfer and economies of scale tend to be larger on the nonagricultural sector compared to the agricultural sector (Balassa; Tyler; and Kavoussi).

One interesting outcome of the model developed in equation 41 is that once trade openness is considered a factor of production and not a component of the technological factor (A), the steady-state levels of physical and human capital may be lower than in the closed economy model of equation 19. Further, the long-run steady-state level of income per capita growth is larger when trade openness is included than otherwise. The theoretical development of the Augmented Solow Model with Trade Openness in equation 41 suggests that a lower level of capital accumulation is needed to achieve the same level of long-run per capita output growth once trade openness is considered as a factor of production. Hence, an economy that is involved in international trade achieves a larger steady-state level of income per capita growth than an economy that does not trade, other things being equal. Countries that trade develop economies of scale, reduce unemployment, grow faster, and achieve higher levels of income per capita than countries under the same conditions that do not trade.

Estimation Method and Misspecification Tests

The model of equation 42 is initially estimated by ordinary least squares (OLS). Traditionally, economic research in the area of economic growth uses the OLS technique. OLS is thought to provide the necessary tools to empirically estimate this linear model. In this particular regard, McGuirk, Driscoll and Alwang suggest tests to determine the presence of misspecification errors for each of the classical OLS assumptions, i.e. normality, functional form, static and dynamic homoskedasticity, no autocorrelation, and parameter stability. Since, this study incorporates cross-country data and it is estimated as a cross-section time-series study by using four years average annual data only the misspecification tests for normality, functional form, and static and dynamic homoskedasticity are performed. Four year averages of real Gross Domestic Product, the investment-output ratio, the labor force, education level, trade openness in agriculture, and trade openness in nonagriculture, are used as base data.

McGuirk, Driscoll and Alwang recommend that tests on the classical OLS assumptions should be performed as much as one can, i.e. one should conduct as many misspecification tests as possible to improve confidence and power of statistical testing of economic hypothesis. In the case of this study, as mentioned before, the tests that will be performed are those for the normality, functional form, static and dynamic homoskedasticity. The no autocorrelation, and parameter stability assumption[19] tests are not conducted. In general, misspecification tests are rarely seen in applied economic theory, especially when estimating the relationship between factors of production and overall economic growth. Whereas some cross-section studies test for the possibility of static heteroskedasticity, most do not conduct misspecification tests on the other relevant assumptions. If the appropriate misspecification tests are omitted then there is a large possibility that the empirical results are biased, inconsistent, and inefficient, which in turn results in a loss of power in the statistical tests. This study provides the results of the misspecification tests on the use of OLS for testing Neoclassical Growth Models in tables 5, 7, 9, 11, 14, 16, and 18. The analysis of the results of the tests are in the next chapter.

According to McGuirk, Driscoll and Alwang to test the normality assumption, three different tests are applied, the kurtosis test, the skewness test, and the omnibus test. For the functional form the Kolmogorov-Gabor polynomial (KG2), and the Regression

Specification Error Test 2 (RESET2), tests are applied. For static and dynamic homoskedasticity the RESET2 and White's heteroskedasticity test are used. Based on the results of Tables 5, 7, 9, 11, 14, 16, and 18, an alternative estimation method is used. At first instance, this study proceeds to use the POOLED estimation technique as described by Kmenta (1986 Section 12.2 pp. 616-625) and implemented by the econometric software SHAZAM. The POOLED technique consists of a Generalized Least Square estimation that accounts for the existence of heteroskedasticity and autocorrelation across countries and time.

The procedure as described in Kmenta (1986) is detailed as follows. The general assumptions about time-series studies is that the error may present an autoregressive process but they need not to be heteroskedastic. On the other hand, a cross-section study assumes that error may be heteroskedastic but not necessarily autoregressive. When both processes are combined it is reasonable to assume that both heteroskedasticity and autocorrelation are present. Therefore, this study combines both assumptions to construct a cross-sectionally heteroskedastic and timewise autoregressive model. The model specification indicates that:

(43) $$E\left(\varepsilon^2{}_{it}\right) = \sigma^2{}_i$$

where σ^2_i indicates the presence of heteroskedasticity for each specific cross section. Furthermore equation 44 indicates that there is cross-sectional independence. Finally equation 45 illustrates that there is an autoregressive process.

[19] McGuirk et al., present a complete description of all available misspecification test for Ordinary Least Squares, besides the ones that are performed in this study.

(44) $$E\left(\varepsilon_{it}\varepsilon_{jt}\right) = 0 \quad (i \neq j)$$

(45) $$\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + \mu_{it}$$

where $\mu_{it} \sim N\left(0, \sigma_{ui}^2\right)$, $\varepsilon_{i1} \sim N\left(\frac{\sigma_{ui}^2}{1-\rho_i^2}\right)$, *and* $E\left(\varepsilon_{i,t-1}\mu_{jt}\right) = 0$ *for all* i, j. To find consistent estimates for the variance covariance matrix, the ordinary least squares method is initially used to obtain consistent estimates of the e_{it}. These error terms are in turn used to estimate the ρ_i elements of the transformed variance covariance matrix. To assure convergence the estimates of the ρ_i elements are confined to have a value within the range of {-1,1} for any given sample size[20]. Thus, the initial observations are transformed by using the correlation estimates. The following specification is copied from Kmenta (1986, p. 619). The transformed variables are denoted by the superscript (*) as follows:

(46) $$Y_{it}^* = \beta_1 X_{it,1}^* + \beta_2 X_{it,2}^* + \ldots + \beta_k X_{it,k}^* + \mu_{it}^*$$

where $Y_{it}^* = \sqrt{1-\hat{\rho}_i^2}\, Y_{it}$ for $t = 1$, and $Y_{it}^* = Y_{it} - \hat{\rho}_i Y_{i,t-1}$ for t = 2, 3, ... , T. In addition, the correspondent transformed explanatory variables are defined in the same manner as the dependent variable. The transformation of the vector of explanatory variables X in equation 46 is expressed as follows.

$X^{*}_{it,k} = \sqrt{1-\hat{\rho}_i^{\,2}}\; X_{it,k}$ for t = 1, and $X^{*}_{it,k} = X_{it,k} - \hat{\rho}_i\, X_{i,t-1,k}$ for t = 2, 3, … , T. Where k = 1, 2, … , K, and i = 1, 2, … , N.

As described in Kmenta, "The purpose of this transformation is to estimate σ^2_i from observations that are, at least asymptotically, nonautoregressive since estimated variances based on autoregressive disturbance are, in general, biased." (p. 620). Therefore, this procedure allows to obtain consistent estimators of ρ_i and σ^2_u, and therefore consistent estimators of the variance covariance matrix. This finally allows to achieve maximum likelihood estimates. For the purpose of the empirical estimations of this study, it is assumed that the parameter ρ presents the same value for all cross-sectional units[21]. In other words, $\rho_i = \rho_j = \rho$ for all i , j = 1, 2, … , N.[22]

Data

Averages consisting of four years are used instead of annual data to avoid the problem of year specific characteristics and also as a tool to increase the size of the number of observations compared to a pure cross-section study. Four year averages are used because it is assumed that within four years most policy effects or economic shocks will be absorbed by the economy. Further, by using four year averages it is possible to reduce large variation on annual data that are commonly presented in developing countries. For instance, it is not rare that income per capita suffers large variations from

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[20] Kmenta indicates that when the sample size is to small there is a possibility for $\hat{\rho}_i$ to have an estimated absolute value larger than 1.

[21] Initial computations to calculate a convergence value for ρ for each cross-sectional unit indicated that there were too few observations to successfully complete the convergence procedure. The alternative estimation required assuming the same value of ρ for all cross-sectional units.

[22] For a complete derivation of the estimation procedure for the POOLED technique see Kmenta (1986).

year to year in countries with an unstable political system. Also trade openness can fluctuate largely due to the imposition of tariff and nontariff barriers to solve temporarily balance of payments disequilibriums. This study assumes that by using four year averages most of this variation will be eliminated. If a cross-section time-series study is conducted without using annual averages then dummy variables should be included if one wants to account for year specific events in each country. Yet, explaining year-specific events requires detailed information that is rarely available in most developing countries.

To determine the contribution that each factor of production has on overall per capita output growth and how they affect productivity of others factors, five different regressions are performed. Estimation 1 includes the average annual investment-output ratio, and the annual average labor force as explanatory variables of income per capita. Estimation 2 includes the average annual investment-output ratio, the secondary enrollment rate, and the average annual labor force as explanatory variables of the average annual per capita GDP. To account for the presence of international trade, estimation 3 includes the average annual degree of trade openness as explanatory variable of per capita GDP, in addition to those included in estimation 2. Estimation 4 decomposes the degree of trade openness used in estimation 3, between agricultural and nonagricultural trade allowing to determine the impact of trade openness on output growth and overall productivity of the rest of factors of production. Finally estimation 5 uses an alternative measure for the degree of trade openness for agricultural and nonagricultural trade, by calculating the ratio of trade openness in agricultural to the value of GDP added by agriculture and the ratio of nonagricultural trade openness to the value of GDP added by nonagriculture.

Data are from the World Bank Economic Database for the World Tables 1994. The country sample includes; low, middle and high income developing countries from Latin America, Africa and Asia. The period under study covers data for 62 developing countries from 1973 to 1992[23]. Difference in income per capita allows for a determination of the effect that trade openness in agriculture and nonagricultural goods has at different stages of economic development. As mentioned before, to increase the size of the sample, a POOLED data model is estimated by dividing the period of study into subperiods of four years. The data is initially collected in basic units, then it is transformed by taking the natural logarithm and therefore avoiding scaling problems. Once the natural logarithms were applied the four year averages were calculated. More recent data was not available at the time this research was conducted. To test for specific region impacts the sample of countries was also aggregated in regions for Latin America, Africa, and Asia. Seven different estimations of each of the alternative growth models are performed[24].

Initially, an overall estimation of the complete sample of countries was conducted, then individual estimations for the regions (Africa, Asia, and Latin America) and by income group (Low, Middle, and High) were performed. The classification of countries by income group was made according to the initial level of income per capita in 1973. The World Bank World Tables 1994 provides income per capita in constant 1987 US dollars. The classification of developing countries by income group is made as follow. Countries

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[23] Appendix 1 provides a complete list of the countries.

[24] Alternative growth models are the Solow, Solow Augmented with Human Capital, and Solow Augmented with Human Capital and Trade Openness. For the trade openness model three alternative estimations are performed. the first one with Openness as total exports plus imports to GDP. The second, with agricultural exports plus imports to GDP and nonagricultural exports plus imports to GDP. The final estimation uses agricultural exports plus imports to value added to GDP, and nonagricultural exports plus imports to nonagricultural GDP value added.

with initial income per capita level below 600 dollars were categorized as low income countries. Countries with income per capita between 601 and 1500 dollars are categorized as middle income countries, and finally countries with income per capita higher than 1500 dollars are categorized as high income countries. On the other hand, the region classification considers Latin America countries to include those countries from Latin America and the Caribbean. Asian countries are countries from Middle East, Central Asia, South Asia, East Asia and the Pacific. African countries are countries from North Africa and South-Saharan Africa. The results of the OLS estimations and correspondent misspecification tests are provided in the next chapter. The final results of the POOLED model are also in the next chapter. Comparisons among alternative estimation techniques are provided to determine the most appropriate method

CHAPTER V

EMPIRICAL RESULTS

This chapter provides the results for the OLS and POOLED estimations of the alternative growth models presented throughout chapter II to IV. OLS results and correspondent misspecification tests are found in Tables 4 through 19. In addition, tables 20 through 28 present the alternative POOLED estimations to correct for misspecification errors found in the OLS estimates. Estimations for seven different groups and five alternative growth models are performed, as mentioned in the previous chapter.

OLS Estimations and Misspecification Tests

The confidence and robustness on the OLS estimates relies on the results of the misspecification tests performed on the OLS classical assumptions. Thus, misspecification tests indicate the precision, and robustness of OLS estimates. Violations of any of the basic assumptions of the OLS technique result in reductions of statistical power of the test statistics, and/or in biased results. The five basic assumptions of the OLS estimation are: errors are normally distributed $N \sim (\mu, \sigma^2)$; zero mean of error term $E(e_t) = \mu$;

homoskedasticity of error terms, i.e., $var(e_i) = \sigma^2$; no autocorrelation $E(e_i, e_j) = 0; i \neq j$; and non-stochastic independent variables.

Before, proceeding with the analysis of the empirical results it may be beneficial to discuss some economic relationships that derive from international trade theory and that are of use in terms of understanding the results discussed in this chapter. International trade theory assumes that a country's overall production and consumption possibilities enhance if a country takes part of the process of international trade following comparative advantage. In turn, this study stresses that the effect of trade patterns based on comparative advantage in the process of development in developing countries is reflected in the sign and statistical significance of empirical estimated coefficients of the different trade openness measures. Thus, a positive sign in any of the trade openness measures implies that resources are being allocated into those economic activities that generate positive changes in income per capita, i.e., income per capita increases the more open the economy is. On the other hand, a negative sign in any of the trade openness measures implies that resources are not being allocated to the most productive activities and therefore income per capita is negatively affected by the promotion or development of such trade activities.

Table 4. OLS Estimated Results of Alternative Neoclassical Growth Models (Full Sample) [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	310	310	310	310	310
Degrees of Freedom	307	306	305	304	304
R^2	0.32	0.65	0.65	0.65	0.72
Constant	12.165	8.662	8.745	8.928	7.311
	(25.17)[i]	(21.37)[i]	(17.73)[i]	(18.90)[i]	(16.19)[i]
Labor Force	-0.256	-0.237	-0.242	-0.258	-0.151
	(-9.121)[i]	(-11.68)[i]	(-8..99)[i]	(-9.21)[i]	(-5.98)[i]
I/Q [b]	1.069	0.553	0.568	0.562	0.409
	(8.13)[i]	(5.56)[i]	(5.02)[i]	(4.93)[i]	(4.03)[i]
School [c]		0.724	0.724	0.699	0.589
		(16.88)[i]	(16.86)[i]	(15.24)[i]	(14.22)[i]
X+M/GDP [d]			-0.022		
			(-0.29)		
AgX+AgM/GDP [e]				-0.118	
				(-1.61)[j]	
NonagX+NonagM/GDP [f]				0.053	
				(0.70)	
AgX+AgM/AgGDP [g]					0.366
					(8.33)[i]
NonagX+NonagM/NonagGDP [h]					-0.362
					(-5.52)[i]
F-test [k]	74.26	187.97	140.59	113.54	155.81
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Value in parenthesis are p-values

According to comparative advantage, a country's income per capita increases by producing those commodities in which it has lower relative production costs compared to other countries, and trade these commodities in the international markets for the commodities in which the country has relatively higher production costs. Therefore, a positive sign in the coefficient of trade openness, in particular in the coefficients of agricultural and/or nonagricultural trade openness; implies that the promotion of trade activities generates incremental increases in income per capita. Per capita income increases as a result of scarce resources being allocated to the production and export of those commodities in which each country has comparative advantage, and/or the country is importing those commodities in which it does not have comparative advantage, compared to the no trade scenario. To determine the importance of trade openness in the process of economic development, this study develops two alternative trade openness measures that are useful to determine how international trade by category of goods relates to overall productivity, and to sector value added productivity.

Let us first analyze the case of trade openness as a proportion of overall Gross Domestic Product. As mentioned above, positive signs in the trade openness coefficients refer to economic activities that follow comparative advantage, and determine that overall productivity of the trading sector is on average higher than productivity in the rest of the economy. For instance, a positive sign in the degree of trade openness in agriculture to Gross Domestic Product implies that the productivity derived from agriculture trade on average is higher than the productivity that might be derived from all other domestic activities. On the other hand, a positive sign in the degree of trade openness in nonagricultural goods implies that the productivity derived from this trading sector is on average higher than the productivity of the other domestic activities. A negative sign in any of these two trade measures implies the opposite, i.e., average domestic productivity is higher than productivity in the correspondent trading sector. Therefore, if a country trading patterns are based on comparative advantage one would expected positive signs on the trade openness coefficients.

The second scenario corresponds to the measures of trade openness that relate trade openness in agricultural to domestic agricultural value added, and trade openness in nonagricultural to domestic nonagricultural value added. In the first instance, these two trade openness measures should reflect the same results as those described in the previous paragraph. However, it is possible that the second set of trade openness measures reverse in sign compared to those described above. The reversal in sign is important in terms of income per capita determination because it shows how trade activities may have higher productivity than average domestic production, yet they do not have higher productivity than the average productivity in their correspondent productive sector. On the other hand, negative coefficients in the degree of trade openness indicate that a country is not trading following a comparative advantage pattern. In other words, the presence of negative coefficients indicates that a country is following an inappropriate trade pattern, i.e., the country is either exporting goods in which it does not have comparative advantage; or it is importing goods in which it does have comparative advantage[25]. Hence, a country

[25] In the perfectly competitive neoclassical framework, comparative advantages are the result of initial resources endowments which in turn cause economy to be more productive than others in the production of specific goods. However, in the real world, comparative advantage can be the result of a number of factors among which protection and trade intervention could play a major role. However, this study does not provide a full analysis of the sources of comparative advantage, whether natural comparative advantage or policy created comparative advantage through the use of commercial policy.

optimizes resource allocation when all four trade openness measures relate positively to income per capita and are statistically significant.

Overall Sample

Table 4 presents the results of the empirical estimations for the complete sample of 62 developing countries. From left to right, Table 4 presents all the correspondent estimations as described in the previous chapters. The first estimation is the simple Neoclassical Solow model. The second estimation corresponds to the Augmented Solow model with Human Capital. Estimations three to five correspond to the Augmented Neoclassical Growth Model with Trade Openness. Three alternative trade openness measures are evaluated. Under the heading Trade Openness, estimation number one estimates the Augmented Solow Model with Human Capital and Overall Trade Openness. Estimation number two is the Augmented Solow with Human Capital and Agricultural and Nonagricultural Trade Openness as proportions of Gross Domestic Product. The final estimation, number three, is the Augmented Solow model with Human Capital and Agricultural and Nonagricultural Trade Openness as proportions to Gross Domestic Product value added in agriculture and nonagriculture, respectively.

The first estimation in Table 4 indicates, as expected, that physical capital accumulation is positive and statistically significant related to income per capita In addition, labor force has a negative and statistically significant effect on income per capita. The inclusion of human capital accumulation in the second estimation of Table 4 shows a significant improvement in terms of income per capita variation as explained by a higher R^2. R^2 increases from 0.32 in the first estimation to 0.68 in the second estimation The school (human capital accumulation) variable is positive and statistically significantly related to income per capita, confirming the theoretical elaboration of the previous chapters. In estimation two the remaining explanatory variables maintained their previous signs and statistical significance. The inclusion of human capital accumulation results in a reduction of the overall value for the physical capital accumulation coefficient, whereas the labor force coefficient remains basically invariant. These results confirm the results of Mankiw, Romer and Weil that human capital inclusion corrects the high initial value of physical capital in the simple Solow model and it also increases the overall performance of the Solow model in explaining income per capita variability. All explanatory variables in estimations one and two of Table 4 are statistically significant at the 1% level of confidence.

The third estimation includes the overall degree of trade openness measured as the ratio of total exports plus total imports to Gross Domestic Product. Results from estimation three indicate that trade openness relates negatively to income per capita, but is not significantly different from zero as indicated by the low value of the t-statistic. The other explanatory variables maintain their magnitudes and statistical significance as before. The result of trade openness not being related to income per capita seems at first glance contrary to previous findings that support export promotion as a source of economic growth. Kavoussi finds for a sample of seventy-three developing countries that export promotion is an important determinant of output growth. In the same regard, Feder states that export promotion increases output growth on a sample of semi-industrialized less developed countries because export oriented policies bring the economy closer to an optimal allocation of resources. Balassa indicates that there is a positive relationship between export growth and output growth for eleven developing countries which have established an industrial base. Ram also found a positive relationship between export growth and output growth Khan and Reinhart show for a sample of twenty-four developing countries that there is evidence to support the hypothesis of export promotion increasing output growth. They also show that the same positive relationship can be obtained when substituting export growth with import growth. However, the latter has a lower impact on output growth than the former. Finally, Moschos shows exports having a positive effect on output growth on a sample of seventy-one developing countries.

Estimation four incorporates a decomposition of the degree of trade openness by category of goods. This decomposition indicates that there is a negative and statistically significant relationship between agricultural trade openness and income per capita at the 5% level of confidence. On the other hand, nonagricultural trade openness, even though it is positively relative to income per capita, is not statistically significant, i.e., not statistically different from zero. The combination of these two results indicates that the more developing countries move their production and trade structure from agricultural to nonagricultural goods the higher the level of income per capita. Nevertheless, it seems that developing countries have not yet achieved the minimum required economic size to develop economies of scale, and to appropriate technology transfer in the nonagricultural sector. In this regard, Tyler argues that the greatest technology transfer in developing countries is derived from manufactured exports. Khan and Reinhart argues that a large technology transfer is derived when imports are used instead of exports as a proxy of openness.

The final estimation on Table 4, attempts to explain the importance of trade openness on agricultural and nonagricultural goods as proportions of their respective value added in Gross Domestic Product. The results of this final estimation reveal that there is a reversal in the sign of the coefficients for agricultural trade and nonagricultural trade openness measures once trade openness is weighted to its correspondent Gross Domestic Product sectoral value added. This reversal in coefficient signs indicates that for the period under study the promotion of agricultural trade has resulted in higher productivity levels in the agricultural sector, whereas promotion of nonagricultural goods has resulted in a reallocation of resources within the nonagricultural sector that do not follow a comparative advantage approach. The relevance of these results is further analyzed by decomposing the sample of countries between low income, middle income, and high income; and by geographical regions, Latin America, Africa, and Asia as presented in the following sections.

Misspecification tests on the estimations of the full sample model indicate the presence of some statistical problems. These problems, in turn, reduce the statistical power of the model. The misspecification tests in Table 5 were only performed for the Augmented Neoclassical Growth Model with Human Capital Accumulation and Trade Openness in Agricultural and Nonagricultural Goods. Results in Table 5 indicate that there is presence of static and dynamic heteroskedasticity; and autocorrelation. Therefore, the use of OLS is not an appropriate technique to conduct the estimation of the Augmented model. The misspecification tests conclude that there is a loss in power in the statistical tests, thus generating a bias in the coefficients. To correct for these misspecification errors, this study proceeds to estimate the growth models by using a POOLED technique that accounts for the presence of static and dynamic heteroskedasticity; and autocorrelation (independence). The results of the POOLED model are discussed elsewhere in this chapter.

Table 5. Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness on Agricultural and Nonagricultural Goods (Full Sample) [a]

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	-1.175	0.242	Fail to Reject Ho
	Kurtosis	0.605	0.515	Fail to Reject Ho
	Omnibus	-1.747	9.210 [a]	Fail to Reject Ho
Functional Form	KG2	6.388	0.000	Reject Ho
	RESET2	9.836	0.002	Reject Ho
Independence	Lag1	20.750	0.000	Reject Ho
Static Homoskedasticity	RESET2	-0.451	0.653	Fail to Reject Ho
	White	6.388	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	18.140	0.000	Reject Ho

[a] Critical value at 1% level of confidence

Low Income Countries

Estimations by income group allows for the determination of the effects on income per capita associated with the size of the economy and the stage of economic development. This study divides the country sample between three income groups, low, middle, and high. Results for the OLS estimation and corespondent misspecification tests of the growth models by income groups are in Tables 6 through 12. The first estimation in Table 6 indicates, as expected, that physical capital accumulation is positive and statistically significant related to income per capita. In addition, the growth of the labor force has a negative and statistically significant effect on income per capita. The inclusion of human capital accumulation in the second estimation of Table 6 shows an improvement in terms of income per capita variation as explained by a higher R^2. R^2 increases from 0.17 in the first estimation to 0.29 in the second estimation. The school variable is positive and statistically significantly related to income per capita. The inclusion of human capital accumulation results in a reduction of the overall value of physical capital accumulation. Labor force is still negatively related to income per capita and has a larger negative value compared to the value determined in estimation one. As in the case for the overall sample, the results of this estimation confirm previous findings by Mankiw, Romer and Weil.

Results from estimation three (number one under the Trade Openness heading) indicate that trade openness relates positively to income per capita. The sign for the other variables remains statistically significant and R^2 increases to 0.31. Trade openness in low income countries results in higher income per capita than otherwise. However, the relative size of the remaining coefficients decreases. Thus indicating, that the productivity in the trading sector is higher than that dedicated to the domestic production. This result confirms the initial hypothesis that trade openness reallocates resources among economic sectors increasing overall income per capita. Furthermore, the inclusion of trade openness reflects a relevant process of technology transfer in developing countries as indicated by the reduction in the constant coefficient from 7.44 in the closed economy model to 6.90 in the open economy estimation.

Table 6. Low Income Countries OLS Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	120	120	120	120	120
Degrees of Freedom	117	116	115	114	114
R^2	0.17	0.29	0.31	0.31	0.37
Constant	7.577	7.442	6.906	7.065	6.337
	(17.44)[i]	(18.52)[i]	(13.73)[i]	(12.98)[i]	(11.94)[i]
Labor Force	-0.077	-0.119	-0.086	-0.089	-0.052
	(-3.49)[i]	(-5.32)[i]	(-2.97)[i]	(-2.54)[i]	(-1.69)[k]
I/Q [b]	0.444	0.343	0.222	0.248	0.219
	(4.15)[i]	(3.39)[i]	(1.82)[k]	(2.00)[j]	(1.85)[k]
School [c]		0.228	0.224	0.225	0.188
		(4.63)[i]	(4.63)[i]	(4.53)[i]	(3.97)[i]
X+M/GDP [d]			0.152		
			(1.74)[k]		
AgX+AgM/GDP [e]				0.055	
				(0.59)	
NonagX+NonagM/GDP [f]				0.067	
				(0.75)	
AgX+AgM/AgGDP [g]					0.229
					(3.68)[i]
NonagX+NonagM/NonagGDP [h]					-0.184
					(-2.05)[j]
F-test [l]	11.80	16.40	13.28	10.17	13.72
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Values in parenthesis are p-values

The decomposition of total trade between agricultural and nonagricultural goods indicates that neither one of them is statistically significant related to income per capita. As mentioned in the previous paragraph, the combination of both trading activities results in positive and statistically significant effects on income per capita, yet each sector individually does not enhance income per capita. Overall economies of scale are achieved once the effects of both agricultural and nonagricultural trade are accounted for. Separately each sector is not fully developed to have by itself a significant effect on income per capita. As stated in the previous chapters, trade enhances income per capita and reallocate resources, but low income countries are yet far from being able to develop the necessary economies of scale and technology transfer, according to the OLS estimation reported in Table 6.

Kavoussi indicates that the positive effects of trade (export promotion) are higher in middle income countries than in low income countries. Kavoussi also finds this same result in terms of the promotion of manufactured exports between middle and low income countries. However, Ram provides different results than Kavoussi. Ram argues that there is not a large significant difference in the estimated coefficient of export promotion between low and middle income countries In Ram's study the largest difference on export promotion coefficients comes about in the different time periods under analysis, not because of income per capita difference among countries. Ram argues that the difference in the initial level of income per capita does not have a significance effect on the sources of economic growth derived from international trade and in particular from export promotion. However, he argues that it is the difference in time periods the one that indicate that export promotion in the 1960-70 decade had a larger impact on output growth compared to 1970-77. Contrary to Ram's results, Moschos provides statistical information indicating that low income countries derived larger positive effects from export promotion than middle income countries do. This dissertation gives support to Moschos' findings.

The final estimation on Table 6, provides information on whether the trading patterns are following sectoral comparative advantage. In the case of agricultural production and trade, results of estimation five (number three under the Trade Openness heading) confirm that low income developing countries are on average producing and exporting those commodities in which they have sectoral comparative advantage and/or that they are importing those agricultural goods in which they do not have comparative advantage. However, for the nonagricultural sector this positive relationship does not hold true. In the nonagricultural trade openness variable there is a reversal in coefficient sign. This negative relationship between nonagricultural trade openness relative to income per capita indicates that developing countries are utilizing resources to produce and export goods in which they do not have lower relative production costs and/or they are importing commodities which they might be able to produce at a lower relative cost than their competitors.

Table 7 presents the results of the misspecification tests on OLS estimates for low income countries. OLS estimates in Table 6 present functional form, static and dynamic heteroskedasticity, and autocorrelation problems. Thus, estimates in Table 6 lack statistical power and need to be reestimated. The results of the POOLED technique for low income countries are in Table 21.

Table 7. Low Income Countries Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness on Agricultural and Nonagricultural Goods [a]

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	-1.500	0134	Fail to Reject Ho
	Kurtosis	-2.014	0.040	Fail to Reject Ho
	Omnibus	6.310	9.210 [a]	Fail to Reject Ho
Functional Form	KG2	3.453	0.000	Reject Ho
	RESET2	0.049	0.824	Fail to Reject Ho
Independence	Lag1	9.347	0.000	Reject Ho
Static Homoskedasticity	RESET2	-0.925	0.358	Fail to Reject Ho
	White	3.453	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	8.246	0.000	Reject Ho

[a] Critical value at 1% level of confidence

Middle Income Countries

Table 8 presents the result of the OLS estimations for the middle income countries sample. The first estimation in Table 8 indicates, that physical capital accumulation is positive and statistically significant related to income per capita. In addition, the growth of the labor force has a negative and statistically significant effect on income per capita. The relative impact of labor force on income per capita is the same for low and middle income countries. Physical capital accumulation has a larger positive effect on income per capita for middle income countries than for low income countries. The overall magnitude of physical capital is 0.625 in Table 8 compared to 0.444 in Table 6, indicating that the process of physical capital accumulation in middle income countries generates economies of scale not generated in low income countries. In addition R^2 for the first estimation in Table 8 is 0.29 compared to 0.17 in Table 6. The inclusion of the human capital accumulation variable reduces the amount of unexplained variability in income per capita. Schooling (human capital accumulation) affects income per capita both positively and significantly, and the inclusion of the human capital accumulation variable results in a reduction of the overall value for the physical capital accumulation, confirming previous results by Mankiw, Romer and Weil, and Knight, Loayza and Villanueva. Labor force is negatively related to income per capita and it has a larger negative sign compared to estimation one, given statistical support to the underlined hypothesis that physical and human capital need to be spread out more thinly as the labor force grows.

Estimations for low and middle income countries indicate results that are somehow different. Kavoussi finds statistical support to the hypothesis that there is a significant difference between the effect of labor force on output growth of low and middle income countries, and physical capital does not differ widely between income groups. Ram does not find any significant relationship of labor force and physical capital and income per capita growth for the sample of low and middle income countries for the two subperiods of 1960-70 and 1970-77.

Table 8. Middle Income Countries OLS Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	125	125	125	125	125
Degrees of Freedom	122	121	120	119	119
R^2	0.29	0.41	0.41	0.44	0.42
Constant	8.880	8.351	8.556	8.765	8.743
	(17.53) [i]	(17.46) [i]	(16.64) [i]	(17.76) [i]	(16.32) [i]
Labor Force	-0.073	-0.108	-0.123	-0.143	-0.133
	(-2.29) [j]	(-3.58) [i]	(-3.70) [i]	(-4.29) [i]	(-3.86) [i]
I/Q [b]	0.625	0.556	0.583	0.511	0.587
	(6.77) [i]	(6.47) [i]	(6.52) [i]	(5.66) [i]	(6.57) [i]
School [c]		0.278	0.278	0.232	0.288
		(4.85) [i]	(4.84) [i]	(3.98) [i]	(5.00) [i]
X+M/GDP [d]			-0.082		
			(-1.08)		
AgX+AgM/GDP [e]				-0.221	
				(-2.98) [i]	
NonagX+NonagM/GDP [f]				0.135	
				(1.65) [k]	
AgX+AgM/AgGDP [g]					-0.084
					(-1.61) [k]
NonagX+NonagM/NonagGDP [h]					0.012
					(0.17)
F-test [l]	25.10	27.86	21.06	19.31	17.22
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Values in parenthesis are p-values

Results from the third estimation (number one under the Trade Openness heading) indicate that trade openness relates negatively to income per capita. However, this relationship is not statistically different from zero as indicated by the low t-value. Moschos argues that low income countries benefit the most from export promotion policies, contrary to the commonly held view that middle and high income countries benefit the most. Kavoussi states that export promotion in middle income countries has a positive impact on output growth and this impact is about twice as larger as for low income countries. The results reported by Kavoussi are clearly opposite than those reported in this dissertation. Under this estimation, the remaining variables maintaining their relative magnitudes and signs.

Further analysis of the impact of trade openness on per capita output growth indicates that, as shown in estimation four, trade openness in agricultural has a negative and significant relationship with income per capita. In addition, trade openness in nonagricultural goods has a positive and statistically significant relationship with income per capita. The combination of these two opposite effects explains the nonsignificant relationship of trade openness to income per capita found in the previous estimation. As expected, middle income countries show that trade openness in nonagricultural goods has a positive effect on income per capita whereas after a certain level of income per capita agricultural goods do not contribute much to the process of economic growth. Economies of scale and technology transfer are better appropriated in economies that have passed a minimum level of income per capita. In this regard, Kavoussi indicates that manufactured exports have a larger positive impact on output growth for middle income countries compared to low income countries. Moreover, Tyler argues that " since the technological change parameter estimates decreases in the equations with manufactured export growth included, it is suggested that manufacturing export activity is accompanied by greater technological progress" (p. 129).

The final estimation reported in Table 8, illustrates that middle income countries do not trade agricultural goods according to their sectoral comparative advantage. The negative sign of trade openness in agriculture indicates that middle income countries are either exporting commodities in which they do not have sectoral comparative advantage and/or they are importing goods in which they have comparative advantage. For the nonagricultural sector there is a positive relationship between the degree of trade openness and income per capita growth indicating that middle income countries may trade based on a sectoral comparative advantage. However, the estimated coefficient is not statistically significant different from zero.

Misspecification tests for the middle income countries estimation of the Augmented Neoclassical model with Human Capital and Trade Openness in Agricultural and Nonagricultural Goods indicates the presence of statistical problems. These problems are violations of the normality, functional form, autocorrelation, static and dynamic homoskedasticity assumptions of the OLS technique. The reestimated models which correct for these statistical problems are in Table 22.

Table 9. Middle Income Countries Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness in Agricultural and Nonagricultural Goods

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	-3.866	0.000	Reject Ho
	Kurtosis	2.355	0.018	Reject Ho
	Omnibus	20.492	9.210 *	Reject Ho
Functional Form	KG2	2.540	0.000	Reject Ho
	RESET2	0.009	0.921	Fail to Reject Ho
Independence	Lag1	11.29	0.000	Reject Ho
Static Homoskedasticity	RESET2	-2.157	0.030	Reject Ho
	White	2.540	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	12.150	0.000	Reject Ho

* Critical value at 1% level of confidence

High Income Countries

Results for the high income countries are reported in Table 10. Estimation of the Solow model indicates, as before, that the size of the labor force is negatively related, and physical capital is positively related to income per capita. The absolute value of the physical capital coefficient is higher for the high income countries than for the low and middle income countries. This indicates that physical capital is a greater source of economic growth in high income countries than otherwise. High income countries derive larger economies of scale from physical capital than the rest of the countries.

The second estimation indicates that human capital accumulation is an important source of economic growth in high income developing countries. Human capital accumulation increases the explanation for income per capita variability as reflected in the increased R^2 (0.20 to 0.59). Moreover, the value of the coefficient for physical capital accumulation increases as a result of the inclusion of human capital, contrary to the results found in the previous estimations of the same model for low and middle income countries. In the high income countries higher levels of schooling imply that countries appropriate and accumulate physical capital in a more efficient way due to the generation of economies of scale that are not present at lower levels of income per capita. However, Mankiw, Romer and Weil indicate that the inclusion of human capital as an explanatory variable of income per capita reduces the overall impact of physical capital on per capita output. Knight, Loayza and Villanueva also show that including human capital reduces the overall positive impact of physical capital on per capita output both by using panel and cross-section data for a sample of 75 developing countries.

The third estimation (number one under the Trade Openness heading) indicates that trade openness has a positive relationship with income per capita, yet this relationship is not statistically significant. At first glance, one would tend to conclude that trade openness is not important in the process of economic growth of high income developing countries. However, the decomposition of trade openness by category of goods allows us to understand the lack of statistical significance of overall trade openness.

Table 10. High Income Countries OLS Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness		
			1	2	3
Number of Observations	65	65	65	65	65
Degrees of Freedom	62	61	60	59	59
R^2	0.20	0.59	0.60	0.62	0.67
Constant	10.038	3.238	2.589	3.214	3.247
	(16.91)[i]	(3.31)[i]	(2.28)[j]	(2.88)[i]	(3.19)[i]
Labor Force	-0.074	0.031	0.067	0.038	0.017
	(-2.08)[j]	(1.07)	(1.55)	(0.87)	(0.42)
I/Q [b]	0.732	0.817	0.649	0.665	0.558
	(3.24)[i]	(5.03)[i]	(2.95)[i]	(3.06)[i]	(2.75)[i]
School [c]		1.331	1.325	1.218	1.196
		(7.71)[i]	(7.69)[i]	(6.66)[i]	(7.38)[i]
X+M/GDP [d]			0.116		
			(1.12)		
AgX+AgM/GDP [e]				-0.161	
				(-1.38)	
NonagX+NonagM/GDP [f]				0.167	
				(1.71)[k]	
AgX+AgM/AgGDP [g]					0.254
					(3.60)[i]
NonagX+NonagM/NonagGDP [h]					-0.233
					(-1.93)[j]
F-test [l]	7.78	29.93	22.86	19.06	24.20
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Values in parenthesis are p-values

For the most part, previous empirical studies of economic growth such as Balassa; Tyler; Feder; Moschos; Knight, Loayza and Villanueva; desegregate developing countries between low and middle income countries, without considering the likelihood of a third group of developing countries which have a rather larger income per capita compared to the rest of developing countries. Results in this dissertation show that the empirical implications of factor of production on income per capita are sensitive to the initial definition of low, middle, and high income developing countries.

Estimation four shows that trade openness in agricultural has a negative but not statistically significant relationship with income per capita. In addition, trade openness in nonagricultural goods has a positive and statistically significant relationship with income per capita. The combination of these two opposite effects explains the nonsignificant relationship of trade openness to income per capita found in estimation three. This same result is found in the correspondent estimation for middle income countries. Economies of scale and technology transfer derived from nonagricultural trade are better appropriated in economies that have reached a minimum level of income per capita. The coefficient for nonagricultural trade in high income countries is 0.167 compared to 0.135 in middle income countries. Both coefficients are statistically significant at the 10% level. In addition, the negative impact of agricultural trade on income per capita is smaller for high income than for middle income countries, -0.16 to -0.22, respectively. The inclusion of schooling and trade openness largely decrease the value of the technological factor coefficient. Hence a large proportion of technology transfer comes about because of education and international trade.

Results derived from the income group estimations show that in low income countries trade in agricultural and nonagricultural goods results in positive effects on income per capita. However, for middle and high income developing countries, economies of scale are derived mostly through the trade of nonagricultural goods, whereas trade in agricultural goods reduces income per capita. This, in turn, confirms previous results (Kavoussi; Tyler; and Balassa) indicating that productivity in manufacture trade is higher than otherwise. The results of this dissertation give statistical support to the hypothesis of international trade having a positive impact on income per capita. Nevertheless, the positive effects of trade vary across income group and trade activities as mentioned above.

The final estimation on Table 10, illustrates a reversal in the impact of the sectoral trade openness coefficients on income per capita when compared to the previous estimations. The reversal in coefficient signs indicates that trade in agricultural goods does follow a sectoral comparative, whereas for nonagricultural goods the estimated coefficient indicates that high income developing countries are promoting trade not consistent with a sectoral comparative advantage. This, in turn, means that high income countries would be better off by redirecting trade to the promotion of alternative goods with a higher productivity than the ones currently promoted, i.e., high income countries are either exporting goods that do not have comparative advantage or they are importing goods which can be produced at a lower relative domestic cost. All the remaining variables in estimation five, maintain their previous signs and coefficients magnitudes. The physical capital accumulation coefficient drops from 0.665 to 0.558 indicating that promotion of trade activities that do not have sectoral comparative advantage reduce the productivity of physical capital.

Table 11. High Income Countries Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness in Agricultural and Nonagricultural Goods

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	-2.292	0.020	Reject Ho
	Kurtosis	0.935	0.347	Fail to Reject Ho
	Omnibus	6.129	9.210 [a]	Fail to Reject Ho
Functional Form	KG2	12.398	0.000	Reject Ho
	RESET2	17.095	0.000	Reject Ho
Independence	Lag1	7.453	0.000	Reject Ho
Static Homoskedasticity	RESET2	-0.837	0.406	Fail to Reject Ho
	White	12.398	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	4.263	0.000	Reject Ho

[a] Critical value at 1% level of confidence

Results of the misspecification tests for high income countries are reported in Table 11. As expected, there are statistical problems with the OLS estimation that reduce the power of the statistical tests The functional form, autocorrelation, static and dynamic homoskedasticity assumptions are violated. POOLED estimates for high income countries are reported in Table 23.

Table 12. OLS Estimates of Alternative Growth Models by Income Group with GDP per capita as Dependent Variable

	Overall Sample	Low Income	Middle Income	High Income
Physical Capital	Positive and significant	Positive and significant	Positive and significant. Most important factor of production	Positive and significant with ***highest*** value among groups
Human Capital	Positive and significant. Reduces value of physical capital. Increases R^2 Confirms MRW and KLV	Positive and significant. Reduces value of physical capital. Increases R^2 Confirms MRW and KLV	Positive and significant. Reduces impact of physical capital. Confirms MRW and KLV	Positive significant Increases value of physical capital => contradicts MRW and KLV
Labor Force	Negative and significant	Negative and significant	Negative and significant	Negative but not significant
Trade Openness	Negative but not significant. No support for trade openness promotion hypothesis	Positive and significant. ***Highest*** among income groups and decreases all other coefficient values	Negative but not significant. Other variables remain equal	Positive but not significant
Agric. Trade /GDP	Negative and significant	Positive but not significant	Negative and significant	Negative and significant
Nonagic. Trade /GDP	Positive but not significant	Positive but not significant	Positive and significant with higher values than low and overall sample	Positive and significant. ***Highest*** value among groups
Agric. Trade / Agri Value Added	Positive and significant => productivity in trading sector higher than nontrading => comparative advantage	Positive and significant. There are sectoral comparative advantages	Negative and significant. No sectoral comparative advantage	Positive and significant Sectoral comparative advantage
Nonagic. Trade / Nonagr. Value Added	Negative and significant => productivity of nontrading sector higher than trading => no comparative advantage	Negative and significant. No sectoral comparative advantage	Positive but not significant. No negative effects	Negative and significant promotion of low productive trade activities
Misspecification Tests	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation

To conclude this section table 12 presents a summary of the most relevant results of the OLS estimations of the alternative growth models by income group. Perhaps, the most relevant results in Table 12 are that under the OLS estimation technique, low income countries have the highest absolute positive value of trade openness on income per capita growth. In addition, for middle income countries physical capital is the most important factor of production, and for high income countries physical capital and trade openness in nonagricultural goods are the highest values among all groups. Furthermore, there is a definitive tendency for trade openness in agricultural goods to have a negative impact on income per capita for all income groups. While trade in nonagricultural goods has a positive and significant relationship with income per capita. A reversal in terms of sectoral comparative advantage is also found for all income groups, which in turn implies that most countries are promotion trade openness not necessarily following a comparative advantage approach. This has major economic implications in terms of resource use allocation and possibilities for developing countries to increase income per capita in the long run. However, the OLS misspecification tests indicate the presence of static and dynamic heteroskedasticity, and autocorrelation. As indicated above, the model is reestimated by using the POOLED technique.

Latin America

Regional estimations of the alternative growth models are presented in Tables 13 through 19. The decomposition of the sample of 62 developing countries by regions allow for the determination of specific effects that are associated with inherent characteristics of particular regions. The first group of countries in this section are the Latin American countries.

The first two estimations on Table 13 confirm the results previously explained for the overall sample and the income groups. Labor force is negatively and significantly related to income per capita, whereas physical capital positively affects income per capita. In addition, human capital accumulation has a positive effect on income per capita. The importance of the positive effect of human capital on income per capita is reflected in the increase in the R^2 from 0.15 to 0.61 when the variable is added to the estimation.

Contrary to previous studies that find statistical support for the hypothesis of export promotion as a source of economic growth (Michaely; Balassa; Tyler; Kavoussi; Feder; Mbaku; Moran; Moschos; and Ram), OLS estimates for Latin America do not find support to the hypothesis of trade openness increasing income per capita. Renelt and Levine argue that the same results should be obtained by using either exports or total trade as a measure of trade openness. However, the OLS estimates in Table 13 indicate that Renelt and Levine's argument may not hold in all cases. To further investigate the negative relationship between trade openness and income per capita this study decomposes trade by category of goods.

Table 13. Latin America OLS Estimated Results of Alternative Neoclassical Growth Models [a]

		Augmented Growth Models			
	Solow	Human Capital	Trade Openness		
			1	2	3
Number of Observations	100	100	100	100	100
Degrees of Freedom	97	96	95	94	94
R^2	0.14	0.61	0.62	0.67	0.63
Constant	9.868	5.514	6.555	6.623	6.539
	(13.84)[i]	(8.67)[i]	(8.15)[i]	(9.26)[i]	(8.02)[i]
Labor Force	-0.095	-0.053	-0.130	-0.148	-0.110
	(-2.25)[j]	(-1.83)[k]	(-2.77)[i]	(-3.31)[i]	(-2.35)[j]
I/Q [b]	0.747	0.435	0.518	0.513	0.461
	(3.32)[i]	(2.79)[i]	(3.27)[i]	(3.46)[i]	(2.92)[i]
School [c]		0.866	0.854	0.755	0.743
		(10.62)[i]	(10.63)[i]	(9.44)[i]	(7.25)[i]
X+M/GDP [d]			-0.248		
			(-2.06)[j]		
AgX+AgM/GDP [e]				-0.387	
				(-4.24)[i]	
NonagX+NonagM/GDP [f]				-0.001	
				(-0.01)	
AgX+AgM/AgGDP [g]					0.136
					(1.59)
NonagX+NonagM/NonagGDP [h]					-0.242
					(-2.13)[j]
F-test [l]	8.26	49.44	39.40	38.57	31.72
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Values in parenthesis are p-values

Trade decomposition indicates that both, trade openness in agricultural and nonagricultural goods, have a negative impact on income per capita in Latin America. This, in turn, implies that Latin America's agricultural exports have on average a lower productivity compared to the average productivity of the rest of the economy. This is especially true when one considers that agricultural imports in Latin America have remained constant as a proportion of Gross Domestic Product for the period under study (See Figure 12, Appendix). On the other hand , the total amount of nonagricultural imports is larger than the total amount of exports. Thus, the composition of exports and imports in Latin America indicates that trade has been biased toward the importation on nonagricultural goods which impact income per capita negatively. Given the negativity of the estimated coefficients it seems plausible that Latin American countries import nonagricultural goods in which they may have a comparative advantage and therefore Latin America countries should be producing and exporting these goods. It is also possible that the process of import substitution of the 1960s and 1970s created a deterioration in the production structure, generating a bias toward the production of goods in which the region did not originally have a comparative advantage. Nevertheless, Barboza finds that there is a positive and statistically significant relationship between total export growth and output growth for a sample of 19 Latin American countries for the years 1970 through 1992.

Misspecification tests in Table 14 indicate the presence of statistical problems with the functional form, autocorrelation, and static and dynamic homoskedasticity OLS assumptions. Again the reestimation of the alternative growth models for Latin America is provided in Table 25.

Table 14. Latin America Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness in Agricultural and Nonagricultural Goods

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	0.1788	0.857	Fail to Reject Ho
	Kurtosis	-2.642	0.008	Reject Ho
	Omnibus	7.013	9.210 *	Fail to Reject Ho
Functional Form	KG2	9.381	0.000	Reject Ho
	RESET2	14.940	0.000	Reject Ho
Independence	Lag1	9.853	0.000	Reject Ho
Static Homoskedasticity	RESET2	-1.052	0.295	Fail to Reject Ho
	White	9.381	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	5.709	0.000	Reject Ho

* Critical value at 1% level of confidence

African Countries

Results for the alternative growth models for Africa are in Table 15. The first two estimations in Table 15 confirm the results of previous estimations. Physical and human capital are positively related to income per capita, whereas labor force is negatively related. Moreover, the inclusion of human capital increases the overall explanatory power of the regression (R^2 increases from 0.27 to 0.58). Physical capital is the most important factor of production, as before. The third estimation indicates that overall trade openness is negatively related to income per capita, even though it is not statistically significant. Using a sample of 37 African countries Mbaku indicates that exports have a positive impact on output growth. He also states that export growth is a more important determinant of output growth for middle income African countries compared to low income countries

Estimation four investigates the nature of the negative relationship between trade openness and income per capita. This estimation indicates that agricultural trade has a negative impact on income per capita, i.e., trade in agricultural goods derives a lower than average productivity compared to the overall productivity of the economy. However, the productivity of agricultural trade is larger than the correspondent productivity of the agricultural value added to Gross Domestic Product as indicated by the agricultural trade openness coefficient which is positive and statistically significant at the 10% level in estimation five. In other words, trade in agricultural goods follow a sectoral comparative advantage pattern.

To determine how international trade affects output growth in Africa, this study proceeds to analyze the combined information derived from Table 15, and figures 13, 14, and 15 in the appendix. Figures 13, 14, and 15 in the appendix show that there has been a change in the structure of exports in the African countries redirecting exports toward the increase of nonagricultural exports and the consequent reduction of agricultural exports. On the other hand, these countries have increased non agricultural goods leading to an increase in total imports, whereas agricultural imports have remained mostly constant as a proportion of Gross Domestic Product at the 5%-6% level.

Table 15. Africa OLS Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	130	130	130	130	130
Degrees of Freedom	127	126	125	124	124
R^2	0.27	0.58	0.58	0.60	0.60
Constant	10.480	7.870	7.948	8.338	7.080
	(14.50)[i]	(12.94)[i]	(11.24)[i]	(12.46)[i]	(9.09)[i]
Labor Force	-0.219	-0.167	-0.173	-0.214	-0.118
	(-4.51)[i]	(-4.49)[i]	(-3.62)[i]	(-4.31)[i]	(-2.26)[j]
I/Q [b]	0.669	0.458	0.469	0.448	0.415
	(4.36)[i]	(3.88)[i]	(3.60)[i]	(3.36)[i]	(3.18)[i]
School [c]		0.538	0.542	0.517	0.504
		(9.78)[i]	(9.28)[i]	(8.41)[i]	(8.18)[i]
X+M/GDP [d]			-0.032		
			(-0.21)		
AgX+AgM/GDP [e]				-0.201	
				(-1.99)[j]	
NonagX+NonagM/GDP [f]				0.064	
				(0.49)	
AgX+AgM/AgGDP [g]					0.152
					(1.86)[k]
NonagX+NonagM/NonagGDP [h]					-0.164
					(-1.26)
F-test [l]	23.80	59.58	44.36	37.18	37.59
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Values in parenthesis are p-values

Hence, African trade patterns in conjunction with the empirical estimates of Table 15 indicate that the change in composition of international trade in Africa results in higher income per capita levels because less trade in agricultural goods results in higher income per capita, and higher levels of trade in nonagricultural goods result in higher levels of income per capita. Finally, estimation five indicates that trade in agricultural goods follows a sectoral comparative advantage as shown by the positive coefficient for agricultural trade openness. Trade openness in nonagricultural goods indicates African countries do not have a sectoral comparative advantage; yet the estimated coefficient is not statistically significant.

Table 16. Africa Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness in Agricultural and Nonagricultural Goods

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	-0.939	0.347	Fail to Reject Ho
	Kurtosis	-0.810	0.418	Fail to Reject Ho
	Omnibus	1.538	9.210 [a]	Fail to Reject Ho
Functional Form	KG2	3.766	0.000	Reject Ho
	RESET2	12.391	0.000	Reject Ho
Independence	Lag1	12.100	0.000	Reject Ho
Static Homoskedasticity	RESET2	0.107	0.915	Fail to Reject Ho
	White	3.766	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	10.381	0.000	Reject Ho

[a] Critical value at 1% level of confidence

For the African estimations the misspecification tests of Table 16, indicate the presence of autocorrelation, and static and dynamic heteroskedasticity. As mentioned before, to correct for heteroskedasticity the alternative models are reestimated by using a POOLED technique. Final results for Africa are in Table 26.

Asian Countries

The final OLS regional estimation corresponds to Asia. Empirical estimations for Asia in Table 17 confirm previous results for the other income and regional groups. Physical capital remains as the most important factor of production, and labor force is negatively related to income per capita. Human capital positively affects the level of income per capita and increases R^2 from 0.65 to 0.71. For the Asian countries the increase in trade activities resulted in increases in income per capita. The promotion of trade activities increases R^2, and the coefficient for trade openness is positive and statistically significant. The decomposition of trade openness indicates that nonagricultural trade results in positive changes in income per capita, with a coefficient of 0.321 and significant at 5% level. Agricultural trade in Asia has a negative relationship with income per capita, i.e., the larger the proportion of agricultural trade to Gross Domestic Product the lower the level of income per capita. This relationship is not statistically significant as shown by the low value of the t-ratio. An interesting result derived from estimation four in Table 17 is that the nonagricultural trade openness coefficient is the largest of its kind among all the estimations for the same model for different income and regional groups. Thus, one concludes that the promotion of nonagricultural trade in Asia results in larger positive effects on income per capita than in any other case. Asian countries on average have a more appropriate technology adoption and derive larger economies of scale from the nonagricultural trading sector when compared to other countries.

Table 17. Asia OLS Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models: Human Capital	Augmented Growth Models: Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	80	80	80	80	80
Degrees of Freedom	77	76	75	74	74
R^2	0.65	0.71	0.73	0.73	0.79
Constant	15.047	11.89	10.249	10.813	8.594
	(20.40)[i]	(11.65)[i]	(7.998)[i]	(8.53)[i]	(7.44)[i]
Labor Force	-0.372	-0.347	-0.289	-0.291	-0.201
	(-9.30)[i]	(-9.42)[i]	(-5.14)[i]	(-5.03)[i]	(-4.29)[i]
I/Q [b]	1.725	1.256	0.783	0.763	0.649
	(7.71)[i]	(5.38)[i]	(2.41)[j]	(2.36)[j]	(2.30)[j]
School [c]		0.579	0.572	0.523	0.537
		(4.11)[i]	(4.15)[i]	(3.57)[i]	(4.41)[i]
X+M/GDP [d]			0.296		
			(2.05)[j]		
AgX+AgM/GDP [e]				-0.041	
				(-0.24)	
NonagX+NonagM/GDP [f]				0.321	
				(1.95)[j]	
AgX+AgM/AgGDP [g]					0.478
					(5.20)[i]
NonagX+NonagM/NonagGDP [h]					-0.477
					(-2.70)[i]
F-test [k]	72.48	63.89	50.99	40.95	57.21
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Values in parenthesis are p-values

Estimation three confirms the result of estimation four. The coefficient for overall trade openness measure is 0.296 at a 5% level of significance. Thus, overall the positive effects of trade openness are larger in Asia than in any other regional or income group. It is possible to state that Asian countries have developed economies of scale and technology transfer that no other income or regional group of countries included in this study has achieved.

The final estimation on Table 17 indicates that, at the sectoral level, Asian countries have a relative comparative advantage in the trade of agricultural goods, whereas they do not have sectoral comparative advantage in the nonagricultural goods. These particular results indicate that Asian countries are promoting trade activities in the nonagricultural sector that have on average a lower productivity than the rest of the sector. This may be the result of the combination of different factors. The nature of these factors can be summarized within two major categories. On the one hand, Asian countries are importing goods in which they have a comparative advantage, and/or they export goods that may have lower than average sectoral productivity. This particular result is interesting because it indicates that even though the promotion of nonagricultural trade in Asian countries has resulted in the largest positive effect on income per capita when compared to the rest of the sample, Asian countries could be even better-off by promoting trade on those activities with higher than average sectoral productivity. It seems that Asia countries have developed comparative advantage in the trade of nonagricultural goods. However, this comparative advantage in the world market may not reflect the inherent comparative advantage of domestic nonagricultural production as reflected by the negative sign of the nonagricultural trade openness as ratio of value added in nonagriculture. In other words, one can state that the results in Table 17 indicate that Asian countries have developed comparative advantage compared to other countries by the use of trade policies, however, this activities still have a productivity lower than the average sectoral productivity.

To evaluate the impact of trade orientation on income per capita for the Asian countries this study compares the sign and magnitude of the estimated coefficients with the historical trade patterns. Figure 16, in the appendix, illustrates that there has been a tendency in Asian countries to relative increase the proportion of nonagricultural trade to GDP, while decreasing agricultural trade. The pattern of the Asian trade structure combined with the positive sign of nonagricultural trade and the negative sign on agricultural trade indicate that on average Asian countries have increased income per capita by changing the structure of international trade. Trade on non primary goods have increased from nearly 22% in 1973 to almost 50% in 1992. More interesting, however, is the fact that on average Asian countries have changed their export structure from being net exporters of agricultural goods during the 1970s to net exporters of nonagricultural goods from 1980 and on. On the other hand, Asian countries' imports of agricultural goods have remained fairly constant during the period of study, whereas imports of nonagricultural goods have increased from nearly 17% in 1973 to 30% in 1992.

Table 18 presents the results of the misspecification tests for the Asian estimates. Autocorrelation, and static and dynamic heteroskedasticity are found in the estimated Augmented Model. As before, this suggests that the use of OLS is inappropriate.

Table 18. Asia Estimated Results of the Misspecification Tests on the OLS Assumptions for the Augmented Neoclassical Growth Model with Human Capital and Trade Openness in Agricultural and Nonagricultural Goods

Assumption	Test	t-statistic	p-value	Test Result
Normality	Skewness	-1 137	0.254	Fail to Reject Ho
	Kurtosis	0.172	0.865	Fail to Reject Ho
	Omnibus	1.323	9.210 *	Fail to Reject Ho
Functional Form	KG2	4.133	0.000	Reject Ho
	RESET2	1.622	0.207	Fail to Reject Ho
Independence	Lag1	9.115	0.000	Reject Ho
Static Homoskedasticity	RESET2	1.185	0.239	Fail to Reject Ho
	White	4.133	0.000	Reject Ho
Dynamic Homoskedasticity	Lag2	7.655	0.000	Reject Ho

* Critical value at 1% level of confidence

To summarize the main results of the OLS estimations of the alternative growth models by regional estimations, this study presents table 19. As expected physical and human capital have a positive effect on income per capita across regional groups. In addition, under the OLS estimation there is little support to the trade openness promotion hypothesis. Only for the Asian region there is a positive and significant relationship between trade openness and income per capita. Trade openness in agricultural goods has a negative relationship with income per capita, while the positive effect from trade openness comes about through trade in nonagricultural goods. Finally, a reversal of signs in terms of sectoral comparative advantage is found indicating that trade openness has not necessarily been based on the promotion of those activities that have the highest productivity levels. Again, these results may have large implications for policy evaluation in developing countries. Yet misspecification tests reject the use of OLS as an appropriate technique.

Table 19. OLS Estimates of Alternative Growth Models by Region with GDP per capita as Dependent Variable

	Overall Sample	Latin America	Africa	Asia
Physical Capital	Positive and significant	Positive and significant	Positive and most important factor	Positive and most important factor
Human Capital	Positive and significant. Increases R^2. Reduces physical capital value confirming MRW and KLV	Positive and significant. Increases R^2. Most important factor. Reduce physical capital value. Confirms MRW and KLV	Positive and significant and increases R^2. Reduces physical capital value. Confirms MRW and KLV	Positive and significant and increases R^2. Reduces physical capital value. Confirms MRW and KLV
Labor Force	Negative and significant	Negative and significant	Negative and significant	Negative and significant
Trade Openness	Negative but not significant. No support for trade openness promotion hypothesis	Negative and significant. Reject trade openness promotion hypothesis	Negative but not significant. No support for trade openness hypothesis	Positive and significant. ***Highest*** value among region groups. Confirms trade openness promotion
Agric. Trade /GDP	Negative and significant	Negative and significant	Negative and significant	Negative but not significant
Nonagic. Trade /GDP	Positive but not significant	Negative but not significant	Positive but not significant	Positive and significant with ***highest*** value among groups
Agric. Trade / Agri Value Added	Positive and significant => productivity in trading sector higher than nontrading => comparative advantage.	Positive but not significant. There is no evidence to test comparative advantage hypothesis	Positive and significant. Higher productivity in trading sector than domestic sector	Positive and significant with sectoral comparative advantage
Nonagic. Trade / Nonagr. Value Added	Negative and significant => productivity of nontrading sector higher than trading => no comparative advantage	Negative and significant. Reject sectoral comparative advantage hypothesis	Negative but not significant	Negative and significant with no sectoral comparative advantage
Misspecification Tests	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation	Reject hypothesis of static and dynamic homoskedasticity and no autocorrelation

POOLED Estimations

Misspecification tests on the OLS assumptions indicate a loss of statistical power of the OLS estimates across estimations by income and regional groups. The most common statistical problems detected by the misspecification tests are autocorrelation of the error terms, and static and dynamic heteroskedasticity, and in few cases, nonnormality of the error terms. As mentioned in the previous chapter, misspecification tests on OLS assumptions are rarely seen in the use of OLS to determine the relationship between factors of production and income per capita growth. To correct and improve the confidence and statistical power of the estimates and statistical tests, this study proceeds to reestimate the alternative growth models by using the POOLED technique. The POOLED technique is a Generalized Least Square (GLS) method that accounts for the presence of heteroskedasticity and autocorrelation, which in turn yields more appropriate results than the correspondent OLS. Results from the POOLED models are shown from Tables 20 through 28 in the same sequence as before. As before the sample of countries is divided by income and region. Overall one expects that the confidence and robustness of the estimates will improve indicating a better approximation of the true relationship between factors of production and income per capita in developing countries. Keeping this in mind, this study proceeds to present the results of the POOLED estimations.

Overall Sample

The first reestimated results correspond to the overall sample of 62 developing countries. Table 20 illustrates the estimates for the alternative growth models for this sample. POOLED estimates retain, for the most part, the same basic characteristics of the correspondent OLS estimates. However, some of the estimates vary in magnitude and more importantly in significance from the OLS estimates.

The first estimation in Table 20 indicates that labor force is negatively related to income per capita, and physical capital is positively related to income per capita. However, the newly estimated coefficients for labor force and physical capital have smaller absolute values than the corresponding OLS estimates. For instance, physical capital reduces from 1.067 to 0.251 from the OLS to the POOLED method, respectively. This result is of particular interest because it confirms initial doubts on the high value of physical capital. It is clear that the presence of autocorrelation and static and dynamic heteroskedasticity in the OLS estimates result in overestimated values for the coefficients. This situation repeats itself throughout the reestimations of the alternative models.

The introduction of human capital in the second estimation results in a significant increase in R^2 from 0.27 to 0.48, improving the overall explanatory power of the model. R^2 from the POOLED estimation corresponds to Buse (1973)[26] R^2. Moreover, the introduction of human capital marginally reduces the overall value of physical capital, confirming Mankiw, Romer and Weil hypothesis that the single Solow model overestimates the real contribution of physical capital to income per capita. Furthermore, the human capital coefficient of the POOLED estimation is about half compared to the previous OLS result for the same model .

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[26] It is not possible to compare R^2 from the OLS estimations with the POOLED estimations.

Table 20. POOLED Estimated Results of Alternative Neoclassical Growth Models (Full Sample) [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness		
			1	2	3
Number of Observations	310	310	310	310	310
Degrees of Freedom	307	306	305	304	304
R^{2k}	0.27	0.48	0.50	0.60	0.51
Constant	9.486	9.493	9.267	9.768	8.837
	(20.15)[i]	(25.99)[i]	(26.15)[i]	(31.68)[i]	(22.88)[i]
Labor Force	-0.168	-0.252	-0.23	-0.265	-0.208
	(-5.42)[i]	(-10.48)[i]	(-9.73)[i]	(-12.48)[i]	(-8.20)[i]
I/Q [b]	0.251	0.238	0.213	0.207	0.200
	(8.88)[i]	(8.34)[i]	(7.19)[i]	(7.59)[i]	(6.03)[i]
School [c]		0.388	0.372	0.340	0.375
		(11.86)[i]	(11.58)[i]	(11.24)[i]	(11.11)[i]
X+M/GDP [d]			0.084		
			(2.63)[i]		
AgX+AgM/GDP [e]				-0.139	
				(-4.96)[i]	
NonagX+NonagM/GDP [f]				0.173	
				(6.39)[i]	
AgX+AgM/AgGDP [g]					0.118
					(4.04)[i]
NonagX+NonagM/NonagGDP [h]					-0.020
					(-0.56)
F-test [l]	56.55	95.57	76.97	92.99	63.28
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Reported R^2 is Buse (1973) R-square
[l] Values in parenthesis are p-values

The third estimation indicates that trade openness is positive and statistically significant, whereas it was not statistically significant under the OLS estimation. The change in results confirms the hypothesis of trade openness being an important determinant of income per capita growth in developing countries. Estimation four indicates that the largest positive effect of trade openness on income per capita comes about because of trade in nonagricultural goods. On the other hand, agricultural trade is statistically significantly negative. In this regard, the POOLED results confirm previous findings by Kavoussi. Kavoussi indicates that the largest positive effect of export promotion comes about because of manufactured exports. This dissertation elaborates more on the issue of positive effects of trade on output growth by arguing that, on average, it is total trade (exports plus imports) in nonagricultural goods that brings the positive effects on income per capita. For the most part, the POOLED estimates confirm the previous results by Feder; Balassa; Tyler; Ram; Khan and Reinhart; Edwards; Knight, Loayza and Villanueva; and Moschos of the positive effect of trade on output growth. However, it is relevant to mention that with the exception of Edwards; and Knight, Loayza and Villanueva; the rest of the studies relate export growth to output growth and not total trade as this dissertation does. In addition, all the previous studies use the OLS technique to conduct empirical estimations without testing for the presence of misspecification errors. This dissertation shows that there are statistical problems with the use of OLS that in turn bias the final results. This consideration is relevant because accounting for these statistical problems enables more appropriate estimates that yield more conclusive results.

Figures 1, 2, and 3 in the appendix show the trade patterns by category of goods for the overall sample. Incidentally, there has been a tendency in the overall sample to change the structure of international trade from a highly agricultural base to a more nonagricultural structure. This change in trade structure indicates that on average exports of nonfuel primary goods decreased from 13% in 1973 to 8% in 1992, whereas on average exports of all other goods increased from about 5% in 1973 to almost 11% in 1992. On the other hand, imports of nonfuel primary goods remained constant at 5% of GDP. Imports of all other goods increased from 17% to 24% for the same period. Therefore, the combination of these two trade trends and the correspondent coefficient estimates for trade on agricultural and nonagricultural goods on Table 20 indicate that on average developing countries have had a successful trade policy, thus increasing income per capita for that particular matter. Finally, estimation five indicates that trade in agricultural goods is based on sectoral comparative advantage as shown in the positive and statistically significant coefficient. This study, therefore, provides statistical and theoretical support to the hypothesis of trade openness having a positive effect on income per capita.

Comparisons among estimation techniques indicate that OLS does provide biased estimates that tend to increase the real value of coefficients for physical capital , human capital, and labor force; and reduce the statistical significance of the positive effects of trade openness on income per capita compared to the correspondent POOLED estimates. In addition, POOLED results tend to be more in accordance with the results of previous studies, such as Balassa; Tyler; Mbaku; Ram; Feder; Michaely; Moschos; Khan and Reinhart; Knight, Loayza and Villanueva; and Edwards.

Low Income Countries

Table 21 presents the reestimated results for the low income countries. Comparisons between estimation techniques indicate, as expected, that the POOLED estimates have lower absolute values than their corespondent OLS estimates. As before, physical capital and human capital are positively and significantly related to income per capita. The coefficient for physical capital declines from 0.444 to 0.174 between the first OLS and the POOLED estimation. In addition, the human capital coefficient declines from 0.226 to 0.161 in the second estimation. The inclusion of human capital reduces the relative impact of physical capital on income per capita, but not as dramatically as in the OLS estimates. Human capital also increases R^2 from 0.18 to 0.29. The size of the labor force remains negatively related to the growth in per capita GDP.

Results from the third estimation indicate that trade openness is positively and significantly related to income per capita. In low income countries, the inclusion of trade openness as an explanatory variable of income per capita results in a reduction of the physical capital coefficient, indicating that capital productivity in the exporting sector is higher than its correspondent domestic productivity. Hence, physical capital has a higher productivity in the trading sector.

Table 21. Low Income Countries POOLED Estimated Results of Alternative Neoclassical Growth Models [a]

		Augmented Growth Models			
	Solow	Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	120	120	120	120	120
Degrees of Freedom	117	116	115	114	114
R^{2l}	0.18	0.29	0.32	0.33	0.36
Constant	6.988	7.125	6.621	6.853	6.506
	(12.36)[i]	(13.60)[i]	(12.01)[i]	(12.12)[i]	(12.27)[i]
Labor Force	-0.069	-0.109	-0.064	-0.076	-0.058
	(-1.93)[j]	(-3.13)[i]	(-1.70)[k]	(-1.95)[j]	(-1.59)
I/Q [b]	0.174	0.145	0.079	0.063	0.091
	(4.66)[i]	(4.24)[i]	(2.04)[j]	(1.44)	(2.36)[j]
School [c]		0.161	0.116	0.106	0.121
		(4.11)[i]	(3.03)[i]	(2.72)[i]	(3.26)[i]
X+M/GDP [d]			0.132		
			(3.17)[i]		
AgX+AgM/GDP [e]				-0.029	
				(-0.60)	
NonagX+NonagM/GDP [f]				0.152	
				(3.15)[i]	
AgX+AgM/AgGDP [g]					0.125
					(3.34)[i]
NonagX+NonagM/NonagGDP [h]					-0.006
					(-0.14)
F-test [m]	13.21	16.03	13.91	11.58	12.96
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Reported R^2 is Buse (1973) R-square
[m] Values in parenthesis are p-values

The analysis of the sources of growth derived from trade openness indicate that trade in nonagricultural goods is positive and significantly related to income per capita. Agricultural trade openness relates negatively but is not statistically significant. However, the decomposition of trade results in a loss of statistical power for the physical capital coefficient. As mentioned before, Kavoussi indicates that the positive effects of trade (export promotion) are higher in middle income countries than in low income countries. Kavoussi also finds this same result in terms of the promotion of manufactured exports between middle and low income countries. However, Ram argues that there is not significantly large difference in the estimated coefficient of export promotion between low and middle income countries. In Ram's study the largest difference in export promotion coefficients comes about in the different time periods under analysis, not because of income per capita difference among countries. Ram argues that the difference in the initial level of income per capita does not have a significant effect on the sources of economic growth derived from international trade and in particular from export promotion. However, he argues that the source of difference is in time periods. Export promotion in the 1960-70 decade accordingly to Ram had a larger impact on output growth compared to 1970-77. Contrary to Ram's results, Moschos provides statistical information indicating that low income countries derived larger positive effects from export promotion than middle income countries do. This dissertation gives support to Moschos' findings.

The fifth estimation of Table 21 indicates the same results as before. However, trade in nonagricultural goods as a ratio of value added in nonagriculture becomes insignificant in this estimation compared to the correspondent OLS results.

A comparative analysis of historical international trade trends in low income countries and the correspondent empirical estimates can be performed with the help of figures 1, 2, and 3 in the appendix. Figure 1 indicates that trade in agricultural goods remained fairly constant during the period of analysis. On the other hand, the largest variation in trade for low income countries has occurred as a result of variations in trade in nonagricultural goods. Figure 2 indicates a secular change in the structure of exports in low income countries. This change implies that low income countries dedicate more resources to the export of nonagricultural goods which represented 4% of GDP on average in 1973 increasing to 8% in 1992. Trade in agricultural goods represented 11% of GDP in 1974 compared to 9% in 1992. According to estimation four in Table 21 and the change in trade patterns during the period of analysis, low income countries increased income per capita through the redirection of international trade from agriculture to nonagriculture. However, another important factor is that imports of nonagricultural goods has increased largely during the period of analysis resulting in large balance of trade deficits. In addition to the balance of trade deficit many of the countries have a large balance of payments deficits that may result in macroeconomic disequilibriums that may obscure the gains derived from the international trade process. These trade and balance of payments deficits work in opposition and may result in lower levels of income per capita. The measure of this affect is outside the scope of this dissertation.

Table 22. Middle Income Countries POOLED Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness		
			1	2	3
Number of Observations	125	125	125	125	125
Degrees of Freedom	122	121	120	119	119
R^2 [l]	0.31	0.54	0.61	0.59	0.64
Constant	7.305	7.448	7.266	8.019	7.433
	(11.89)[i]	(15.84)[i]	(16.56)[i]	(16.50)[i]	(17.77)[i]
Labor Force	-0.001	-0.053	-0.041	-0.096	-0.053
	(-0.37)	(-1.60)	(-1.35)	(-2.78)[i]	(-1.80)[k]
I/Q [b]	0.327	0.359	0.344	0.328	0.339
	(7.47)[i]	(11.08)[i]	(11.54)[i]	(10.52)[i]	(11.83)[i]
School [c]		0.211	0.227	0.216	0.240
		(7.12)[i]	(8.49)[i]	(6.95)[i]	(9.17)[i]
X+M/GDP [d]			0.076		
			(2.49)[i]		
AgX+AgM/GDP [e]				-0.106	
				(-3.16)[i]	
NonagX+NonagM/GDP [f]				0.137	
				(4.31)[i]	
AgX+AgM/AgGDP [g]					-0.019
					(-0.68)
NonagX+NonagM/NonagGDP [h]					0.099
					(2.99)[i]
F-test [m]	27.88	48.26	46.84	35.30	42.44
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Reported R^2 is Buse (1973) R-square
[m] Values in parenthesis are p-values

Middle Income Countries

Table 22 illustrates the POOLED results of the reestimated growth models for the middle income countries. As in the previous reestimations for low income countries and the overall sample, the value of the estimated coefficients is smaller under the POOLED estimation technique than under the OLS estimations. In the first estimation labor is negatively related and physical capital is positively related to income per capita, confirming the underlined hypothesis of the Solow model of equation 13.

As indicated in the previous scenarios for low income countries and the overall sample the absolute value for most of the coefficients have been reduced when accounting for the presence of static and/or dynamic heteroskedasticity. The affect of the labor force on income per capita is not statistically significant for the middle income countries, even though it maintains the negative relationship with income per capita. Moreover, physical capital has a lower absolute value under the POOLED estimation. The inclusion of human capital increases R^2 from 0.31 to 0.54 and it also marginally increases the coefficient for physical capital indicating that physical capital accumulation is positively affected by human capital accumulation, i.e., both types of capital accumulation follow a complementary process. Estimation three indicates that trade openness is positively related to income per capita and is statistically significant. This result is important because the previous OLS estimation for the same model indicated that overall trade openness was not related to income per capita. The decomposition of trade openness by category of goods in estimation four indicates that trade in agricultural goods is negatively and significantly related to income per capita, whereas trade in nonagricultural goods is positively related and significantly related to income per capita. These two results confirmed previous findings under the OLS estimates. However, the absolute value of trade openness in nonagricultural goods is higher than before and the value of agricultural trade openness is smaller than before.

Previous OLS estimations for low and middle income countries indicate results that are somehow different. Kavoussi finds statistical support for the hypothesis that there is a significant difference in the effect of labor force on output growth between low and middle income countries, and physical capital does not differ widely between income groups. Ram does not find statistical significance in the estimated coefficients of labor force and physical capital for the sample of low and middle income countries for the two subperiods of 1960-70 and 1970-77.

Results from the third estimation (number one under the Trade Openness heading) indicate that trade openness relates positively to income per capita. However, the trade openness coefficient is not as large in middle income countries compared to low income countries. In this regard, Moschos argues that low income countries are the ones that benefit the most from export promotion policies, contrary to the commonly held view that middle and high income countries benefit the most from export promotion. Kavoussi states that export promotion in middle income countries has a positive impact on output growth and this impact is about twice as large as for low income countries. The results reported by Kavoussi are not supported in the findings of this dissertation. Under this estimation, the remaining variables maintain their relative magnitudes and signs.

Further analysis of the impact of trade openness on per capita output growth indicates that, as shown in estimation four, trade openness in agriculture has a negative and significant relationship with income per capita. In addition, trade openness in nonagricultural goods has a positive and significant relationship with income per capita. As expected, middle income countries show that trade openness in nonagricultural goods has a positive effect on income per capita whereas after a certain level of income per capita agricultural goods do not contribute much to the process of economic growth. Economies of scale and technology transfer is better appropriated in economies that have passed a minimum level of income per capita. In this regard, Kavoussi indicates that manufactured exports have a larger positive impact on output growth for middle income countries compared to low income countries. Moreover, Tyler argues that " since the technological change parameter estimates decreases in the equations with manufactured export growth included, it is suggested that manufacturing export activity is accompanied by greater technological progress" (p. 129).

Table 23. High Income Countries POOLED Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Augmented Growth Models			
		Human Capital	Trade Openness		
			1	2	3
Number of Observations	665	65	65	65	65
Degrees of Freedom	62	61	60	59	59
R^{2k}	0.10	0.52	0.51	0.63	0.59
Constant	8.641	5.943	5.786	5.815	5.335
	(12.73)[i]	(8.33)[i]	(7.71)[i]	(8.24)[i]	(8.02)[i]
Labor Force	-0.032	-0.028	-0.017	-0.035	-0.009
	(-0.71)	(-1.10)	(-0.51)	(-1.00)	(-0.32)
I/Q [b]	0.198	0.392	0.386	0.339	0.345
	(2.46)[i]	(4.20)[i]	(4.14)[i]	(4.65)[i]	(3.90)[i]
School [c]		0.727	0.729	0.627	0.697
		(6.36)[i]	(6.13)[i]	(5.56)[i]	(6.08)[i]
X+M/GDP [d]			0.023		
			(0.33)		
AgX+AgM/GDP [e]				-0.356	
				(-4.49)[i]	
NonagX+NonagM/GDP [f]				0.212	
				(4.44)[i]	
AgX+AgM/AgGDP [g]					0.281
					(4.66)[i]
NonagX+NonagM/NonagGDP [h]					-0.224
					(-3.31)[i]
F-test [l]	3.39	22.50	15.75	20.65	16.87
	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Reported R^2 is Buse (1973) R-square
[l] Values in parenthesis are p-values

High Income Countries

As expected the reestimation of the growth models reported in Table 23 indicates that most of the values for the newly estimated coefficients are lower than their correspondent OLS estimates. However, most of the previous results are confirmed by the use of POOLED technique. Estimations for the high income countries indicate that labor is negatively related and physical capital is positively related to income per capita. Yet, the size of the affect of labor force on per capita output is not statistically significant and the R^2 corresponding to the Solow model is 0.1. The inclusion of human capital in estimation two increases R^2 to 0.52 implying that human capital is an important source of economic growth in high income countries. In addition, for high income countries the inclusion of human capital increases the overall value of the physical capital coefficient indicating that the process of capital accumulation is enhanced by the investment in human capital. However, Mankiw, Romer and Weil indicate that the inclusion of human capital as an explanatory variable for income per capita reduces the overall impact of physical capital on per capita output. Knight, Loayza and Villanueva also show that including human capital reduces the overall positive impact of physical capital on per capita output both by using panel and cross-section data for a sample of 75 developing countries. Moreover, human capital is the most important factor of production in high income countries as indicated by its largest coefficient compared to the rest of the factors of production. The nonstatistical significance of labor force across all estimations and the high value for the human capital accumulation coefficient indicate that labor is a large source of economic development in high income countries. In addition, the combination of these two elements implies that the effect of labor productivity on income per capita more than offsets the negative effect that population growth has on income per capita in high income countries.

The inclusion of trade openness in estimation three, indicates that income per capita increases as trade increases. Yet, this relationship is not statistically significant. At first this result seems to be unplausible, because one would expect trade openness to be an important determinant of economic growth in high income countries. However, the lack of significance for the trade openness variable is better understood by analyzing estimation four, which indicates that trade in agricultural goods is negatively and significantly related to income per capita growth, while nonagricultural trade is positive and significantly related to income per capita growth. The combined effects of the agricultural and nonagricultural trade variable into a single trade openness variable explains the lack of significance for the overall trade openness in estimation three. Indeed, R^2 increases from 0.51 in estimation three to 0.64 in estimation four, indicating that the decomposition of trade openness into agricultural and nonagricultural variables significantly improves the explanatory value of trade openness on income per capita growth and helps to explain the process of economic development in high income countries.

Results in estimation five provide statistical support to the hypothesis that trade in nonagricultural goods do not necessarily follows a sectoral comparative advantage as indicated by the negative value of the coefficient of nonagricultural trade. On the other hand, trade in agricultural goods has a sectoral comparative advantage as shown by the positive and statistically significant coefficient value for agricultural trade. Overall, the POOLED estimates provide better information than the previous OLS estimates in terms of the sources of economic development in high income countries. These results are shown as lower values of the estimates more in accordance with previous studies and more significant estimates for the degree of trade openness. For the most part, previous empirical studies in the field of economic growth such as Balassa; Tyler; Feder; Moschos; Knight, Loayza and Villanueva; desegregate developing countries between low and middle income countries, without considering a third group of developing countries that have a rather large income per capita compared to the rest of the developing countries. Results in this dissertation show that the empirical implications of factor of production on income per capita are sensitive to the initial definition of low, middle, and high income developing countries.

Similar results are obtained by the estimation for middle income countries. Economies of scale and technology transfer derived from nonagricultural trade are better appropriated in economies that have passed a minimum level of income per capita. The coefficient for nonagricultural trade in high income countries is 0.167 compared to 0.135 in middle income countries. Both coefficients are statistically significant at the 10% level. In addition, the negative impact of agricultural trade on income per capita is smaller for high income than middle income countries, -0.1615 to -0.221, respectively. The inclusion of schooling and trade openness largely decrease the value of the constant, i.e., technological factor coefficient. Hence a large proportion of technology transfer results from education and international trade.

Results derived from the estimations of different income groups include results in positive effects on income per capita of trade in agricultural and nonagricultural goods. However, for low, middle and high income developing countries, economies of scale are derived mostly through the trade of nonagricultural goods, whereas trade in agricultural goods reduces income per capita. This, in turn, confirms previous results (Kavoussi; Tyler; and Balassa) indicating that productivity in manufacture trade is higher than otherwise. The results of this dissertation give statistical support to the hypothesis that international trade has a positive impact on income per capita. Nevertheless, the positive effects of trade vary across income group and trade activities.

A summary of the POOLED estimation results is presented in table 24. Table 24 allows comparison of the main implications of the POOLED estimates with the previous OLS estimations in Table 12. Perhaps, the most relevant result in Table 24 is that under the POOLED estimation technique, low income countries have the highest absolute positive value of trade openness on income per capita growth. Under the POOLED estimation trade openness is positive and statistically significant for all income groups, except for high income countries, a result not found under the OLS estimations. Furthermore, for middle income countries physical capital is the most important factor of production, and for high income countries human capital is the most important factor of production. In the correspondent estimation for high income countries this study also finds that trade in nonagricultural goods has the highest value among income groups. Furthermore, there is a definitive tendency for trade openness in agricultural goods to have a negative impact on income per capita for all income groups. In general, there is also a tendency for a reversal in terms of sectoral comparative advantage for all income groups, which in turn implies that most countries that promote trade openness are not necessarily following a comparative advantage approach. This, as mentioned before, may have major economic implications in terms of resource use allocation and possibilities for developing countries to increase income per capita in the long run. Finally the POOLED estimates have in general lower absolute values than the correspondent OLS estimates, resulting in better approximation of results from previous studies.

Latin America Countries

POOLED estimates for Latin America in Table 25 confirm most of the previous results of previous OLS estimates in Table 13. Estimations one and two provide the basic similar results with labor force relating negatively, physical capital relating positively, and human capital having a positive impact on income per capita. Furthermore, the absolute value of the coefficients is lower than before.

As before, human capital has a larger positive impact on income per capita than physical capital. This particular result contradicts previous findings in Mankiw, Romer, and Weil; and in Knight, Loayza, and Villanueva. In addition the inclusion of human capital improves the overall coefficient of physical capital as in the case of high income countries. R^2 increases from 0.17 to 0.38 from estimation one to estimation two. Estimation three indicates that trade openness is negatively related to income per capita but not statistically significant, whereas the corresponding OLS estimation in Table 13 indicates that this negative relationship was statistically significant. The remaining coefficients maintain the characteristics identified in estimation two.

Table 24. POOLED Estimates of Alternative Growth Models by Income Group with GDP per capita as Dependent Variable

	Overall Sample	Low Income	Middle Income	High Income
Physical Capital	Positive and significant	Positive and significant	Positive and significant. Most important factor	Positive and significant
Human Capital	Positive and significant. Most important factor Reduces physical capital and increases R^2. Supports MRW	Positive and significant, marginally reduces physical capital, increases R^2. Supports MRW	Positive and significant. Increases R^2, marginally reduces physical capital. Support MRW	Positive and significant. Most important factor. Increases physical capital, contradicts MRW
Labor Force	Negative and significant	Negative and significant	Negative and significant but very low value	Negative but not significant
Trade Openness	Positive and significant. Reduces all other coefficients. Contrary to OLS results	Positive and significant. Most important factor => support for openness hypothesis. ***Highest*** value among groups	Positive and significant, lower than low income countries	Positive but not significant. All other variables remain the same
Agric. Trade /GDP	Negative and significant	Negative but not significant	Negative and significant	Negative and significant
Nonagic. Trade /GDP	Positive and significant	Positive and significant	Positive and significant	Positive and significant with ***highest*** value among groups
Agric. Trade / Agri Value Added	Positive and significant => sectoral comparative advantage	Positive and significant => sectoral comparative advantage	Negative but not significant	Positive and significant => sectoral comparative advantage pattern
Nonagic. Trade / Nonagr. Value Added	Negative but not significant	Negative but not significant	Positive and significant => there are sectoral comparative advantages in the nonagricultural trading sector	Negative and significant => trade does not follow a sectoral comparative advantage
POOLED vs. OLS	POOLED accounts for the presence heteroskedasticity and autocorrelation resulting in more robust estimates than OLS. In addition, empirical estimations provide better statistical support to the Augmented Neoclassical Growth Model with Trade Openness in Agricultural and Nonagricultural Goods. In general, there is a tendency for POOLED estimates to have a lower absolute value than OLS estimates, giving statistical support to previous literature			

Table 25. Latin America POOLED Estimated Results of Alternative Neoclassical Growth Models [a]

		Augmented Growth Models			
	Solow	Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
Number of Observations	100	100	100	100	100
Degrees of Freedom	97	96	95	94	94
R^2 [l]	0.17	0.38	0.38	0.44	0.38
Constant	7.983	7.145	7.138	7.089	7.152
	(9.33)[i]	(10.87)[i]	(10.52)[i]	(11.84)[i]	(10.26)[i]
Labor Force	-0.026	-0.074	-0.079	-0.091	-0.076
	(-0.44)	(-1.74)[k]	(-1.77)[k]	(-2.29)[j]	(-1.62)[k]
I/Q [b]	0.261	0.328	0.331	0.349	0.298
	(4.40)[i]	(5.21)[i]	(4.88)[i]	(4.90)[i]	(4.44)[i]
School [c]		0.454	0.472	0.486	0.427
		(6.07)[i]	(6.13)[i]	(6.26)[i]	(5.44)[i]
X+M/GDP [d]			-0.029		
			(-0.46)		
AgX+AgM/GDP [e]				-0.154	
				(-2.56)[j]	
NonagX+NonagM/GDP [f]				0.051	
				(0.86)	
AgX+AgM/AgGDP [g]					0.079
					(1.49)
NonagX+NonagM/NonagGDP [h]					-0.059
					(-0.98)
F-test [m]	10.03	19.64	14.51	15.08	11.54
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Reported R^2 is Buse (1973) R-square
[m] Values in parenthesis are p-values

Trade openness by category of goods indicates that agricultural trade has a negative and statistically significant relationship with income per capita. On the other hand, nonagricultural trade is positively related to income per capita but not statistically significant. However, the coefficient for nonagricultural trade is larger the POOLED estimation compared to the OLS, and for agricultural trade the coefficient is smaller under POOLED. This particular result shows that the promotion of nonagricultural trade has resulted in positive effects on income per capita even though it has not reach the threshold point to generate economies of scale and the complete appropriation of technology transfer. This is specially true when one considers that Latin American countries are net exporters of agricultural goods, and net importers of nonagricultural goods. In turn, total Latin America exports represent on average less than twenty percent of Gross Domestic Product, whereas total imports represent on average of approximately twenty-five percent of Gross Domestic Product.

In Latin America the most important sources of economic growth are generated domestically through the processes of physical and human capital accumulation. International trade has resulted in continuous and persistent balance of trade deficits that do not enhance the rate of growth of income per capita. Barboza finds statistical evidence to support the hypothesis of export promotion as a source of economic growth in Latin America for a sample of 19 countries from 1970 to 1992. It is possible to conclude that the persistent trade balance deficits have offset the positive effects derived from the process of export promotion and that even though technology transfer is being appropriate through the import of capital goods, the combined impact of these two processes may not result in increments of income per capita. It is likely however, that in some specific cases the processes of trade liberalization results in actual increases of income per capita as predicted by the model in chapter III.

The final estimation gives statistical support to the hypothesis that agricultural trade has been based on sectoral comparative advantage, whereas this has not been the case in nonagricultural trade. It is not surprising however, that nonagricultural trade does not have a sectoral comparative advantage. Exports of nonagricultural goods has received large support from Latin America governments through the use of tariff and nontariff barriers, which have clearly created distortions in the trade patterns[27]. On the other hand, even though agricultural trade has followed a sectoral comparative advantage it still has an average productivity that is lower than the average Gross Domestic Product productivity. Lower productivity in agricultural trade is explained for the low value added components of agricultural products. Thus, initial sectoral comparative advantages in agricultural production are not being exploited by Latin American countries.

African Countries

Reestimation of the alternative growth models for Africa in Table 26 confirms most of the previous results of Table 15. However, some important differences are found. First, the absolute value of the estimated coefficients for physical and human capital are smaller than the previous OLS estimates. Second value and statistical significance of trade

[27] Latin American countries were heavily involved in the process of Import Substitution during the 1960s and part of the 1970s. In addition, the changes in domestic production structure to meet the needs of the Import Substitution process are for the most part still in place in most of the Latin America countries. During the 1980s and in the course of the 1990s, Latin American countries, as well as many other developing countries, have been involved in the process of structural change to develop those economic activities in which there is a comparative advantage. It is therefore, not surprising that the combination of a production structure that was oriented to the substitution of imports and the large amount of imports of capital goods as a proportion of Gross Domestic Product obscure the positive effect of the process of export promotion.

openness coefficients vary with respect to the correspondent OLS estimates. Empirical estimates of the Solow and Augmented Solow Model with Human Capital Accumulation yield the same results under POOLED and OLS techniques. Labor is negatively related to income per capita, and physical and human capital are positively related to income per capita. R^2 increases from estimation one to estimation two from 0.21 to 0.36. Human capital also has a larger absolute value than physical capital indicating that investment in education has a higher productivity than investment in physical capital, and that there is a need in Africa to increase labor-skills. As indicated previously, the particular result of human capital being more important in terms of income per capita determination than physical capital is opposite to the findings of Mankiw, Romer, and Weil; and Knight, Loayza, and Villanueva.

Perhaps the most interesting results of the reestimated growth models for Africa is that overall trade openness is positive and significantly related to income per capita, whereas previous OLS estimations indicated the opposite. This also confirms the hypothesis that correcting for the presence of static and dynamic heteroskedasticity yields more robust estimates than the correspondent OLS initial estimations. In addition, trade openness increases R^2 marginally from 0.36 to 0.38. The decomposition of trade openness in estimation four indicates that agricultural trade is negative and statistically significantly related to income per capita, and nonagricultural trade is positive and significantly related to income per capita. In this regard, Mbaku indicates using a sample of 37 African countries that exports have a positive impact on output growth. He also states that export growth is a more important determinant of output growth for middle income African countries compared to low income countries.

Figures 13, 14, and 15 in the appendix illustrate trade patterns for African countries. Figure 14 shows African countries changing their trade strategy to the promotion of nonagricultural trade. In 1972, nonprimary exports represented less than 5% of Gross Domestic Product, and in 1992 they represented 10%. On the other hand, agricultural exports (nonfuel primary) represented about 16% of Gross Domestic Product in 1972 and declined to about 11% in 1992 Figure 15 shows imports of agricultural goods relatively constant under the period of study, whereas, nonagricultural imports increase from 18% to 26% for the same period. Indeed, on average for the African countries the relative change in trade structure has resulted in positive effects on income per capita. It is relevant to notice that the absolute value of the agricultural trade coefficient is greater than the correspondent coefficient for agricultural trade. Finally, estimation five indicates that trade in agricultural goods are based on sectoral comparative advantages as indicated by the positive and statistically significant coefficient. Nonagricultural trade shows a positive coefficient, yet not statistically significant.

Table 26. African Countries POOLED Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Human Capital	Trade Openness 1	Trade Openness 2	Trade Openness 3
		Augmented Growth Models			
Number of Observations	130	130	130	130	130
Degrees of Freedom	127	126	125	124	124
R[l]	0.20	0.36	0.38	0.41	0.37
Constant	8.801	9.519	9.238	10.132	8.805
	(9.85)[i]	(13.07)[i]	(12.84)[i]	(13.48)[i]	(11.71)[i]
Labor Force	-0.167	-0.259	-0.234	-0.294	-0.202
	(-2.79)[i]	(-5.29)[i]	(-4.73)[i]	(-5.66)[i]	(-3.94)[i]
I/Q [b]	0.169	0.148	0.119	0.121	0.114
	(4.97)[i]	(3.87)[i]	(2.90)[i]	(2.81)[i]	(2.78)[i]
School [c]		0.235	0.215	0.214	0.184
		(6.08)[i]	(5.45)[i]	(5.22)[i]	(4.67)[i]
X+M/GDP [d]			0.112		
			(2.02)[j]		
AgX+AgM/GDP [e]				-0.097	
				(-1.67)[k]	
NonagX+NonagM/GDP [f]				0.159	
				(2.75)[i]	
AgX+AgM/AgGDP [g]					0.110
					(2.48)[i]
NonagX+NonagM/NonagGDP [h]					0.006
					(0.12)
F-test [m]	16.67	23.49	19.37	17.45	14.60
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Significant at 10% level
[l] Reported R^2 is Buse (1973) R-square
[m] Values in parenthesis are p-values

Asian Countries

Estimations for the sample of Asian countries outperformed the rest of the estimation by income and by region. The explanation power of the alternative growth models is indicated by higher R^2 than otherwise. Estimation one indicates as expected that labor force has a negative and statistically significant relationship with income per capita. In addition, the coefficient of labor force is the highest compared to the rest of the estimations. Physical capital is positive and statistically significant with a coefficient of 0.527. This coefficient has the highest absolute value compared to the rest of the estimations for the other income and region groups. This indicates that Asian countries have developed higher economies of scale through the accumulation of physical capital than otherwise.

Furthermore, estimation two shows human capital accumulation having a higher coefficient than physical capital. The positive effects of human capital on income per capita are demonstrated by an increase in the overall explanatory power of the growth model, R^2 increases to 0.62. However, the inclusion of human capital reduces the value of the coefficient of physical capital to 0.349. Human capital is the most important factor of production for the Asian countries, yielding the highest contribution to income per capita compared to the other factors of production.

Estimation three indicates that overall trade openness is positive and significantly related to income per capita. However, the magnitude of this coefficient is smaller under the POOLED estimation than the OLS. Yet, the trade openness coefficient is still the highest compared to the rest of the coefficients for trade openness in the income and region group estimations. As stated before, the process of international trade resulted in larger technology transfer in the Asian countries than in any other countries. In addition, the inclusion of trade openness as an explanatory variable of income per capita results in a reduction of the magnitude in the remaining coefficients, indicating that some of the human and physical capital productivity is derived from the process of international trade. R^2 marginally increases from estimation two to estimation three from 0.62 to 0.63. Overall R^2 derived from the Asian estimates are higher than otherwise.

Estimation four indicates that agricultural trade openness has a negative and significant relationship with income per capita. This relationship was negative but not statistically significant in the corresponding OLS estimation. The negative value of the agricultural trade coefficient indicates that the productivity derived from agricultural trade is lower than the average productivity derived from the Gross Domestic Product. Second, nonagricultural trade has a positive and significant effect on income per capita. Productivity derived from nonagricultural trade is higher in absolute terms than that derived from agricultural trade. Furthermore, the productivity of nonagricultural trade in Asian countries is the highest compared to the rest of the estimations by income and region group. Nonagricultural trade in Asian countries has greater productivity than the average domestic activities. Thus, trade in nonagricultural goods follows a comparative advantage pattern. In turn the trade patterns based on comparative advantage allow Asian countries to better appropriate technology transfer and develop larger economies of scale than any other income or region group. The positive impact of trade and education is also captured as reflected by the highest R^2 among all estimations.

Table 27. Asian Countries POOLED Estimated Results of Alternative Neoclassical Growth Models [a]

	Solow	Human Capital	Augmented Growth Models: Trade Openness 1	2	3
Number of Observations	80	80	80	80	80
Degrees of Freedom	77	76	75	74	74
R^{2k}	0.41	0.62	0.63	0.65	0.70
Constant	11.411	8.271	7.969	9.008	7.272
	(14.63)[i]	(10.83)[i]	(11.38)[i]	(10.62)[i]	(10.27)[i]
Labor Force	-0.258	-0.235	-0.186	-0.234	-0.141
	(-5.79)[i]	(-6.19)[i]	(-5.07)[i]	(-5.40)[i]	(-4.02)[i]
I/Q [b]	0.527	0.349	0.211	0.225	0.167
	(4.96)[i]	(4.60)[i]	(2.84)[i]	(3.17)[i]	(2.20)[i]
School [c]		0.689	0.549	0.458	0.540
		(7.27)[i]	(5.56)[i]	(4.00)[i]	(5.50)[i]
X+M/GDP [d]			0.183		
			(2.59)[i]		
AgX+AgM/GDP [e]				-0.131	
				(-1.95)[j]	
NonagX+NonagM/GDP [f]				0.260	
				(3.82)[i]	
AgX+AgM/AgGDP [g]					0.238
					(3.69)[i]
NonagX+NonagM/NonagGDP [h]					0.032
					(0.39)
F-test [l]	26.65	42.24	32.05	27.73	34.03
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

[a] Values in parenthesis are t-ratios
[b] Investment-output ratio
[c] Secondary enrollment ratio
[d] Total Exports plus Total Imports-Gross Domestic Product Ratio
[e] Nonfuel primary Exports and Imports-Gross Domestic Product Ratio
[f] All other Exports and Imports-Gross Domestic Product Ratio
[g] Nonfuel primary Exports and Imports-Agricultural Gross Domestic Product Ratio
[h] All other Exports and Imports-Nonagricultural Gross Domestic Product Ratio
[i] Significant at 1% level
[j] Significant at 5% level
[k] Reported R^2 is Buse (1973) R-square
[l] Values in parenthesis are p-values

The impact of international trade on income per capita is better understood by analyzing figures 16, 17, and 18 in the appendix. Figure 16 illustrates that trade in nonagricultural goods increased on average in the Asian countries from about 24% of Gross Domestic Product in 1973 to 50% in 1992. On the other hand, trade of agricultural goods slowly decreased from 17% in 1973 to about 12% in 1992. It is even more interesting to notice that the largest variation in the trade structure in Asian countries comes about because a significant change in the export composition. Exports of nonagricultural goods represented about 6% of Gross Domestic Product in the early 1970s, whereas in 1992 it accounted for 21% of GDP. Exports of agricultural goods decreased from 11% of GDP in 1973 to 6% in 1992. Imports of agricultural goods remained mostly constant at 6% of Gross Domestic Product for the entire period. However, imports of nonagricultural goods increased from 17% to 30% for the same period. Finally, estimation five indicates that trade in agricultural goods has a higher than average productivity compared to the value added in the agricultural production. On the other hand, nonagricultural trade has a higher than average productivity than the value added in nonagricultural goods. However, the latter is not statistically significant.

To conclude the empirical results section, this study presents the summary of the POOLED estimations by region of developing countries in the following table 28. Table 28 allows to determine the main difference in terms of empirical results between the OLS estimates and the POOLED estimates. As expected physical and human capital have a positive effect on income per capita across regional groups. In addition, under the POOLED estimation there is support for the trade openness promotion hypothesis, whereas in the OLS estimation results were weak. Trade openness results indicate that

Asian countries are the ones that have benefited the most from the process of trade openness. The major contribution comes about because the promotion of trade openness in nonagricultural goods, where Asian countries have the highest positive value compared to the rest of regional groups.

As for the OLS estimates, the POOLED results of this section indicate that there is a negative and significant relationship between trade openness in agricultural goods and income per capita. Hence, giving statistical support to the hypothesis that on average trade in agricultural goods has not been beneficial for most developing countries. Finally, under the POOLED estimates this study finds that there are sectoral comparative advantages in the agricultural sector, while there is no statistical support to reject or fail to reject the same hypothesis for trade in nonagricultural goods.

Table 28. POOLED Estimates of Alternative Growth Models by Region with GDP per capita as Dependent Variable

	Overall Sample	Latin America	Africa	Asia
Physical Capital	Positive and significant	Positive and significant	Positive and significant	Positive and significant. Higher value than other groups
Human Capital	Positive and significant. Most important factor. Reduces physical capital and increases R^2. Supports MRW	Positive and significant. Most important factor. Increases physical capital => no support to MRW. Increases R^2	Positive and significant. Most important factor of production. Marginally reduces physical capital value => support to MRW	Positive and significance. Reduces physical capital => support to MRW. Most important factor, and highest among groups
Labor Force	Negative and significant	Negative but not significant	Negative and significant	Negative and significant
Trade Openness	Positive and significant. Reduces all other coefficients. Contrary to OLS results	Negative but not significant. Other coefficients remain the same	Positive and significant. Reduces other coefficient values => higher productivity in trading sector	Positive and significant. Highest value among all groups.
Agric. Trade /GDP	Negative and significant. Deterioration on income per capita due to trade in agricultural goods	Negative and significant. Deterioration on income per capita due to trade in agricultural goods	Negative and significant. Deterioration on income per capita due to trade in agricultural goods	Negative and significant. Deterioration on income per capita due to trade in agricultural goods
Nonagic. Trade /GDP	Positive and significant	Positive but not significant	Positive and significant	Positive and significant. Highest among groups.
Agric. Trade / Agri Value Added	Positive and significant => sectoral comparative advantage	Positive but not significant	Positive and significant => sectoral comparative advantage	Positive and significant => sectoral comparative advantage
Nonagic. Trade / Nonagr. Value Added	Negative but not significant	Negative but not significant	Positive but not significant	Positive but not significant
POOLED vs. OLS	POOLED accounts for the presence heteroskedasticity and autocorrelation resulting in more robust estimates than OLS. In addition, empirical estimations provide better statistical support to the Augmented Neoclassical Growth Model with Trade Openness in Agricultural and Nonagricultural Goods. In general, there is a tendency for POOLED estimates to have a lower absolute value than OLS estimates, giving statistical support to previous literature			

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This dissertation proposes that by endogenizing technological change as a function of the degree of trade openness promotion, one can explain the effect that trade openness has on output growth, factor accumulation and overall factor productivity in the context of the Solow model. In turn, the model specification developed in this study allows to determine both the direct and indirect effects that trade openness has on the long-run rate of growth of income per capita and on the correspondent steady-state level.

A significant difference between the closed economy Solow model and the expanded open economy model developed in this study is that the long-run steady-state level of income per capita is always larger in the open economy model. Thus, allowing open economies to achieve larger steady-state levels of income per capita and greater long-run rates of growth of income per capita. This result suggests that a lower level of capital accumulation (human and physical) is needed in the open economy compared to the closed economy to achieve the same level of long-run per capita output. The second implication is that in the open economy model, lower levels of domestic savings are associated with larger levels of per capita output growth. This is possible, because the productivity of physical and human capital is enhanced as a result of the process of technology transfer associated with international trade. Thirdly, as trade factors vary, endogenized technological change allows economies to achieve different steady-state levels of income per capita and physical and human capital. This particular implication of the expanded model is not possible in the closed economy model with exogenous technological change. Thus, by endogenizing technological change through the incorporation of openness as a factor of production, the proposed Barboza-Dicks model provides evidence to allow for endogenous changes in steady-state levels that is not possible in the Solow model.

At the empirical level two alternative estimation methods were used, i.e., OLS and POOLED techniques. Overall misspecification tests on the OLS assumptions indicate the presence of static and dynamic heteroskedasticity and autocorrelation To account for these statistical problems the alternative growth models were reestimated using the POOLED technique. Results were then divided by income and regional groups.

The overall pattern derived from the empirical evidence based on a sample of 62 developing countries indicates that low income developing countries benefit the most from trade openness. This result is significant in that it contradicts previous findings that indicate that high income developing countries gain the most from trade promotion. Furthermore, middle income developing countries obtain the largest positive effects from physical capital accumulation, and high income developing countries benefit the most from investment in human capital. These particular results are important in terms of economic policy formulation in developing countries, because they indicate important changes in the main sources of growth as income levels vary.

In terms of trade openness promotion, all income group countries benefit from the promotion of nonagricultural trade, however, high income countries are the ones that benefit the most. On the other hand, there is statistical evidence indicating that trade openness in agricultural goods results in a negative impact on income per capita for all income groups. These two elements have important implications for policy analysis in developing and developed countries, as they indicate two major trends. First, developing countries may need to increase trade openness promotion in nonagricultural goods as a means to increase income per capita and to accelerate the rate of growth of income per capita toward its steady-state level. Second, developing countries may need to redirect agricultural trade openness policies so as to reverse the negative impact on income per capita growth, hence facilitating the process of economic growth.

In terms of regional grouping estimations, this study finds similar results as those for the income groups. Physical and human capital have a positive effect on income per capita, while labor force has a negative impact. In addition, trade openness was an important source of growth for Africa and Asia, but not for Latin America. The decomposition of trade between agricultural and nonagricultural indicate that the largest sources of income growth come about because trade in nonagricultural goods. On the other hand, trade in agricultural goods has a negative and significant impact on income per capita, for all regional groups.

Furthermore, Asian countries outperformed the rest of the sample countries, in all different categories. Asian countries derive the largest positive effect from investment in physical capital and human capital compared to the rest of the sample. In addition, Asian countries have the largest positive effect of trade openness on income per capita, and they also derive the highest positive effect from the promotion of trade openness in nonagricultural goods. Finally Asian countries minimize the negative effect of trade in agricultural goods compared to the rest of the sample, because Asian countries have the lowest ratios of agricultural trade to Gross Domestic Product relative to the rest of the regional groups. There are indeed, some important policy implications that can be derived from the Asian experience, that may be useful to enhance the process of economic growth in the rest of the sample countries.

Some final considerations for future research. First, it is relevant to address the possible effects of the International Trade Negotiations under the World Trade Organization on the process of economic development in developing countries. Second, estimate the effects of trade openness in a dynamic framework to determine both the static and dynamic gains/losses associated with the promotion of free trade. Finally, research could be conducted to determine whether countries converge, and at what speed, toward the steady-state level of income per capita, other things given.

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APPENDIX

Appendix 1.

Table 1. List of Countries Under Study

Argentina	Malta
Bangladesh	Mauritania
Barbados	Mauritius
Benin	Mexico
Bolivia	Morocco
Brazil	Myanmar
Burundi	Nepal
Cameroon	Nicaragua
Central African Republic	Niger
Chile	Nigeria
China	Pakistan
Colombia	Panama
Costa Rica	Papua New Guinea
Cote d'Ivoire	Paraguay
Ecuador	Peru
Egypt	Philippines
Ethiopia	Salvador
Fiji	Senegal
Gambia	Sierra Leone
Ghana	Singapore
Greece	Sri Lanka
Guatemala	Sudan
Haiti	Tanzania
Honduras	Thailand
India	Togo
Indonesia	Trinidad and Tobago
Jamaica	Tunisia
Kenya	Turkey
Malawi	Uruguay
Malaysia	Zambia
Mali	Zimbabwe

Table 2. List of Countries by Region and Income Level

Africa [a]	Latin America [b]	Asia [c]	Low [d]	Middle [e]	High [f]
Burundi	Argentina	Bangladesh	Bangladesh	Bolivia	Argentina
Benin	Bolivia	China	Benin	Cameroon	Barbados
Central Afric Rep	Brazil	Fiji	Burundi	Chile	Brazil
Cote d'Ivoire	Barbados	Greece	Central Afric Rep	Colombia	Fiji
Cameroon	Chile	Indonesia	China	Costa Rica	Greece
Egypt	Colombia	India	Egypt	Cote d'Ivoire	Jamaica
Ethiopia	Costa Rica	Sri Lanka	Ethiopia	Ecuador	Malta
Ghana	Ecuador	Myanmar	Gambia	El Salvador	Mexico
Gambia	Guatemala	Malaysia	Haiti	Ghana	Nicaragua
Kenya	Honduras	Nepal	India	Guatemala	Panama
Morocco	Haiti	Pakistan	Indonesia	Honduras	Singapore
Mali	Jamaica	Philippines	Kenya	Malaysia	Trinidad & Tobago
Malta	Mexico	Papua New Guinea	Malawi	Mauritius	Uruguay
Mauritania	Nicaragua	Singapore	Mali	Morocco	
Mauritius	Panama	Thailand	Mauritania	Papua New Guinea	
Malawi	Peru	Turkey	Myanmar	Paraguay	
Niger	Paraguay		Nepal	Peru	
Nigeria	Salvador		Niger	Philippines	
Sudan	Trinidad & Tobago		Nigeria	Senegal	
Senegal	Uruguay		Pakistan	Sudan	
Sierra Leone			Sierra Leone	Thailand	
Togo			Sri Lanka	Tunisia	
Tunisia			Tanzania	Turkey	
Tanzania			Togo	Zambia	
Zambia				Zimbabwe	
Zimbabwe					

[a] Africa includes North Africa and South-Saharan Africa

[b] Latin America includes Latin America and the Caribbean

[c] Asia includes Middle East, Central Asia, South Asia, East Asia and Pacific

[d] Low Income countries have in 1973 a income per capita in 1987 dollars of less than $600

[e] Middle Income countries have in 1973 a income per capita in 1987 dollars between $601 and $1500

[f] High Income countries have in 1973 a income per capita in 1987 dollars greater than $1500

Table 3. List of Countries Under Study and Correspondent Acronyms

Bangladesh	BGD
Benin	BEN
Burundi	BDI
Central African Republic	CAF
China	CHN
Egypt	EGY
Ethiopia	ETH
Gambia	GMB
Haiti	HTI
India	IND
Indonesia	IDN
Kenya	KEN
Malawi	MWI
Mali	MLI
Mauritania	MRT
Myanmar	MMR
Nepal	NPL
Niger	NER
Nigeria	NGA
Pakistan	PAK
Sierra Leone	SLE
Sri Lanka	LKA
Tanzania	TZA
Togo	TGO
Bolivia	BOL
Cameroon	CMR
Chile	CHL
Colombia	COL
Costa Rica	CRI
Cote d'Ivoire	CIV
Ecuador	ECU
El Salvador	SLV
Ghana	GHA
Guatemala	GTM
Honduras	HND
Malaysia	MYS
Mauritius	MUS
Morocco	MAR
Papua New Guinea	PNG
Paraguay	PRY
Peru	PER
Philippines	PHL
Senegal	SEN
Sudan	SDN
Thailand	THA
Tunisia	TUN
Turkey	TUR
Zambia	ZMB
Zimbabwe	ZWE
Argentina	ARG
Barbados	BRB
Brazil	BRA
Fiji	FJI
Greece	GRC
Jamaica	JAM
Malta	MLT
Mexico	MEX
Nicaragua	NIC
Panama	PAN
Singapore	SGP
Trinidad and Tobago	TTO
Uruguay	URY

Appendix 2.

Table 1. Low Income Developing Countries, Per Capita Income of $0-600 in 1973 @ 1987=100 [a]

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Burundi									
1973-1976	0.90	14.57	-2.09	-2.37	-1.60	-1.42	5.22	-2.78	-1.52
1977-1980	1.00	14.62	-1.86	-2.04	-1.27	-1.24	5.36	-2.01	-1.25
1981-1984	1.24	14.69	-2.07	-1.96	-1.46	-1.17	5.32	-1.72	-1.32
1985-1988	1.44	14.77	-1.92	-1.99	-1.26	-1.26	5.42	-1.88	-1.26
1989-1992	1.73	14.87	-2.16	-1.90	-1.45	-1.23	5.40	-1.75	-1.33
Benin									
1973-1976	2.20	14.27	-2.17	-1.52	-1.03	-1.13	5.92	-1.79	-1.09
1977-1980	2.51	14.36	-2.27	-1.51	-1.20	-1.09	5.90	-1.78	-1.12
1981-1984	3.04	14.44	-2.01	-1.30	-0.90	-0.90	5.94	-1.74	-0.90
1985-1988	2.75	14.52	-2.12	-1.55	-1.03	-1.14	5.93	-2.13	-1.10
1989-1992	2.40	14.62	-2.54	-1.99	-1.54	-1.52	5.83	-2.00	-1.53
Bangladesh									
1973-1976	3.15	16.92	-2.88	-2.22	-2.31	-1.38	4.87	-2.54	-1.80
1977-1980	2.88	17.01	-2.67	-1.99	-2.00	-1.27	4.92	-2.10	-1.58
1981-1984	2.92	17.11	-2.76	-2.08	-1.85	-1.57	5.04	-1.96	-1.67
1985-1988	2.86	17.22	-2.84	-2.04	-1.93	-1.52	5.14	-2.06	-1.66
1989-1992	2.92	17.34	-3.02	-2.11	-2.00	-1.66	5.18	-2.09	-1.77
Central African Republic									
1973-1976	2.14	13.93	-1.99	-1.81	-0.99	-1.35	6.07	-1.88	-1.20
1977-1980	2.41	13.98	-2.23	-2.08	-1.25	-1.61	6.12	-2.34	-1.45
1981-1984	2.77	14.03	-2.20	-1.87	-1.24	-1.38	5.97	-2.34	-1.33
1985-1988	2.56	14.09	-2.38	-1.83	-1.44	-1.33	5.97	-2.09	-1.37
1989-1992	2.48	14.15	-2.45	-1.90	-1.56	-1.36	5.87	-2.09	-1.44
China									
1973-1976	3.85	19.98	-4.03	-2.59	-2.91	-2.19	4.61	-1.23	-2.38
1977-1980	4.10	20.08	-3.62	-2.17	-2.41	-1.81	4.78	-1.15	-1.96
1981-1984	3.58	20.18	-3.17	-1.78	-2.07	-1.37	5.06	-1.23	-1.56
1985-1988	3.74	20.27	-2.86	-1.45	-1.60	-1.11	5.42	-0.96	-1.23
1989-1992	3.88	20.34	-2.80	-1.22	-1.40	-0.94	5.65	-1.07	-1.03
Egypt									
1973-1976	3.78	16.11	-1.74	-1.71	-0.46	-1.38	6.06	-1.47	-1.02
1977-1980	3.91	16.20	-1.94	-1.34	-0.38	-1.10	6.33	-1.20	-0.90
1981-1984	4.07	16.30	-1.84	-1.14	-0.18	-0.92	6.51	-1.24	-0.73
1985-1988	4.22	16.41	-2.37	-1.68	-0.72	-1.47	6.52	-1.47	-1.28
1989-1992	4.39	16.51	-2.18	-1.55	-0.41	-1.37	6.50	-1.57	-1.12
Ethiopia									
1973-1976	1.94	16.57	-2.31	-2.32	-1.64	-1.59	4.84	-2.27	-1.61
1977-1980	2.16	16.65	-2.21	-2.00	-1.51	-1.31	4.82	-2.44	-1.41
1981-1984	2.40	16.73	-2.25	-1.82	-1.75	-0.88	4.82	-2.07	-1.32
1985-1988	2.62	16.80	-2.15	-1.85	-1.70	-0.82	4.74	-1.77	-1.29
1989-1992	2.56	16.88	-2.90	-2.21	-2.59	-0.73	4.66	-2.09	-1.80
Gambia									
1973-1976	2.35	12.47	-0.80	-1.20	0.32	-0.81	5.88	-2.47	-0.28
1977-1980	2.42	12.55	-0.96	-0.90	0.34	-0.58	5.91	-1.43	-0.23
1981-1984	2.83	12.60	-0.98	-0.91	0.18	-0.53	5.57	-1.60	-0.25
1985-1988	2.79	12.66	-1.12	-1.05	0.16	-0.72	5.60	-1.83	-0.39
1989-1992	2.89	12.71	-1.22	-0.82	0.22	-0.55	5.74	-1.60	-0.31

Table 1. Low Income Developing Countries, Per Capita Income of $0-600 in 1973 @ 1987=100 [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Haiti									
1973-1976	2.19	14.70	-2.08	-1.83	-1.13	-1.35	5.86	-1.85	-1.25
1977-1980	2.50	14.74	-1.87	-1.50	-0.80	-1.08	5.98	-1.77	-0.97
1981-1984	2.76	14.80	-1.95	-1.44	-0.81	-1.06	5.94	-1.78	-0.97
1985-1988	2.96	14.88	-2.28	-1.82	-1.15	-1.43	5.86	-1.92	-1.33
1989-1992	3.07	14.97	-2.75	-2.22	-1.66	-1.80	5.74	-2.39	-1.75
Indonesia									
1973-1976	3.00	17.73	-2.35	-1.32	-1.22	-0.92	5.37	-1.52	-1.01
1977-1980	3.17	17.81	-2.30	-1.28	-1.00	-0.98	5.67	-1.41	-0.97
1981-1984	3.57	17.91	-2.79	-1.06	-1.33	-0.79	5.98	-1.27	-0.89
1985-1988	3.82	18.00	-2.58	-1.29	-1.14	-1.02	6.05	-1.29	-1.04
1989-1992	3.81	18.09	-2.46	-1.01	-0.91	-0.77	6.21	-1.18	-0.80
India									
1973-1976	3.26	19.30	-3.24	-2.80	-2.28	-2.32	5.49	-1.61	-2.30
1977-1980	3.37	19.37	-3.37	-2.54	-2.30	-2.12	5.57	-1.54	-2.17
1981-1984	3.56	19.45	-3.48	-2.37	-2.34	-1.99	5.64	-1.50	-2.09
1985-1988	3.66	19.53	-3.61	-2.42	-2.36	-2.09	5.76	-1.41	-2.16
1989-1992	3.77	19.60	-3.53	-2.11	-2.25	-1.78	5.90	-1.41	-1.89
Kenya									
1973-1976	2.64	15.57	-1.97	-1.20	-0.82	-0.82	5.89	-1.50	-0.82
1977-1980	2.90	15.72	-1.85	-1.07	-0.70	-0.69	5.98	-1.35	-0.69
1981-1984	2.98	15.86	-2.02	-1.27	-0.78	-0.93	5.86	-1.49	-0.88
1985-1988	3.09	16.00	-2.04	-1.44	-0.77	-1.12	5.88	-1.42	-1.00
1989-1992	3.37	16.14	-2.18	-1.35	-0.77	-1.07	5.91	-1.53	-0.99
Sri Lanka									
1973-1976	3.87	15.37	-1.53	-2.28	-0.28	-1.94	5.55	-1.88	-1.14
1977-1980	3.90	15.47	-1.18	-1.28	0.12	-0.96	5.76	-1.50	-0.51
1981-1984	4.08	15.55	-1.59	-1.01	-0.23	-0.71	5.90	-1.27	-0.56
1985-1988	4.19	15.62	-1.81	-1.12	-0.39	-0.84	6.00	-1.47	-0.71
1989-1992	4.30	15.67	-1.80	-0.86	-0.35	-0.59	6.06	-1.49	-0.53
Mali									
1973-1976	2.01	14.55	-1.74	-1.95	-1.15	-1.13	5.48	-1.86	-1.12
1977-1980	2.20	14.62	-1.99	-1.77	-1.44	-0.91	5.64	-1.79	-1.17
1981-1984	1.98	14.71	-1.51	-1.32	-0.90	-0.54	5.57	-1.82	-0.72
1985-1988	1.84	14.81	-1.77	-1.51	-0.93	-0.95	5.57	-1.63	-0.94
1989-1992	1.89	14.91	-1.62	-1.47	-0.81	-0.88	5.32	-1.51	-0.85
Myanmar									
1973-1976	3.02	16.41	-2.92	-2.84	-2.11	-2.25	5.36	-2.27	-2.19
1977-1980	3.04	16.50	-2.67	-2.63	-1.88	-2.03	5.51	-1.70	-1.96
1981-1984	3.17	16.58	-2.70	-2.78	-1.96	-2.13	5.66	-1.65	-2.04
1985-1988	3.19	16.66	-3.56	-3.36	-2.92	-2.80	5.60	-2.04	-2.76
1989-1992	3.00	16.73	-4.20	-4.06	-3.69	-3.13	5.47	-2.04	-3.43
Mauritania									
1973-1976	1.39	13.06	-0.76	-1.31	0.47	-0.96	6.29	-1.55	-0.30
1977-1980	2.15	13.13	-1.09	-1.22	0.20	-0.90	6.17	-1.12	-0.46
1981-1984	2.59	13.22	-0.86	-1.36	0.39	-1.02	6.16	-1.18	-0.38
1985-1988	2.76	13.33	-0.68	-1.47	0.69	-1.17	6.15	-1.23	-0.31
1989-1992	2.64	13.44	-0.64	-1.02	0.69	-0.71	6.18	-1.65	-0.11

Table 1. Low Income Developing Countries, Per Capita Income of $0-400 in 1973 @ 1987=100 [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Malawi									
1973-1976	1.39	14.68	-1.41	-1.20	-0.43	-0.73	5.18	-1.30	-0.60
1977-1980	1.31	14.77	-1.46	-1.13	-0.45	-0.68	5.19	-1.24	-0.59
1981-1984	1.39	14.87	-1.46	-1.44	-0.37	-1.03	5.09	-1.70	-0.75
1985-1988	1.39	14.98	-1.45	-1.43	-0.33	-1.04	5.01	-1.83	-0.75
1989-1992	1.39	15.08	-1.46	-1.19	-0.24	-0.84	5.04	-1.63	-0.62
Niger									
1973-1976	0.90	14.76	-2.34	-2.50	-1.75	-1.68	5.83	-1.92	-1.72
1977-1980	1.36	14.84	-1.58	-1.82	-0.86	-1.15	5.97	-1.36	-1.00
1981-1984	1.79	14.92	-1.45	-1.87	-0.61	-1.30	5.85	-2.20	-0.94
1985-1988	1.73	15.02	-1.61	-2.02	-0.57	-1.58	5.74	-1.94	-1.10
1989-1992	1.79	15.11	-1.93	-2.31	-0.92	-1.86	5.63	-2.48	-1.41
Nigeria									
1973-1976	2.14	17.11	-3.35	-1.13	-2.19	-0.75	6.00	-1.45	-1.02
1977-1980	2.65	17.24	-3.09	-0.99	-1.83	-0.66	6.33	-1.39	-0.88
1981-1984	3.26	17.35	-3.30	-1.30	-2.15	-0.91	6.07	-1.83	-1.17
1985-1988	3.22	17.46	-3.49	-1.30	-2.52	-0.82	5.70	-2.10	-1.19
1989-1992	2.98	17.56	-2.85	-0.73	-1.60	-0.39	5.79	-1.94	-0.61
Nepal									
1973-1976	2.52	15.53	-4.42	-3.45	-4.02	-2.34	4.93	-2.16	-3.11
1977-1980	2.86	15.60	-3.30	-2.39	-2.78	-1.49	4.95	-1.77	-2.05
1981-1984	3.13	15.69	-3.17	-1.89	-2.61	-1.05	4.96	-1.70	-1.64
1985-1988	3.33	15.78	-2.93	-1.65	-2.28	-0.90	5.05	-1.52	-1.40
1989-1992	3.58	15.87	-3.05	-1.59	-2.44	-0.82	5.16	-1.44	-1.39
Pakistan									
1973-1976	2.74	16.89	-2.32	-1.67	-1.14	-1.30	5.44	-1.91	-1.25
1977-1980	2.66	17.01	-2.50	-1.61	-1.23	-1.28	5.52	-1.69	-1.26
1981-1984	2.77	17.13	-2.63	-1.60	-1.32	-1.28	5.68	-1.67	-1.29
1985-1988	2.92	17.25	-2.57	-1.58	-1.16	-1.30	5.82	-1.68	-1.26
1989-1992	3.02	17.35	-2.62	-1.39	-1.17	-1.12	6.15	-1.64	-1.13
Sierra Leone									
1973-1976	2.44	14.01	-1.85	-1.01	-0.65	-0.64	4.94	-2.00	-0.65
1977-1980	2.52	14.05	-1.84	-0.89	-0.72	-0.50	5.03	-2.01	-0.57
1981-1984	2.84	14.09	-2.39	-1.77	-1.32	-1.34	5.06	-1.92	-1.32
1985-1988	2.91	14.14	-2.10	-1.88	-1.19	-1.37	4.94	-2.32	-1.29
1989-1992	2.80	14.19	-1.74	-1.52	-0.78	-1.18	4.92	-2.06	-0.93
Togo									
1973-1976	3.02	13.80	-1.40	-1.52	-0.15	-1.18	6.06	-1.50	-0.75
1977-1980	3.40	13.89	-1.28	-0.77	0.01	-0.44	6.12	-0.91	-0.29
1981-1984	3.20	13.98	-1.24	-1.03	-0.06	-0.66	5.96	-1.40	-0.44
1985-1988	3.08	14.07	-1.34	-1.28	-0.26	-0.86	5.95	-1.40	-0.61
1989-1992	3.16	14.16	-1.51	-1.41	-0.42	-1.00	5.88	-1.44	-0.76
Tanzania									
1973-1976	1.24	15.91	-1.73	-1.43	-0.70	-0.99	5.18	-1.53	-0.87
1977-1980	1.31	16.02	-2.04	-1.47	-1.11	-0.97	5.14	-1.38	-1.02
1981-1984	1.10	16.14	-2.47	-2.00	-1.67	-1.40	5.05	-1.71	-1.52
1985-1988	1.24	16.25	-2.45	-1.60	-1.81	-0.86	5.05	-1.46	-1.24
1989-1992	1.54	16.36	-1.88	-0.98	-1.10	-0.37	5.17	-0.82	-0.64

[a] Data is expressed as the natural logarithm of a four years average.
[b] Secondary school enrollment ratio
[c] Labor force
[d] Ratio of nonfuel primary exports and imports to Gross Domestic Product
[e] Ratio of all other exports plus imports to Gross Domestic Product
[f] Ratio of nonfuel primary exports and imports to Gross Domestic Agricultural Value Added
[g] Ratio of all other exports and imports to Gross Domestic Nonagricultural Value Added
[h] Per capita income in constant 1987 US $
[i] Ratio of Gross Domestic Investment to Gross Domestic Product
[j] Ratio of total exports and imports to Gross Domestic Product

Table 2. Middle Income Developing Countries, Per Capita Income of $601-1500 in 1973 at 1987=100 [a]

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Bolivia									
1973-1976	3.42	14.25	-1.29	-1.23	0.31	-1.01	6.81	-1.26	-0.56
1977-1980	3.52	14.34	-1.20	-1.20	0.48	-0.99	6.82	-1.56	-0.51
1981-1984	3.56	14.44	-1.69	-1.28	-0.27	-0.99	6.67	-2.28	-0.77
1985-1988	3.58	14.55	-2.19	-1.49	-1.10	-1.08	6.50	-2.29	-1.09
1989-1992	3.51	14.65	-1.92	-1.60	-0.65	-1.34	6.50	-1.99	-1.05
Chile									
1973-1976	3.88	15.00	-1.48	-2.10	1.21	-2.03	7.05	-1.82	-1.05
1977-1980	3.96	15.10	-1.69	-1.83	0.84	-1.75	7.03	-1.57	-1.06
1981-1984	4.13	15.20	-1.78	-1.97	1.02	-1.90	7.22	-1.95	-1.16
1985-1988	4.25	15.30	-1.44	-1.71	1.05	-1.62	7.28	-1.60	-0.88
1989-1992	4.30	15.38	-1.41	-1.41	1.04	-1.32	7.54	-1.34	-0.72
Cote d'Ivoire									
1973-1976	2.56	14.95	-1.03	-1.27	0.27	-0.95	6.94	-1.48	-0.45
1977-1980	2.85	15.05	-1.15	-1.31	0.21	-1.01	7.09	-1.28	-0.54
1981-1984	2.96	15.15	-1.16	-1.28	0.26	-1.00	6.82	-1.67	-0.52
1985-1988	3.00	15.25	-1.19	-1.41	0.09	-1.08	6.78	-2.08	-0.60
1989-1992	3.13	15.35	-1.05	-1.22	0.08	-0.83	6.43	-2.34	-0.44
Cameroon									
1973-1976	2.64	15.02	-1.65	-1.68	-0.42	-1.31	6.48	-1.68	-0.96
1977-1980	2.85	15.08	-1.75	-1.48	-0.58	-1.11	6.68	-1.26	-0.91
1981-1984	3.05	15.15	-2.42	-1.66	-1.02	-1.37	6.96	-1.12	-1.27
1985-1988	3.22	15.22	-2.64	-1.94	-1.16	-1.68	7.02	-1.39	-1.53
1989-1992	3.30	15.30	-2.10	-1.84	-0.75	-1.54	6.60	-1.76	-1.42
Colombia									
1973-1976	3.66	15.76	-2.28	-2.08	-0.85	-1.80	6.80	-1.69	-1.48
1977-1980	3.79	15.86	-2.16	-2.06	-0.65	-1.81	6.94	-1.68	-1.41
1981-1984	3.86	15.96	-2.56	-1.99	-0.87	-1.78	6.94	-1.61	-1.54
1985-1988	3.93	16.07	-2.39	-1.88	-0.63	-1.69	7.00	-1.62	-1.40
1989-1992	4.01	16.17	-2.51	-1.58	-0.68	-1.40	7.05	-1.70	-1.25
Costa Rica									
1973-1976	3.75	13.35	-1.47	-1.00	0.15	-0.78	7.32	-1.43	-0.51
1977-1980	3.84	13.50	-1.55	-0.98	0.08	-0.76	7.45	-1.39	-0.53
1981-1984	3.78	13.64	-1.32	-0.92	0.16	-0.66	7.24	-1.38	-0.41
1985-1988	3.70	13.75	-1.51	-1.16	0.15	-0.95	7.32	-1.36	-0.63
1989-1992	3.74	13.85	-1.50	-0.81	0.29	-0.62	7.37	-1.31	-0.40
Ecuador									
1973-1976	3.69	14.56	-2.13	-1.15	-0.43	-0.95	6.90	-1.47	-0.83
1977-1980	3.91	14.67	-2.18	-1.27	-0.23	-1.11	7.12	-1.32	-0.92
1981-1984	3.98	14.78	-2.54	-1.33	-0.47	-1.19	7.09	-1.58	-1.07
1985-1988	4.02	14.90	-2.05	-1.40	-0.12	-1.24	6.96	-1.57	-0.98
1989-1992	3.97	15.02	-1.92	-1.28	0.08	-1.11	6.96	-1.59	-0.84
Ghana									
1973-1976	3.60	15.15	-1.24	-1.56	-0.54	-0.87	6.15	-2.23	-0.69
1977-1980	3.62	15.25	-1.27	-1.44	-0.74	-0.55	6.11	-2.68	-0.66
1981-1984	3.66	15.35	-1.73	-1.58	-1.13	-0.78	5.90	-3.11	-0.95
1985-1988	3.68	15.46	-1.64	-1.91	-0.91	-1.25	5.89	-2.22	-1.07
1989-1992	3.66	15.57	-1.75	-1.62	-1.03	-0.95	5.90	-1.95	-0.99

Table 2. Middle Income Developing Countries, Per Capita Income of $801-1500 in 1973 at 1987=100 [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Guatemala									
1973-1976	2.52	14.38	-1.89	-1.53	-0.57	-1.22	6.87	-1.76	-1.00
1977-1980	2.72	14.46	-1.79	-1.52	-0.47	-1.21	6.99	-1.66	-0.95
1981-1984	2.87	14.56	-2.26	-1.69	-0.94	-1.38	6.83	-2.02	-1.24
1985-1988	2.99	14.68	-2.07	-1.76	-0.75	-1.45	6.72	-2.10	-1.21
1989-1992	3.33	14.80	-2.14	-1.56	-0.78	-1.27	6.76	-1.91	-1.12
Honduras									
1973-1976	2.80	13.71	-1.28	-1.12	0.06	-0.82	6.75	-1.58	-0.50
1977-1980	3.16	13.84	-1.14	-1.02	0.30	-0.75	6.92	-1.38	-0.38
1981-1984	3.48	13.99	-1.44	-1.36	0.21	-1.14	6.79	-1.81	-0.70
1985-1988	3.51	14.14	-1.61	-1.62	0.07	-1.41	6.80	-1.76	-0.92
1989-1992	2.94	14.29	-1.51	-1.24	0.15	-1.03	6.80	-1.47	-0.68
Morocco									
1973-1976	2.80	15.34	-1.50	-1.70	0.15	-1.49	6.42	-1.50	-0.89
1977-1980	3.07	15.49	-1.86	-1.59	-0.14	-1.39	6.54	-1.32	-1.02
1981-1984	3.36	15.63	-1.75	-1.35	0.17	-1.20	6.56	-1.35	-0.84
1985-1988	3.58	15.76	-1.90	-1.41	-0.13	-1.22	6.66	-1.48	-0.93
1989-1992	3.48	15.89	-2.07	-1.28	-0.31	-1.09	6.73	-1.45	-0.91
Mauritius									
1973-1976	3.71	12.54	-0.69	-0.99	0.90	-0.75	7.10	-1.31	-0.13
1977-1980	3.84	12.66	-0.90	-0.81	1.02	-0.65	7.17	-1.28	-0.16
1981-1984	3.92	12.79	-1.05	-0.87	1.05	-0.74	7.07	-1.59	-0.26
1985-1988	3.93	12.91	-0.94	-0.54	1.16	-0.41	7.35	-1.38	-0.01
1989-1992	3.98	13.00	-1.22	-0.28	1.10	-0.18	7.57	-1.22	0.08
Malaysia									
1973-1976	3.79	15.29	-0.91	-1.01	0.37	-0.69	7.09	-1.34	-0.27
1977-1980	3.89	15.44	-0.94	-0.77	0.48	-0.49	7.35	-1.28	-0.15
1981-1984	3.93	15.56	-1.21	-0.49	0.34	-0.25	7.50	-1.03	-0.09
1985-1988	4.02	15.68	-1.25	-0.40	0.14	-0.12	7.50	-1.36	-0.05
1989-1992	4.05	15.78	-1.32	0.08	0.30	0.15	7.75	-1.12	0.30
Peru									
1973-1976	3.84	15.31	-2.20	-2.30	-0.37	-2.13	7.21	-1.47	-1.55
1977-1980	4.01	15.45	-1.95	-2.07	0.13	-1.94	7.17	-1.52	-1.31
1981-1984	4.11	15.57	-2.36	-2.06	-0.18	-1.94	7.11	-1.29	-1.50
1985-1988	4.16	15.68	-2.20	-2.07	-0.08	-1.94	7.08	-1.55	-1.44
1989-1992	3.95	15.79	-2.28	-2.31	-0.30	-2.16	6.87	-1.80	-1.60
Philippines									
1973-1976	4.04	16.56	-1.75	-1.53	-0.56	-1.17	6.35	-1.28	-0.93
1977-1980	4.15	16.65	-1.94	-1.37	-0.65	-1.05	6.46	-1.18	-0.92
1981-1984	4.20	16.74	-2.27	-1.29	-0.84	-1.02	6.46	-1.33	-0.97
1985-1988	4.21	16.84	-2.33	-1.33	-0.89	-1.06	6.34	-1.76	-1.02
1989-1992	4.29	16.94	-2.32	-0.99	-0.80	-0.75	6.43	-1.52	-0.76
Papua New Guinea									
1973-1976	2.48	14.02	-0.97	-1.56	0.25	-1.21	6.93	-1.72	-0.52
1977-1980	2.42	14.08	-0.73	-1.26	0.34	-0.84	6.91	-1.46	-0.27
1981-1984	2.40	14.15	-0.93	-1.06	0.15	-0.64	6.70	-1.24	-0.30
1985-1988	2.52	14.21	-0.95	-1.19	0.22	-0.81	6.72	-1.53	-0.37
1989-1992	2.52	14.27	-1.05	-1.00	0.26	-0.68	6.64	-1.40	-0.33

Table 2. Middle Income Developing Countries, Per Capita Income of $601-1500 in 1973 at 1987=100 [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Paraguay									
1973-1976	3.07	13.67	-2.08	-2.06	-1.06	-1.61	6.66	-1.51	-1.37
1977-1980	3.21	13.81	-2.27	-1.98	-1.11	-1.61	6.94	-1.28	-1.42
1981-1984	3.41	13.94	-2.73	-2.25	-1.41	-1.93	7.00	-1.38	-1.76
1985-1988	3.38	14.06	-2.26	-1.92	-1.00	-1.59	6.85	-1.42	-1.38
1989-1992	3.39	14.17	-1.83	-1.56	-0.52	-1.24	6.95	-1.44	-0.98
Sudan									
1973-1976	2.64	15.48	-1.84	-1.88	-0.86	-1.40	6.60	-1.76	-1.15
1977-1980	2.76	15.58	-2.25	-2.19	-1.12	-1.79	6.77	-1.95	-1.53
1981-1984	2.90	15.69	-2.24	-2.12	-1.06	-1.74	6.69	-1.84	-1.48
1985-1988	3.00	15.80	-2.58	-2.56	-1.78	-1.93	6.52	-1.87	-1.88
1989-1992	3.09	15.92	-2.32	-2.34	-1.11	-1.99	6.50	-2.00	-1.63
Senegal									
1973-1976	2.30	14.61	-1.24	-1.39	0.09	-1.08	6.53	-1.68	-0.62
1977-1980	2.33	14.74	-1.39	-1.16	0.10	-0.90	6.49	-1.83	-0.57
1981-1984	2.51	14.83	-1.27	-1.00	0.37	-0.78	6.44	-2.15	-0.43
1985-1988	2.69	14.91	-1.77	-1.42	-0.22	-1.18	6.45	-2.17	-0.88
1989-1992	2.77	14.99	-1.85	-1.59	-0.21	-1.38	6.46	-2.05	-1.02
Salvador									
1973-1976	2.99	14.11	-1.36	-1.04	-0.01	-0.74	7.03	-1.58	-0.49
1977-1980	3.20	14.23	-1.46	-1.11	-0.22	-0.77	7.14	-1.65	-0.57
1981-1984	3.23	14.35	-1.94	-1.25	-0.43	-1.00	6.78	-2.05	-0.84
1985-1988	3.37	14.47	-1.89	-1.52	-0.07	-1.34	6.79	-2.10	-0.99
1989-1992	3.24	14.60	-2.47	-1.70	-0.22	-1.58	6.77	-1.95	-1.32
Thailand									
1973-1976	3.28	16.82	-1.85	-1.54	-0.54	-1.23	6.40	-1.34	-0.99
1977-1980	3.34	16.93	-1.76	-1.35	-0.34	-1.07	6.56	-1.28	-0.84
1981-1984	3.42	17.04	-1.86	-1.28	-0.22	-1.06	6.65	-1.24	-0.83
1985-1988	3.37	17.13	-1.91	-1.13	-0.07	-0.96	6.81	-1.25	-0.75
1989-1992	3.47	17.21	-1.90	-0.69	0.13	-0.54	7.16	-0.93	-0.42
Tunisia									
1973-1976	3.07	14.27	-1.90	-1.09	-0.22	-0.89	6.84	-1.34	-0.72
1977-1980	3.21	14.41	-2.14	-0.74	-0.21	-0.58	6.99	-1.20	-0.52
1981-1984	3.51	14.54	-2.09	-0.63	-0.07	-0.49	7.11	-1.16	-0.42
1985-1988	3.70	14.66	-2.18	-0.85	-0.20	-0.70	7.08	-1.50	-0.61
1989-1992	3.80	14.78	-2.15	-0.56	-0.27	-0.39	7.15	-1.35	-0.37

Table 2. Middle Income Developing Countries, Per Capita Income of $601-1600 in 1973 at 1987=100 [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Turkey									
1973-1976	3.42	16.68	-2.94	-2.16	-1.59	-1.86	6.90	-1.51	-1.78
1977-1980	3.55	16.74	-3.29	-2.28	-1.82	-2.02	6.98	-1.56	-1.97
1981-1984	3.64	16.82	-2.63	-1.56	-0.99	-1.34	6.94	-1.59	-1.26
1985-1988	3.79	16.91	-2.51	-1.31	-0.85	-1.10	7.10	-1.29	-1.04
1989-1992	3.95	16.99	-2.60	-1.36	-1.05	-1.12	7.19	-1.11	-1.10
Zambia									
1973-1976	2.74	14.31	-0.82	-1.40	1.28	-1.27	6.13	-1.07	-0.37
1977-1980	2.77	14.42	-0.97	-1.47	0.90	-1.30	5.71	-1.56	-0.49
1981-1984	2.83	14.54	-1.20	-1.52	0.72	-1.36	5.50	-1.83	-0.65
1985-1988	2.94	14.67	-0.92	-1.45	1.09	-1.30	5.44	-1.87	-0.46
1989-1992	3.43	14.81	-0.98	-1.21	0.76	-1.01	5.46	-2.08	-0.54
Zimbabwe									
1973-1976	2.20	14.75	-1.71	-1.28	0.14	-1.11	6.54	-1.43	-0.78
1977-1980	2.14	14.86	-1.75	-1.35	0.30	-1.21	6.40	-1.88	-0.84
1981-1984	3.51	14.97	-1.98	-1.42	0.17	-1.29	6.48	-1.63	-0.97
1985-1988	3.83	15.08	-1.76	-1.38	0.17	-1.22	6.42	-1.65	-0.86
1989-1992	3.92	15.20	-1.77	-1.07	0.34	-0.94	6.41	-1.50	-0.67

[a] Data is expressed as the natural logarithm of a four years average.
[b] Secondary school enrollment ratio
[c] Labor force
[d] Ratio of nonfuel primary exports and imports to Gross Domestic Product
[e] Ratio of all other exports plus imports to Gross Domestic Product
[f] Ratio of nonfuel primary exports and imports to Gross Domestic Agricultural Value Added
[g] Ratio of all other exports and imports to Gross Domestic Nonagricultural Value Added
[h] Per capita income in constant 1987 US $
[i] Ratio of Gross Domestic Investment to Gross Domestic Product
[j] Ratio of total exports and imports to Gross Domestic Product

Table 3. High Income Developing Countries, Per Capita Income of $1500 or > in 1973 @ 1987=100 [a]

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Argentina									
1973-1976	4.02	16.10	-2.84	-2.82	-0.43	-2.73	8.22	-1.37	-2.14
1977-1980	4.03	16.14	-2.38	-2.26	0.22	-2.18	8.24	-1.30	-1.62
1981-1984	4.13	16.18	-2.62	-2.61	-0.12	-2.52	8.14	-1.55	-1.92
1985-1988	4.26	16.22	-2.88	-2.79	-0.37	-2.71	8.09	-1.70	-2.14
1989-1992	4.35	16.27	-2.89	-2.65	-0.30	-2.57	8.05	-1.89	-2.06
Brazil									
1973-1976	3.33	17.42	-2.68	-2.23	-0.49	-2.11	7.41	-1.40	-1.73
1977-1980	3.48	17.56	-2.83	-2.34	-0.59	-2.22	7.54	-1.48	-1.86
1981-1984	3.56	17.66	-2.78	-2.15	-0.42	-2.05	7.46	-1.67	-1.72
1985-1988	3.61	17.75	-2.91	-2.31	-0.56	-2.21	7.57	-1.57	-1.87
1989-1992	3.66	17.84	-3.17	-2.45	-0.77	-2.38	7.53	-1.56	-2.05
Barbados									
1973-1976	4.34	11.57	-1.30	-0.76	1.03	-0.65	8.40	-1.49	-0.30
1977-1980	4.43	11.65	-1.54	-0.61	0.91	-0.52	8.53	-1.48	-0.28
1981-1984	4.51	11.72	-1.89	-0.44	0.87	-0.37	8.54	-1.55	-0.22
1985-1988	4.49	11.78	-2.13	-0.83	0.54	-0.76	8.64	-1.82	-0.58
1989-1992	4.47	11.83	-2.11	-1.00	0.72	-0.98	8.69	-1.67	-0.71
Fiji									
1973-1976	4.10	12.09	-1.38	-1.09	0.08	-0.82	7.43	-1.57	-0.53
1977-1980	4.07	12.20	-1.26	-1.03	0.33	-0.80	7.51	-1.32	-0.44
1981-1984	3.97	12.29	-1.50	-1.02	0.24	-0.83	7.50	-1.41	-0.54
1985-1988	3.94	12.38	-1.49	-1.19	0.20	-0.98	7.44	-1.78	-0.63
1989-1992	4.11	12.45	-1.41	-0.76	0.32	-0.67	7.57	-1.94	-0.34
Greece									
1973-1976	4.37	15.06	-2.34	-1.39	-0.58	-1.20	8.28	-1.23	-1.06
1977-1980	4.39	15.10	-2.43	-1.29	-0.52	-1.13	8.40	-1.27	-1.01
1981-1984	4.45	15.13	-2.30	-1.25	-0.46	-1.08	8.40	-1.52	-0.95
1985-1988	4.55	15.15	-2.19	-1.25	-0.25	-1.10	8.43	-1.64	-0.92
1989-1992	4.58	15.16	-2.18	-1.16	-0.17	-1.02	8.51	-1.60	-0.85
Jamaica									
1973-1976	4.06	13.59	-1.60	-0.92	1.01	-0.84	7.43	-1.41	-0.51
1977-1980	4.11	13.71	-1.59	-0.81	0.95	-0.72	7.25	-1.87	-0.43
1981-1984	4.09	13.83	-1.54	-0.59	1.18	-0.52	7.15	-1.53	-0.26
1985-1988	4.11	13.94	-1.63	-0.74	1.02	-0.67	7.04	-1.48	-0.40
1989-1992	4.12	14.05	-1.67	-0.56	0.98	-0.48	7.16	-1.23	-0.27
Mexico									
1973-1976	3.57	16.68	-3.36	-2.62	-1.13	-2.51	7.36	-1.55	-2.23
1977-1980	3.75	16.85	-3.26	-2.28	-0.88	-2.18	7.49	-1.43	-1.96
1981-1984	3.98	17.00	-3.31	-1.73	-0.78	-1.65	7.59	-1.49	-1.54
1985-1988	3.99	17.12	-3.06	-1.66	-0.63	-1.57	7.47	-1.62	-1.44
1989-1992	4.01	17.25	-3.14	-1.70	-0.61	-1.62	7.53	-1.47	-1.49
Malta									
1973-1976	4.30	11.69	-1.18	-0.11	1.64	-0.05	7.96	-1.39	0.19
1977-1980	4.25	11.76	-1.42	0.01	1.79	0.05	8.31	-1.39	0.22
1981-1984	4.34	11.82	-1.74	-0.14	1.53	-0.10	8.44	-1.23	0.05
1985-1988	4.36	11.86	-1.91	-0.09	1.34	-0.05	8.48	-1.29	0.06
1989-1992	4.44	11.90	-1.96	0.16	1.55	0.19	8.74	-1.19	0.27

Table 3. High Income Developing Countries, Per Capita Income of $1500 or > in 1973 @ 1987=100 [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Nicaragua									
1973-1976	3.26	13.47	-1.38	-1.10	0.04	-0.82	7.44	-1.45	-0.54
1977-1980	3.47	13.58	-1.15	-1.04	0.22	-0.74	7.26	-1.71	-0.39
1981-1984	3.74	13.72	-1.66	-1.27	-0.17	-1.01	7.03	-1.53	-0.75
1985-1988	3.68	13.87	-2.17	-1.38	-0.80	-1.09	6.87	-1.60	-1.01
1989-1992	3.72	14.02	-1.33	-0.97	-0.15	-0.61	6.46	-1.56	-0.44
Panama									
1973-1976	4.05	13.26	-2.10	-0.83	0.05	-0.71	7.57	-1.13	-0.58
1977-1980	4.16	13.36	-2.17	-0.93	-0.01	-0.80	7.59	-1.34	-0.67
1981-1984	4.08	13.47	-2.41	-1.13	-0.12	-1.02	7.68	-1.47	-0.88
1985-1988	4.09	13.58	-2.47	-1.57	-0.22	-1.45	7.70	-2.03	-1.22
1989-1992	4.09	13.69	-2.39	-1.36	-0.20	-1.24	7.55	-2.08	-1.05
Singapore									
1973-1976	3.97	13.70	-0.58	0.63	3.39	0.65	8.34	-0.88	0.89
1977-1980	4.05	13.86	-0.40	0.93	3.80	0.94	8.51	-0.89	1.16
1981-1984	4.20	13.97	-0.80	0.97	3.80	0.98	8.81	-0.74	1.13
1985-1988	4.20	14.04	-0.92	0.94	4.26	0.94	8.96	-0.94	1.08
1989-1992	4.25	14.08	-1.21	0.99	4.76	1.00	9.30	-0.99	1.10
Trinidad and Tobago									
1973-1976	3.95	12.79	-2.16	0.31	1.15	0.35	8.16	-1.39	0.39
1977-1980	4.14	12.87	-2.42	0.05	1.09	0.08	8.44	-1.23	0.13
1981-1984	4.32	12.95	-2.54	-0.44	1.22	-0.42	8.42	-1.32	-0.32
1985-1988	4.42	13.05	-2.57	-0.75	1.05	-0.72	8.30	-1.72	-0.60
1989-1992	4.42	13.13	-2.39	-0.57	1.29	-0.55	8.22	-1.94	-0.42
Uruguay									
1973-1976	4.12	13.92	-2.24	-2.00	-0.51	-1.80	7.78	-1.48	-1.42
1977-1980	4.09	13.93	-2.31	-1.69	-0.39	-1.53	7.90	-1.55	-1.26
1981-1984	4.23	13.96	-2.13	-1.76	-0.07	-1.62	7.75	-1.80	-1.23
1985-1988	4.31	13.98	-2.02	-1.62	-0.00	-1.47	7.67	-2.08	-1.10
1989-1992	4.39	14.02	-2.07	-1.54	0.12	-1.42	7.77	-2.08	-1.08

[a] Data is expressed as the natural logarithm of a four years average
[b] Secondary school enrollment ratio
[c] Labor force
[d] Ratio of nonfuel primary exports and imports to Gross Domestic Product
[e] Ratio of all other exports plus imports to Gross Domestic Product
[f] Ratio of nonfuel primary exports and imports to Gross Domestic Agricultural Value Added
[g] Ratio of all other exports and imports to Gross Domestic Nonagricultural Value Added
[h] Per capita income in constant 1987 US $
[i] Ratio of Gross Domestic Investment to Gross Domestic Product
[j] Ratio of total exports and Imports to Gross Domestic Product

Table 4. Latin America and Caribbean [a]

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Argentina									
1973-1976	4.02	16.10	-2.84	-2.82	-0.43	-2.73	8.22	-1.37	-2.14
1977-1980	4.03	16.14	-2.38	-2.26	0.22	-2.18	8.24	-1.30	-1.62
1981-1984	4.13	16.18	-2.62	-2.61	-0.12	-2.52	8.14	-1.55	-1.92
1985-1988	4.26	16.22	-2.88	-2.79	-0.37	-2.71	8.09	-1.70	-2.14
1989-1992	4.35	16.27	-2.89	-2.65	-0.30	-2.57	8.05	-1.89	-2.06
Bolivia									
1973-1976	3.42	14.25	-1.29	-1.23	0.31	-1.01	6.81	-1.26	-0.56
1977-1980	3.52	14.34	-1.20	-1.20	0.48	-0.99	6.82	-1.56	-0.51
1981-1984	3.56	14.44	-1.69	-1.28	-0.27	-0.98	6.67	-2.26	-0.77
1985-1988	3.58	14.55	-2.19	-1.49	-1.10	-1.08	6.50	-2.29	-1.09
1989-1992	3.51	14.65	-1.92	-1.60	-0.65	-1.34	6.50	-1.99	-1.05
Brazil									
1973-1976	3.33	17.42	-2.68	-2.23	-0.49	-2.11	7.41	-1.40	-1.73
1977-1980	3.48	17.56	-2.83	-2.34	-0.59	-2.22	7.54	-1.48	-1.86
1981-1984	3.56	17.66	-2.78	-2.15	-0.42	-2.05	7.46	-1.67	-1.72
1985-1988	3.61	17.75	-2.91	-2.31	-0.56	-2.21	7.57	-1.57	-1.87
1989-1992	3.66	17.84	-3.17	-2.45	-0.77	-2.38	7.53	-1.56	-2.05
Barbados									
1973-1976	4.34	11.57	-1.30	-0.76	1.03	-0.65	8.40	-1.49	-0.30
1977-1980	4.43	11.65	-1.54	-0.61	0.91	-0.52	8.53	-1.48	-0.28
1981-1984	4.51	11.72	-1.89	-0.44	0.87	-0.37	8.54	-1.55	-0.22
1985-1988	4.49	11.78	-2.13	-0.83	0.54	-0.76	8.64	-1.82	-0.58
1989-1992	4.47	11.83	-2.11	-1.00	0.72	-0.98	8.69	-1.67	-0.71
Chile									
1973-1976	3.88	15.00	-1.48	-2.10	1.21	-2.03	7.05	-1.82	-1.05
1977-1980	3.96	15.10	-1.69	-1.83	0.84	-1.75	7.03	-1.57	-1.06
1981-1984	4.13	15.20	-1.76	-1.97	1.02	-1.90	7.22	-1.95	-1.16
1985-1988	4.25	15.30	-1.44	-1.71	1.05	-1.62	7.28	-1.60	-0.88
1989-1992	4.30	15.38	-1.41	-1.41	1.04	-1.32	7.54	-1.34	-0.72
Colombia									
1973-1976	3.66	15.76	-2.28	-2.08	-0.85	-1.80	6.80	-1.69	-1.48
1977-1980	3.79	15.86	-2.16	-2.06	-0.65	-1.81	6.94	-1.68	-1.41
1981-1984	3.86	15.96	-2.56	-1.99	-0.87	-1.78	6.94	-1.61	-1.54
1985-1988	3.93	16.07	-2.39	-1.88	-0.63	-1.69	7.00	-1.62	-1.40
1989-1992	4.01	16.17	-2.51	-1.58	-0.68	-1.40	7.05	-1.70	-1.25
Costa Rica									
1973-1976	3.75	13.35	-1.47	-1.00	0.15	-0.78	7.32	-1.43	-0.51
1977-1980	3.84	13.50	-1.55	-0.98	0.08	-0.76	7.45	-1.39	-0.53
1981-1984	3.78	13.64	-1.32	-0.92	0.16	-0.66	7.24	-1.38	-0.41
1985-1988	3.70	13.75	-1.51	-1.16	0.15	-0.95	7.32	-1.36	-0.63
1989-1992	3.74	13.85	-1.50	-0.81	0.29	-0.62	7.37	-1.31	-0.40
Ecuador									
1973-1976	3.69	14.56	-2.13	-1.15	-0.43	-0.95	6.90	-1.47	-0.83
1977-1980	3.91	14.67	-2.18	-1.27	-0.23	-1.11	7.12	-1.32	-0.92
1981-1984	3.98	14.78	-2.54	-1.33	-0.47	-1.19	7.09	-1.58	-1.07
1985-1988	4.02	14.90	-2.05	-1.40	-0.12	-1.24	6.96	-1.57	-0.98
1989-1992	3.97	15.02	-1.92	-1.26	0.08	-1.11	6.96	-1.59	-0.84

Table 4. Latin America and Caribbean [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Guatemala									
1973-1976	2.52	14.38	-1.89	-1.53	-0.57	-1.22	6.87	-1.76	-1.00
1977-1980	2.72	14.46	-1.79	-1.52	-0.47	-1.21	6.99	-1.66	-0.95
1981-1984	2.87	14.56	-2.26	-1.69	-0.94	-1.38	6.83	-2.02	-1.24
1985-1988	2.99	14.68	-2.07	-1.76	-0.75	-1.45	6.72	-2.10	-1.21
1989-1992	3.33	14.80	-2.14	-1.56	-0.78	-1.27	6.76	-1.91	-1.12
Honduras									
1973-1976	2.80	13.71	-1.28	-1.12	0.06	-0.82	6.75	-1.58	-0.50
1977-1980	3.16	13.84	-1.14	-1.02	0.30	-0.75	6.92	-1.38	-0.38
1981-1984	3.48	13.99	-1.44	-1.36	0.21	-1.14	6.79	-1.81	-0.70
1985-1988	3.51	14.14	-1.61	-1.62	0.07	-1.41	6.80	-1.76	-0.92
1989-1992	2.94	14.29	-1.51	-1.24	0.15	-1.03	6.80	-1.47	-0.68
Haiti									
1973-1976	2.19	14.70	-2.08	-1.83	-1.13	-1.35	5.86	-1.85	-1.25
1977-1980	2.50	14.74	-1.87	-1.50	-0.80	-1.08	5.98	-1.77	-0.97
1981-1984	2.76	14.80	-1.95	-1.44	-0.81	-1.06	5.94	-1.78	-0.97
1985-1988	2.96	14.88	-2.28	-1.82	-1.15	-1.43	5.66	-1.92	-1.33
1989-1992	3.07	14.97	-2.75	-2.22	-1.66	-1.80	5.74	-2.39	-1.75
Jamaica									
1973-1976	4.06	13.59	-1.60	-0.92	1.01	-0.84	7.43	-1.41	-0.51
1977-1980	4.11	13.71	-1.59	-0.81	0.95	-0.72	7.25	-1.87	-0.43
1981-1984	4.09	13.83	-1.54	-0.59	1.18	-0.52	7.15	-1.53	-0.26
1985-1988	4.11	13.94	-1.63	-0.74	1.02	-0.67	7.04	-1.48	-0.40
1989-1992	4.12	14.05	-1.67	-0.56	0.98	-0.48	7.16	-1.23	-0.27
Mexico									
1973-1976	3.57	16.68	-3.36	-2.62	-1.13	-2.51	7.36	-1.55	-2.23
1977-1980	3.75	16.85	-3.26	-2.28	-0.88	-2.18	7.49	-1.43	-1.96
1981-1984	3.98	17.00	-3.31	-1.73	-0.78	-1.65	7.59	-1.49	-1.54
1985-1988	3.99	17.12	-3.06	-1.66	-0.63	-1.57	7.47	-1.62	-1.44
1989-1992	4.01	17.25	-3.14	-1.70	-0.61	-1.62	7.53	-1.47	-1.49
Nicaragua									
1973-1976	3.26	13.47	-1.38	-1.10	0.04	-0.82	7.44	-1.45	-0.54
1977-1980	3.47	13.58	-1.15	-1.04	0.22	-0.74	7.26	-1.71	-0.39
1981-1984	3.74	13.72	-1.66	-1.27	-0.17	-1.01	7.03	-1.53	-0.75
1985-1988	3.68	13.87	-2.17	-1.38	-0.80	-1.09	6.87	-1.60	-1.01
1989-1992	3.72	14.02	-1.33	-0.97	-0.15	-0.61	6.46	-1.56	-0.44
Panama									
1973-1976	4.05	13.26	-2.10	-0.83	0.05	-0.71	7.57	-1.13	-0.58
1977-1980	4.16	13.36	-2.17	-0.93	-0.01	-0.80	7.59	-1.34	-0.67
1981-1984	4.08	13.47	-2.41	-1.13	-0.12	-1.02	7.68	-1.47	-0.88
1985-1988	4.09	13.58	-2.47	-1.57	-0.22	-1.45	7.70	-2.03	-1.22
1989-1992	4.09	13.69	-2.39	-1.36	-0.20	-1.24	7.55	-2.08	-1.05
Peru									
1973-1976	3.84	15.31	-2.20	-2.30	-0.37	-2.13	7.21	-1.47	-1.55
1977-1980	4.01	15.45	-1.95	-2.07	0.13	-1.94	7.17	-1.52	-1.31
1981-1984	4.11	15.57	-2.36	-2.06	-0.18	-1.94	7.11	-1.29	-1.50
1985-1988	4.16	15.68	-2.20	-2.07	-0.08	-1.94	7.08	-1.55	-1.44
1989-1992	3.95	15.79	-2.28	-2.31	-0.30	-2.16	6.87	-1.80	-1.60

Table 4. Latin America and Carlbbean [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Paraguay									
1973-1976	3.07	13.67	-2.08	-2.06	-1.06	-1.61	6.66	-1.51	-1.37
1977-1980	3.21	13.81	-2.27	-1.98	-1.11	-1.61	6.94	-1.28	-1.42
1981-1984	3.41	13.94	-2.73	-2.25	-1.41	-1.93	7.00	-1.38	-1.76
1985-1988	3.38	14.06	-2.26	-1.92	-1.00	-1.59	6.85	-1.42	-1.38
1989-1992	3.39	14.17	-1.83	-1.56	-0.52	-1.24	6.95	-1.44	-0.98
Salvador									
1973-1976	2.99	14.11	-1.36	-1.04	-0.01	-0.74	7.03	-1.58	-0.49
1977-1980	3.20	14.23	-1.46	-1.11	-0.22	-0.77	7.14	-1.65	-0.57
1981-1984	3.23	14.35	-1.94	-1.25	-0.43	-1.00	6.78	-2.05	-0.84
1985-1988	3.37	14.47	-1.89	-1.52	-0.07	-1.34	6.79	-2.10	-0.99
1989-1992	3.24	14.60	-2.47	-1.70	-0.22	-1.58	6.77	-1.95	-1.32
Trinidad and Tobago									
1973-1976	3.95	12.79	-2.16	0.31	1.15	0.35	8.16	-1.39	0.39
1977-1980	4.14	12.87	-2.42	0.05	1.09	0.08	8.44	-1.23	0.13
1981-1984	4.32	12.95	-2.54	-0.44	1.22	-0.42	8.42	-1.32	-0.32
1985-1988	4.42	13.05	-2.57	-0.75	1.05	-0.72	8.30	-1.72	-0.60
1989-1992	4.42	13.13	-2.39	-0.57	1.29	-0.55	8.22	-1.94	-0.42
Uruguay									
1973-1976	4.12	13.92	-2.24	-2.00	-0.51	-1.80	7.78	-1.48	-1.42
1977-1980	4.09	13.93	-2.31	-1.69	-0.39	-1.53	7.90	-1.55	-1.26
1981-1984	4.23	13.96	-2.13	-1.76	-0.07	-1.62	7.75	-1.80	-1.23
1985-1988	4.31	13.98	-2.02	-1.62	-0.00	-1.47	7.67	-2.08	-1.10
1989-1992	4.39	14.02	-2.07	-1.54	0.12	-1.42	7.77	-2.08	-1.08

[a] Data is expressed as the natural logarithm of a four years average
[b] Secondary school enrollment ratio
[c] Labor force
[d] Ratio of nonfuel primary exports and imports to Gross Domestic Product
[e] Ratio of all other exports plus imports to Gross Domestic Product
[f] Ratio of nonfuel primary exports and imports to Gross Domestic Agricultural Value Added
[g] Ratio of all other exports and imports to Gross Domestic Nonagricultural Value Added
[h] Per capita income in constant 1987 US $
[i] Ratio of Gross Domestic Investment to Gross Domestic Product
[j] Ratio of total exports and imports to Gross Domestic Product

Table 6. Middle East, North Africa and South-Saharan Africa [a]

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Burundi									
1973-1976	0.90	14.57	-2.09	-2.37	-1.60	-1.42	5.22	-2.78	-1.52
1977-1980	1.00	14.62	-1.86	-2.04	-1.27	-1.24	5.36	-2.01	-1.25
1981-1984	1.24	14.69	-2.07	-1.96	-1.46	-1.17	5.32	-1.72	-1.32
1985-1988	1.44	14.77	-1.92	-1.99	-1.26	-1.26	5.42	-1.88	-1.28
1989-1992	1.73	14.87	-2.16	-1.90	-1.45	-1.23	5.40	-1.75	-1.33
Benin									
1973-1976	2.20	14.27	-2.17	-1.52	-1.03	-1.13	5.92	-1.79	-1.09
1977-1980	2.51	14.36	-2.27	-1.51	-1.20	-1.09	5.90	-1.78	-1.12
1981-1984	3.04	14.44	-2.01	-1.30	-0.90	-0.90	5.94	-1.74	-0.90
1985-1988	2.75	14.52	-2.12	-1.55	-1.03	-1.14	5.93	-2.13	-1.10
1989-1992	2.40	14.62	-2.54	-1.99	-1.54	-1.52	5.83	-2.00	-1.53
Central African Republic									
1973-1976	2.14	13.93	-1.99	-1.81	-0.99	-1.35	6.07	-1.88	-1.20
1977-1980	2.41	13.98	-2.23	-2.08	-1.25	-1.61	6.12	-2.34	-1.45
1981-1984	2.77	14.03	-2.20	-1.87	-1.24	-1.38	5.97	-2.34	-1.33
1985-1988	2.56	14.09	-2.38	-1.83	-1.44	-1.33	5.97	-2.09	-1.37
1989-1992	2.48	14.15	-2.45	-1.90	-1.56	-1.36	5.87	-2.09	-1.44
Cote d'Ivoire									
1973-1976	2.56	14.95	-1.03	-1.27	0.27	-0.95	6.94	-1.48	-0.45
1977-1980	2.85	15.05	-1.15	-1.31	0.21	-1.01	7.09	-1.28	-0.54
1981-1984	2.96	15.15	-1.16	-1.28	0.26	-1.00	6.82	-1.67	-0.52
1985-1988	3.00	15.25	-1.19	-1.41	0.09	-1.08	6.78	-2.08	-0.60
1989-1992	3.13	15.35	-1.05	-1.22	0.08	-0.83	6.43	-2.34	-0.44
Cameroon									
1973-1976	2.64	15.02	-1.65	-1.66	-0.42	-1.31	6.48	-1.68	-0.86
1977-1980	2.85	15.08	-1.75	-1.48	-0.58	-1.11	6.68	-1.26	-0.91
1981-1984	3.05	15.15	-2.42	-1.66	-1.02	-1.37	6.96	-1.12	-1.27
1985-1988	3.22	15.22	-2.64	-1.94	-1.16	-1.68	7.02	-1.39	-1.53
1989-1992	3.30	15.30	-2.10	-1.84	-0.75	-1.54	6.60	-1.76	-1.42
Egypt									
1973-1976	3.78	16.11	-1.74	-1.71	-0.46	-1.38	6.06	-1.47	-1.02
1977-1980	3.91	16.20	-1.94	-1.34	-0.38	-1.10	6.33	-1.20	-0.90
1981-1984	4.07	16.30	-1.84	-1.14	-0.18	-0.92	6.51	-1.24	-0.73
1985-1988	4.22	16.41	-2.37	-1.68	-0.72	-1.47	6.52	-1.47	-1.28
1989-1992	4.39	16.51	-2.18	-1.55	-0.41	-1.37	6.50	-1.57	-1.12
Ethiopia									
1973-1976	1.94	16.57	-2.31	-2.32	-1.64	-1.59	4.84	-2.27	-1.61
1977-1980	2.16	16.65	-2.21	-2.00	-1.51	-1.31	4.82	-2.44	-1.41
1981-1984	2.40	16.73	-2.25	-1.82	-1.75	-0.88	4.82	-2.07	-1.32
1985-1988	2.62	16.80	-2.15	-1.85	-1.70	-0.82	4.74	-1.77	-1.29
1989-1992	2.56	16.88	-2.90	-2.21	-2.59	-0.73	4.66	-2.09	-1.80
Ghana									
1973-1976	3.60	15.15	-1.24	-1.56	-0.54	-0.87	6.15	-2.23	-0.69
1977-1980	3.62	15.25	-1.27	-1.44	-0.74	-0.55	6.11	-2.68	-0.66
1981-1984	3.66	15.35	-1.73	-1.58	-1.13	-0.78	5.90	-3.11	-0.95
1985-1988	3.68	15.46	-1.64	-1.91	-0.91	-1.25	5.89	-2.22	-1.07
1989-1992	3.66	15.57	-1.75	-1.62	-1.03	-0.95	5.90	-1.95	-0.99

Table 6. Middle East, North Africa and South-Saharan Africa [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Gambia									
1973-1976	2.35	12.47	-0.80	-1.20	0.32	-0.81	5.88	-2.47	-0.28
1977-1980	2.42	12.55	-0.96	-0.90	0.34	-0.58	5.91	-1.43	-0.23
1981-1984	2.83	12.60	-0.98	-0.91	0.18	-0.53	5.57	-1.60	-0.25
1985-1988	2.79	12.66	-1.12	-1.05	0.16	-0.72	5.60	-1.83	-0.39
1989-1992	2.89	12.71	-1.22	-0.82	0.22	-0.55	5.74	-1.60	-0.31
Kenya									
1973-1976	2.64	15.57	-1.97	-1.20	-0.82	-0.82	5.89	-1.50	-0.82
1977-1980	2.90	15.72	-1.85	-1.07	-0.70	-0.69	5.98	-1.35	-0.69
1981-1984	2.98	15.86	-2.02	-1.27	-0.78	-0.93	5.86	-1.49	-0.88
1985-1988	3.09	16.00	-2.04	-1.44	-0.77	-1.12	5.88	-1.42	-1.00
1989-1992	3.37	16.14	-2.18	-1.35	-0.77	-1.07	5.91	-1.53	-0.99
Morocco									
1973-1976	2.80	15.34	-1.50	-1.70	0.15	-1.49	6.42	-1.50	-0.89
1977-1980	3.07	15.49	-1.86	-1.59	-0.14	-1.39	6.54	-1.32	-1.02
1981-1984	3.36	15.63	-1.75	-1.35	0.17	-1.20	6.56	-1.35	-0.84
1985-1988	3.58	15.76	-1.90	-1.41	-0.13	-1.22	6.66	-1.48	-0.93
1989-1992	3.48	15.89	-2.07	-1.28	-0.31	-1.09	6.73	-1.45	-0.91
Mali									
1973-1976	2.01	14.55	-1.74	-1.95	-1.15	-1.13	5.48	-1.86	-1.12
1977-1980	2.20	14.62	-1.99	-1.77	-1.44	-0.91	5.64	-1.79	-1.17
1981-1984	1.98	14.71	-1.51	-1.32	-0.90	-0.54	5.57	-1.82	-0.72
1985-1988	1.84	14.81	-1.77	-1.51	-0.93	-0.95	5.57	-1.63	-0.94
1989-1992	1.89	14.91	-1.62	-1.47	-0.81	-0.88	5.32	-1.51	-0.85
Malta									
1973-1976	4.30	11.69	-1.18	-0.11	1.64	-0.05	7.96	-1.39	0.19
1977-1980	4.25	11.76	-1.42	0.01	1.79	0.05	8.31	-1.39	0.22
1981-1984	4.34	11.82	-1.74	-0.14	1.53	-0.10	8.44	-1.23	0.05
1985-1988	4.36	11.86	-1.91	-0.09	1.34	-0.05	8.48	-1.29	0.06
1989-1992	4.44	11.90	-1.96	0.16	1.55	0.19	8.74	-1.19	0.27
Mauritania									
1973-1976	1.39	13.06	-0.76	-1.31	0.47	-0.96	6.29	-1.55	-0.30
1977-1980	2.15	13.13	-1.09	-1.22	0.20	-0.90	6.17	-1.12	-0.46
1981-1984	2.59	13.22	-0.86	-1.36	0.39	-1.02	6.16	-1.18	-0.38
1985-1988	2.76	13.33	-0.68	-1.47	0.69	-1.17	6.15	-1.23	-0.31
1989-1992	2.64	13.44	-0.64	-1.02	0.69	-0.71	6.18	-1.65	-0.11
Mauritius									
1973-1976	3.71	12.54	-0.69	-0.99	0.90	-0.75	7.10	-1.31	-0.13
1977-1980	3.84	12.66	-0.90	-0.81	1.02	-0.65	7.17	-1.28	-0.16
1981-1984	3.92	12.79	-1.05	-0.87	1.05	-0.74	7.07	-1.59	-0.26
1985-1988	3.93	12.91	-0.94	-0.54	1.16	-0.41	7.35	-1.38	-0.01
1989-1992	3.98	13.00	-1.22	-0.28	1.10	-0.18	7.57	-1.22	0.08
Malawi									
1973-1976	1.39	14.68	-1.41	-1.20	-0.43	-0.73	5.18	-1.30	-0.60
1977-1980	1.31	14.77	-1.46	-1.13	-0.45	-0.68	5.19	-1.24	-0.59
1981-1984	1.39	14.87	-1.46	-1.44	-0.37	-1.03	5.09	-1.70	-0.75
1985-1988	1.39	14.98	-1.45	-1.43	-0.33	-1.04	5.01	-1.83	-0.75
1989-1992	1.39	15.08	-1.46	-1.19	-0.24	-0.84	5.04	-1.63	-0.62

Table 6. Middle East, North Africa and South-Saharan Africa [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Niger									
1973-1976	0.90	14.76	-2.34	-2.50	-1.75	-1.68	5.83	-1.92	-1.72
1977-1980	1.36	14.84	-1.58	-1.82	-0.86	-1.15	5.97	-1.36	-1.00
1981-1984	1.79	14.92	-1.45	-1.87	-0.61	-1.30	5.95	-2.20	-0.94
1985-1988	1.73	15.02	-1.61	-2.02	-0.57	-1.58	5.74	-1.94	-1.10
1989-1992	1.79	15.11	-1.93	-2.31	-0.92	-1.86	5.63	-2.48	-1.41
Nigeria									
1973-1976	2.14	17.11	-3.35	-1.13	-2.19	-0.75	6.00	-1.45	-1.02
1977-1980	2.65	17.24	-3.09	-0.99	-1.83	-0.66	6.33	-1.39	-0.88
1981-1984	3.26	17.35	-3.30	-1.30	-2.15	-0.91	6.07	-1.83	-1.17
1985-1988	3.22	17.46	-3.49	-1.30	-2.52	-0.82	5.70	-2.10	-1.19
1989-1992	2.98	17.56	-2.85	-0.73	-1.60	-0.39	5.79	-1.94	-0.61
Sudan									
1973-1976	2.64	15.48	-1.84	-1.88	-0.86	-1.40	6.60	-1.76	-1.15
1977-1980	2.76	15.58	-2.25	-2.19	-1.12	-1.79	6.77	-1.95	-1.53
1981-1984	2.90	15.69	-2.24	-2.12	-1.06	-1.74	6.69	-1.84	-1.48
1985-1988	3.00	15.80	-2.58	-2.56	-1.78	-1.93	6.52	-1.87	-1.88
1989-1992	3.09	15.92	-2.32	-2.34	-1.11	-1.99	6.50	-2.00	-1.63
Senegal									
1973-1976	2.30	14.61	-1.24	-1.39	0.09	-1.08	6.53	-1.68	-0.62
1977-1980	2.33	14.74	-1.39	-1.16	0.10	-0.90	6.49	-1.83	-0.57
1981-1984	2.51	14.83	-1.27	-1.00	0.37	-0.78	6.44	-2.15	-0.43
1985-1988	2.69	14.91	-1.77	-1.42	-0.22	-1.18	6.45	-2.17	-0.88
1989-1992	2.77	14.99	-1.85	-1.59	-0.21	-1.38	6.46	-2.05	-1.02
Sierra Leone									
1973-1976	2.44	14.01	-1.85	-1.01	-0.65	-0.64	4.94	-2.00	-0.65
1977-1980	2.52	14.05	-1.84	-0.89	-0.72	-0.50	5.03	-2.01	-0.57
1981-1984	2.84	14.09	-2.39	-1.77	-1.32	-1.34	5.06	-1.92	-1.32
1985-1988	2.91	14.14	-2.10	-1.88	-1.19	-1.37	4.94	-2.32	-1.29
1989-1992	2.80	14.19	-1.74	-1.52	-0.78	-1.18	4.92	-2.06	-0.93
Togo									
1973-1976	3.02	13.80	-1.40	-1.52	-0.15	-1.18	6.06	-1.50	-0.75
1977-1980	3.40	13.89	-1.28	-0.77	0.01	-0.44	6.12	-0.91	-0.29
1981-1984	3.20	13.98	-1.24	-1.03	-0.06	-0.66	5.96	-1.40	-0.44
1985-1988	3.08	14.07	-1.34	-1.28	-0.26	-0.86	5.95	-1.40	-0.61
1989-1992	3.16	14.16	-1.51	-1.41	-0.42	-1.00	5.88	-1.44	-0.76
Tunisia									
1973-1976	3.07	14.27	-1.90	-1.09	-0.22	-0.89	6.84	-1.34	-0.72
1977-1980	3.21	14.41	-2.14	-0.74	-0.21	-0.58	6.99	-1.20	-0.52
1981-1984	3.51	14.54	-2.09	-0.63	-0.07	-0.49	7.11	-1.16	-0.42
1985-1988	3.70	14.66	-2.18	-0.85	-0.20	-0.70	7.08	-1.50	-0.61
1989-1992	3.80	14.78	-2.15	-0.56	-0.27	-0.39	7.15	-1.35	-0.37

Table 5. Middle East, North Africa and South-Saharan Africa [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Tanzania									
1973-1976	1.24	15.91	-1.73	-1.43	-0.70	-0.99	5.18	-1.53	-0.87
1977-1980	1.31	16.02	-2.04	-1.47	-1.11	-0.97	5.14	-1.38	-1.02
1981-1984	1.10	16.14	-2.47	-2.00	-1.67	-1.40	5.05	-1.71	-1.52
1985-1988	1.24	16.25	-2.45	-1.60	-1.81	-0.86	5.05	-1.46	-1.24
1989-1992	1.54	16.36	-1.88	-0.98	-1.10	-0.37	5.17	-0.82	-0.64
Zambia									
1973-1976	2.74	14.31	-0.82	-1.40	1.28	-1.27	6.13	-1.07	-0.37
1977-1980	2.77	14.42	-0.97	-1.47	0.90	-1.30	5.71	-1.56	-0.49
1981-1984	2.83	14.54	-1.20	-1.52	0.72	-1.36	5.50	-1.83	-0.65
1985-1988	2.94	14.67	-0.92	-1.45	1.09	-1.30	5.44	-1.87	-0.46
1989-1992	3.43	14.81	-0.98	-1.21	0.76	-1.01	5.46	-2.08	-0.54
Zimbabwe									
1973-1976	2.20	14.75	-1.71	-1.28	0.14	-1.11	6.54	-1.43	-0.78
1977-1980	2.14	14.86	-1.75	-1.35	0.30	-1.21	6.40	-1.88	-0.84
1981-1984	3.51	14.97	-1.98	-1.42	0.17	-1.29	6.48	-1.63	-0.97
1985-1988	3.83	15.08	-1.76	-1.38	0.17	-1.22	6.42	-1.65	-0.86
1989-1992	3.92	15.20	-1.77	-1.07	0.34	-0.94	6.41	-1.50	-0.87

[a] Data is expressed as the natural logarithm of a four years average.
[b] Secondary school enrollment ratio
[c] Labor force
[d] Ratio of nonfuel primary exports and imports to Gross Domestic Product
[e] Ratio of all other exports plus imports to Gross Domestic Product
[f] Ratio of nonfuel primary exports and imports to Gross Domestic Agricultural Value Added
[g] Ratio of all other exports and imports to Gross Domestic Nonagricultural Value Added
[h] Per capita income in constant 1987 US $
[i] Ratio of Gross Domestic Investment to Gross Domestic Product
[j] Ratio of total exports and imports to Gross Domestic Product

Table 6. Central Asia, South Asia, East Asia and Pacific [a]

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Bangladesh									
1973-1976	3.15	16.92	-2.88	-2.22	-2.31	-1.38	4.87	-2.54	-1.80
1977-1980	2.88	17.01	-2.67	-1.99	-2.00	-1.27	4.92	-2.10	-1.58
1981-1984	2.92	17.11	-2.76	-2.08	-1.85	-1.57	5.04	-1.96	-1.67
1985-1988	2.86	17.22	-2.84	-2.04	-1.93	-1.52	5.14	-2.06	-1.66
1989-1992	2.92	17.34	-3.02	-2.11	-2.00	-1.66	5.18	-2.09	-1.77
China									
1973-1976	3.85	19.98	-4.03	-2.59	-2.91	-2.19	4.61	-1.23	-2.38
1977-1980	4.10	20.08	-3.62	-2.17	-2.41	-1.81	4.78	-1.15	-1.96
1981-1984	3.58	20.18	-3.17	-1.78	-2.07	-1.37	5.06	-1.23	-1.56
1985-1988	3.74	20.27	-2.86	-1.45	-1.60	-1.11	5.42	-0.96	-1.23
1989-1992	3.88	20.34	-2.80	-1.22	-1.40	-0.94	5.65	-1.07	-1.03
Fiji									
1973-1976	4.10	12.09	-1.38	-1.09	0.08	-0.82	7.43	-1.57	-0.53
1977-1980	4.07	12.20	-1.26	-1.03	0.33	-0.80	7.51	-1.32	-0.44
1981-1984	3.97	12.29	-1.50	-1.02	0.24	-0.83	7.50	-1.41	-0.54
1985-1988	3.94	12.38	-1.49	-1.19	0.20	-0.98	7.44	-1.78	-0.63
1989-1992	4.11	12.45	-1.41	-0.76	0.32	-0.67	7.57	-1.94	-0.34
Greece									
1973-1976	4.37	15.06	-2.34	-1.39	-0.58	-1.20	8.28	-1.23	-1.06
1977-1980	4.39	15.10	-2.43	-1.29	-0.52	-1.13	8.40	-1.27	-1.01
1981-1984	4.45	15.13	-2.30	-1.25	-0.46	-1.08	8.40	-1.52	-0.95
1985-1988	4.55	15.15	-2.19	-1.25	-0.25	-1.10	8.43	-1.64	-0.92
1989-1992	4.58	15.16	-2.18	-1.16	-0.17	-1.02	8.51	-1.60	-0.85
Indonesia									
1973-1976	3.00	17.73	-2.35	-1.32	-1.22	-0.92	5.37	-1.52	-1.01
1977-1980	3.17	17.81	-2.30	-1.28	-1.00	-0.96	5.67	-1.41	-0.97
1981-1984	3.57	17.91	-2.79	-1.06	-1.33	-0.79	5.98	-1.27	-0.89
1985-1988	3.82	18.00	-2.58	-1.29	-1.14	-1.02	6.05	-1.29	-1.04
1989-1992	3.81	18.09	-2.46	-1.01	-0.91	-0.77	6.21	-1.18	-0.80
India									
1973-1976	3.26	19.30	-3.24	-2.80	-2.28	-2.32	5.49	-1.61	-2.30
1977-1980	3.37	19.37	-3.37	-2.54	-2.30	-2.12	5.57	-1.54	-2.17
1981-1984	3.56	19.45	-3.48	-2.37	-2.34	-1.99	5.64	-1.50	-2.09
1985-1988	3.66	19.53	-3.61	-2.42	-2.36	-2.09	5.76	-1.41	-2.16
1989-1992	3.77	19.60	-3.53	-2.11	-2.25	-1.78	5.90	-1.41	-1.89
Sri Lanka									
1973-1976	3.87	15.37	-1.53	-2.28	-0.28	-1.94	5.55	-1.88	-1.14
1977-1980	3.90	15.47	-1.18	-1.28	0.12	-0.96	5.76	-1.50	-0.51
1981-1984	4.08	15.55	-1.59	-1.01	-0.23	-0.71	5.90	-1.27	-0.56
1985-1988	4.19	15.62	-1.81	-1.12	-0.39	-0.84	6.00	-1.47	-0.71
1989-1992	4.30	15.67	-1.80	-0.86	-0.35	-0.59	6.06	-1.49	-0.53
Myanmar									
1973-1976	3.02	16.41	-2.92	-2.84	-2.11	-2.25	5.36	-2.27	-2.19
1977-1980	3.04	16.50	-2.67	-2.63	-1.88	-2.03	5.51	-1.70	-1.96
1981-1984	3.17	16.58	-2.70	-2.78	-1.96	-2.13	5.66	-1.65	-2.04
1985-1988	3.19	16.66	-3.56	-3.36	-2.92	-2.60	5.60	-2.04	-2.76
1989-1992	3.00	16.73	-4.20	-4.06	-3.69	-3.13	5.47	-2.04	-3.43

Table 6. Central Asia, South Asia, East Asia and Pacific [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Malaysia									
1973-1976	3.79	15.29	-0.91	-1.01	0.37	-0.69	7.09	-1.34	-0.27
1977-1980	3.89	15.44	-0.94	-0.77	0.48	-0.49	7.35	-1.28	-0.15
1981-1984	3.93	15.56	-1.21	-0.49	0.34	-0.25	7.50	-1.03	-0.09
1985-1988	4.02	15.68	-1.25	-0.40	0.14	-0.12	7.50	-1.36	-0.05
1989-1992	4.05	15.78	-1.32	0.08	0.30	0.15	7.75	-1.12	0.30
Nepal									
1973-1976	2.52	15.53	-4.42	-3.45	-4.02	-2.34	4.93	-2.16	-3.11
1977-1980	2.86	15.60	-3.30	-2.39	-2.78	-1.49	4.95	-1.77	-2.05
1981-1984	3.13	15.69	-3.17	-1.89	-2.61	-1.05	4.96	-1.70	-1.64
1985-1988	3.33	15.78	-2.93	-1.65	-2.28	-0.90	5.05	-1.52	-1.40
1989-1992	3.58	15.87	-3.05	-1.59	-2.44	-0.82	5.16	-1.44	-1.39
Pakistan									
1973-1976	2.74	16.89	-2.32	-1.67	-1.14	-1.30	5.44	-1.91	-1.25
1977-1980	2.66	17.01	-2.50	-1.61	-1.23	-1.28	5.52	-1.69	-1.26
1981-1984	2.77	17.13	-2.63	-1.60	-1.32	-1.28	5.68	-1.67	-1.29
1985-1988	2.92	17.25	-2.57	-1.58	-1.16	-1.30	5.82	-1.68	-1.26
1989-1992	3.02	17.35	-2.62	-1.39	-1.17	-1.12	6.15	-1.64	-1.13
Philippines									
1973-1976	4.04	16.56	-1.75	-1.53	-0.56	-1.17	6.35	-1.28	-0.93
1977-1980	4.15	16.65	-1.94	-1.37	-0.65	-1.05	6.46	-1.18	-0.92
1981-1984	4.20	16.74	-2.27	-1.29	-0.84	-1.02	6.46	-1.33	-0.97
1985-1988	4.21	16.84	-2.33	-1.33	-0.89	-1.06	6.34	-1.78	-1.02
1989-1992	4.29	16.94	-2.32	-0.99	-0.80	-0.75	6.43	-1.52	-0.76
Papua New Guinea									
1973-1976	2.48	14.02	-0.97	-1.56	0.25	-1.21	6.93	-1.72	-0.52
1977-1980	2.42	14.08	-0.73	-1.26	0.34	-0.84	6.91	-1.46	-0.27
1981-1984	2.40	14.15	-0.93	-1.06	0.15	-0.64	6.70	-1.24	-0.30
1985-1988	2.52	14.21	-0.95	-1.19	0.22	-0.81	6.72	-1.53	-0.37
1989-1992	2.52	14.27	-1.05	-1.00	0.26	-0.68	6.64	-1.40	-0.33
Singapore									
1973-1976	3.97	13.70	-0.58	0.63	3.39	0.65	8.34	-0.88	0.89
1977-1980	4.05	13.86	-0.40	0.93	3.60	0.94	8.51	-0.89	1.16
1981-1984	4.20	13.97	-0.80	0.97	3.80	0.98	8.81	-0.74	1.13
1985-1988	4.20	14.04	-0.92	0.94	4.26	0.94	8.96	-0.94	1.08
1989-1992	4.25	14.08	-1.21	0.99	4.76	1.00	9.30	-0.99	1.10

Table 6. Central Asia, South Asia, East Asia and Pacific [a], continued

	S [b]	L [c]	OA [d]	ONA [e]	XA [f]	XNA [g]	PC [h]	IQ [i]	XGDP [j]
Thailand									
1973-1976	3.28	16.82	-1.85	-1.54	-0.54	-1.23	6.40	-1.34	-0.99
1977-1980	3.34	16.93	-1.76	-1.35	-0.34	-1.07	6.56	-1.28	-0.84
1981-1984	3.42	17.04	-1.86	-1.28	-0.22	-1.06	6.65	-1.24	-0.83
1985-1988	3.37	17.13	-1.91	-1.13	-0.07	-0.96	6.81	-1.25	-0.75
1989-1992	3.47	17.21	-1.90	-0.69	0.13	-0.54	7.16	-0.93	-0.42
Turkey									
1973-1976	3.42	16.68	-2.94	-2.16	-1.59	-1.86	6.90	-1.51	-1.78
1977-1980	3.55	16.74	-3.29	-2.28	-1.82	-2.02	6.98	-1.56	-1.97
1981-1984	3.64	16.82	-2.63	-1.56	-0.99	-1.34	6.94	-1.59	-1.26
1985-1988	3.79	16.91	-2.51	-1.31	-0.85	-1.10	7.10	-1.29	-1.04
1989-1992	3.95	16.99	-2.60	-1.36	-1.05	-1.12	7.19	-1.11	-1.10

[a] Data is expressed as the natural logarithm of a four years average.
[b] Secondary school enrollment ratio
[c] Labor force
[d] Ratio of nonfuel primary exports and imports to Gross Domestic Product
[e] Ratio of all other exports plus imports to Gross Domestic Product
[f] Ratio of nonfuel primary exports and imports to Gross Domestic Agricultural Value Added
[g] Ratio of all other exports and imports to Gross Domestic Nonagricultural Value Added
[h] Per capita income in constant 1987 US $
[i] Ratio of Gross Domestic Investment to Gross Domestic Product
[j] Ratio of total exports and imports to Gross Domestic Product

Figure 1. Low Income Countries, Exports plus Imports to GDP Ratio by Category

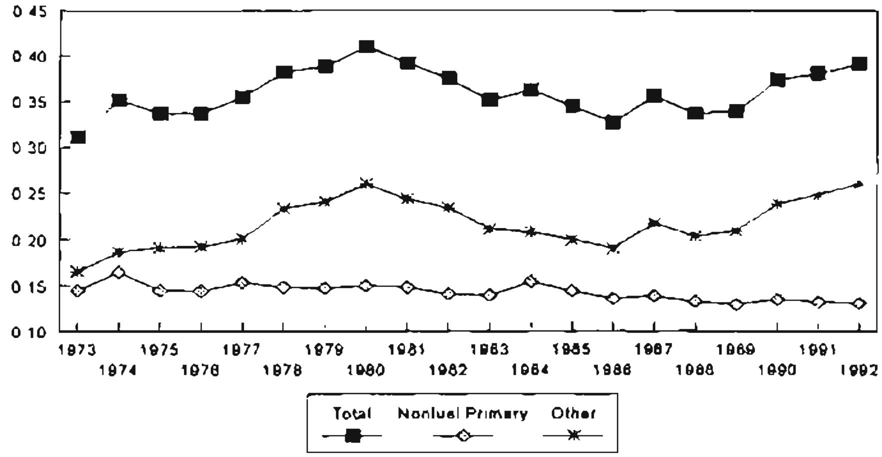


Figure 2. Low Income Countries, Exports to GDP Ratio by Category

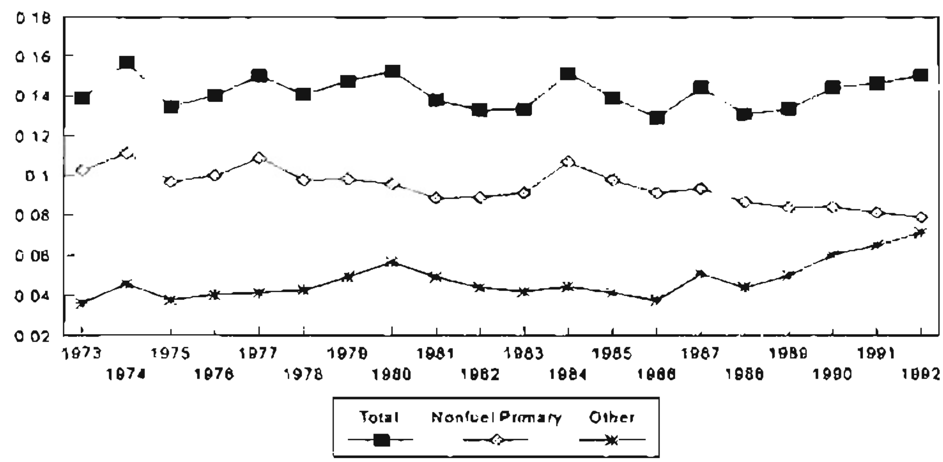


Figure 3. Low Income Countries, Imports to GDP Ratio by Category

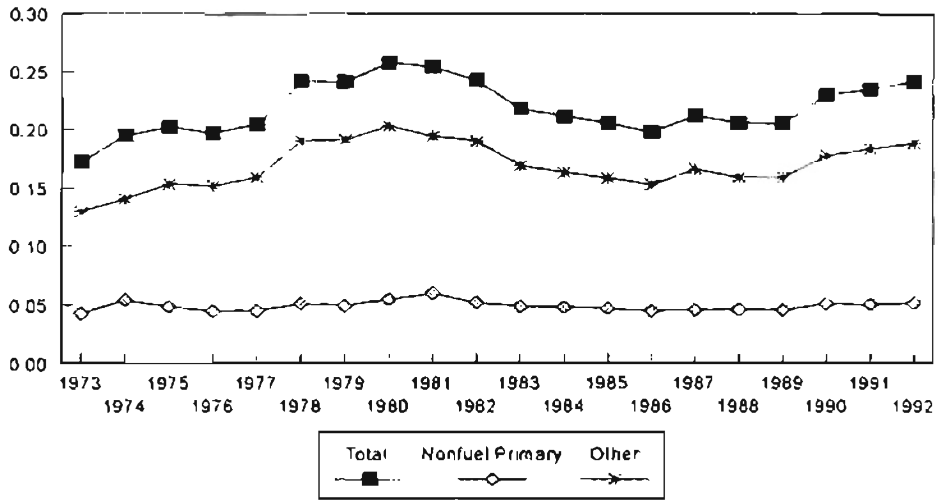


Figure 4. Middle Income Countries, Export plus Imports to GDP Ratio by Category

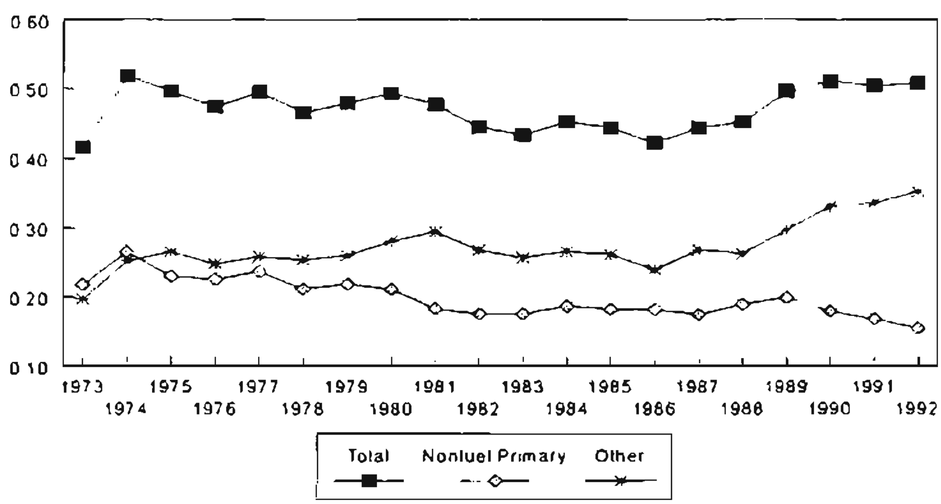


Figure 5. Middle Income Countries, Exports to GDP Ratio by Category

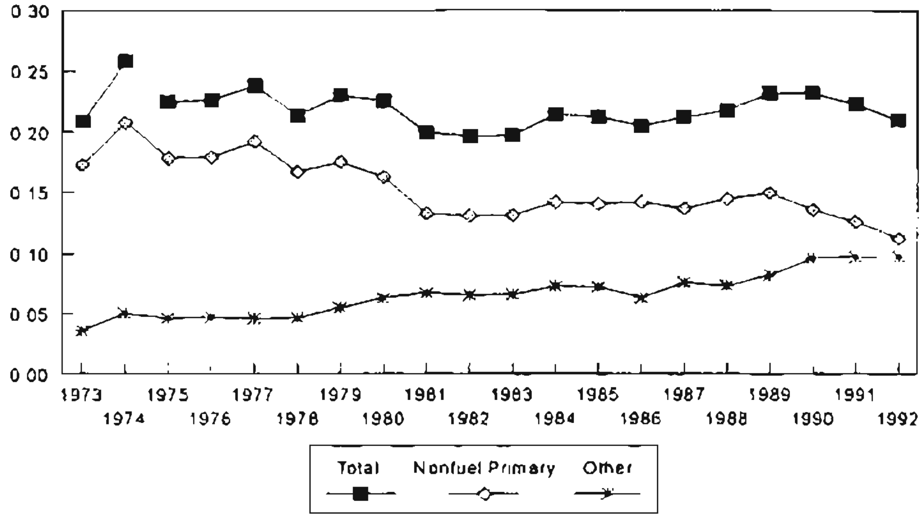


Figure 6. Middle Income Countries, Imports to GDP Ratio by Category

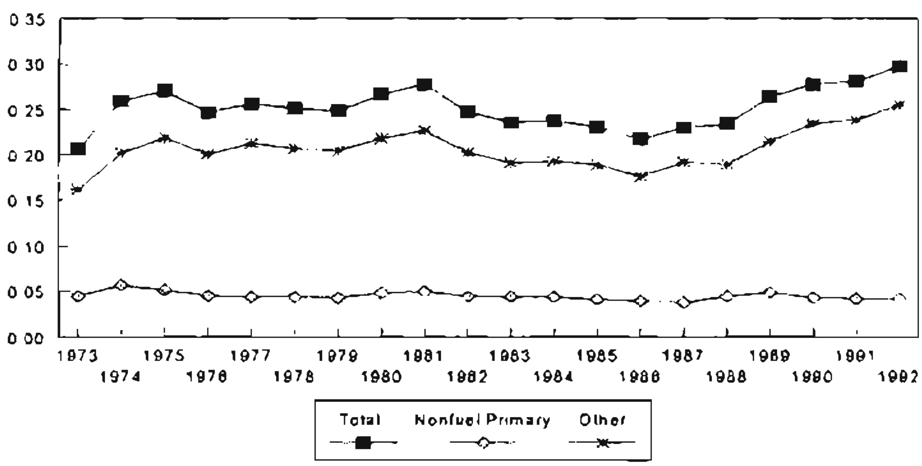


Figure 7. High Income Countries, Export plus Imports to GDP Ratio by Category

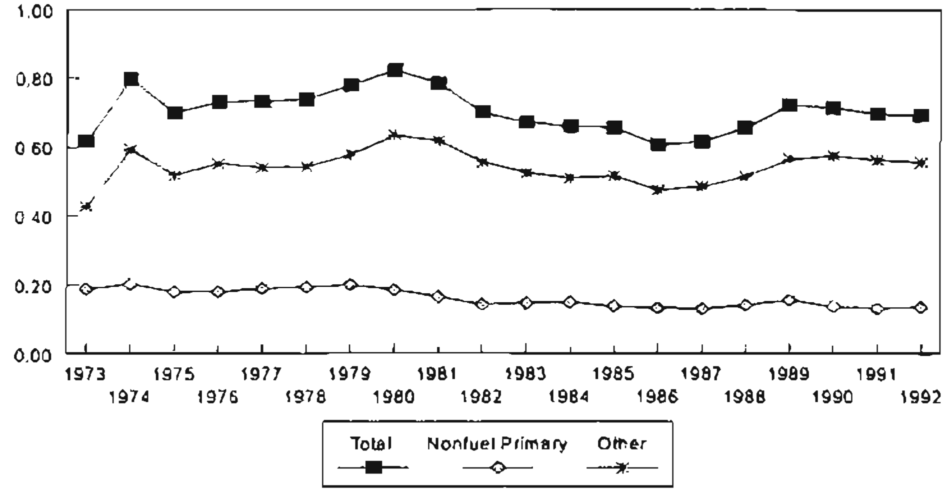


Figure 8. High Income Countries, Exports to GDP Ratio by Category

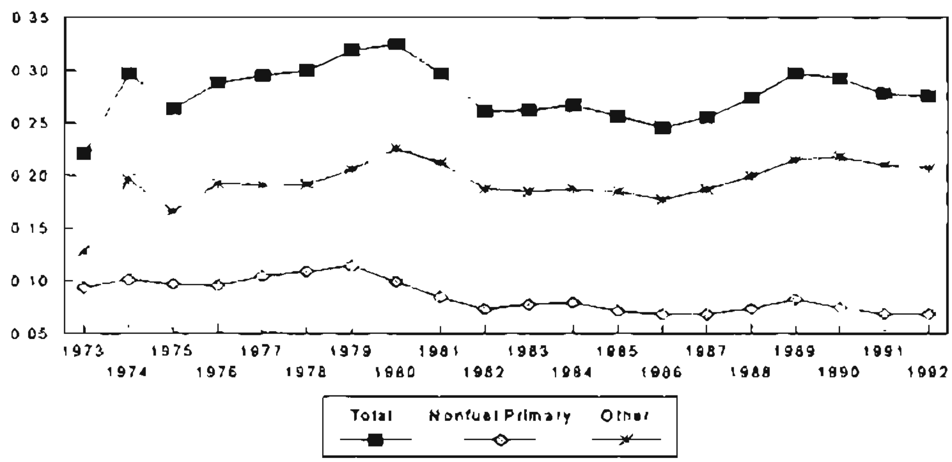


Figure 9. High Income Countries, Imports to GDP Ratio by Category

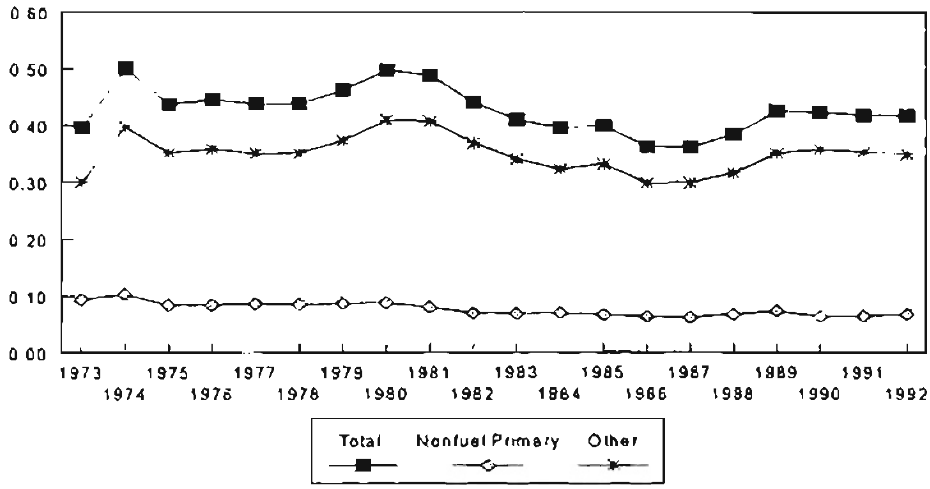


Figure 10. Latin America, Exports plus Imports to GDP Ratio by Category

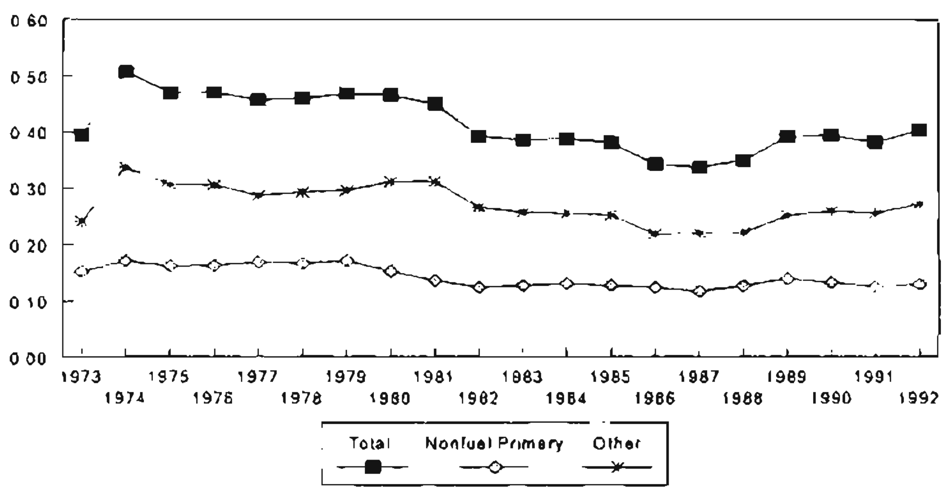


Figure 11. Latin America, Exports to GDP Ratio by Category

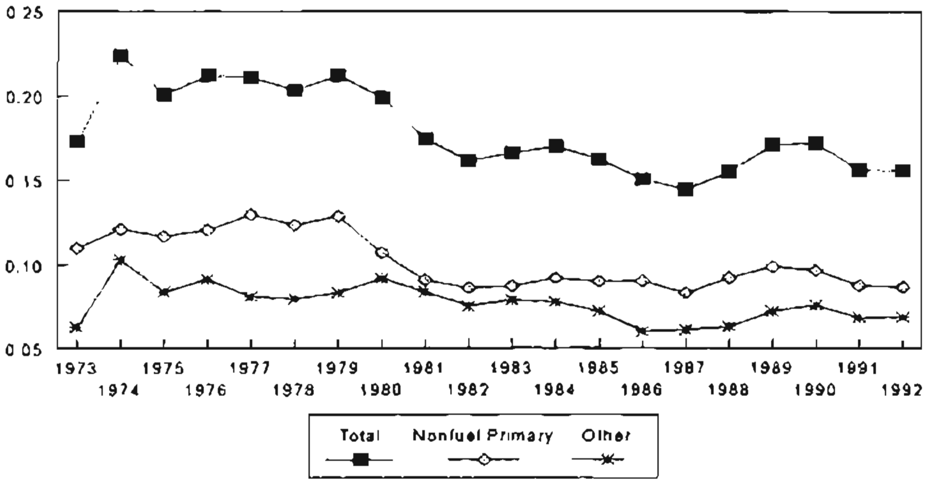


Figure 12. Latin America, Imports to GDP Ratio by Category

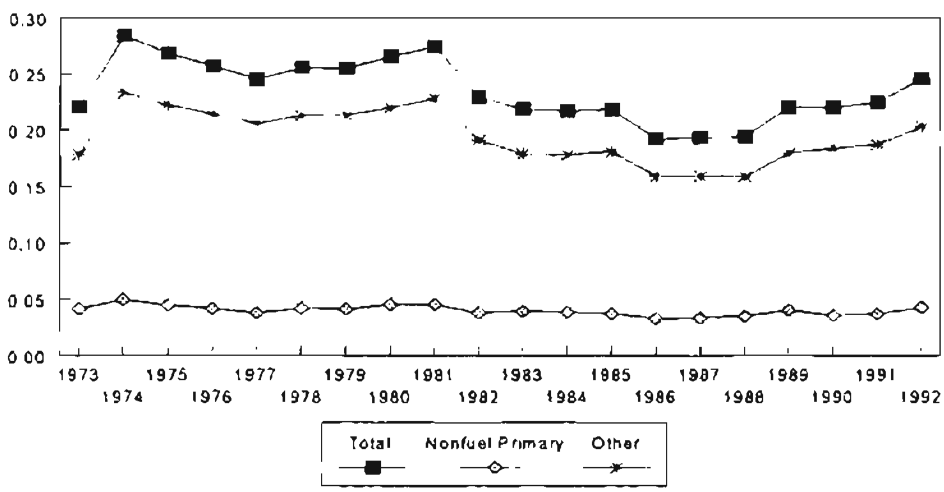


Figure 13. Africa, Exports plus Imports to GDP Ratio by Category

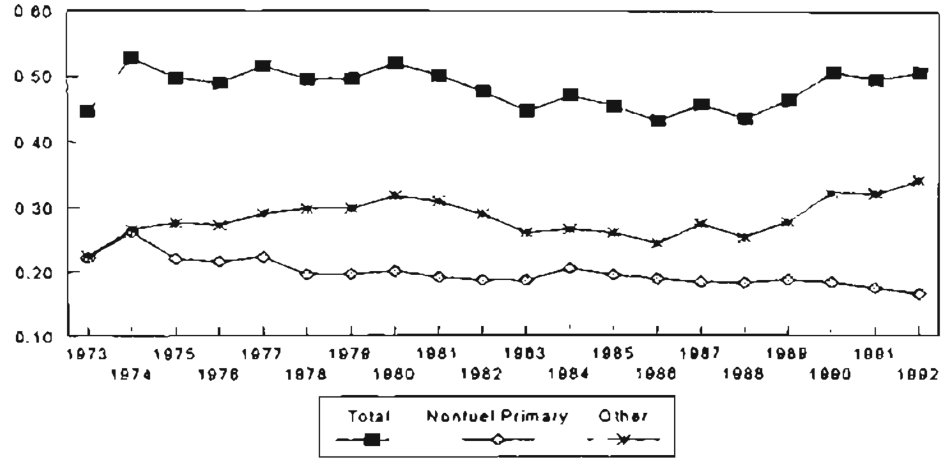


Figure 14. Africa, Export to GDP Ratio by Category

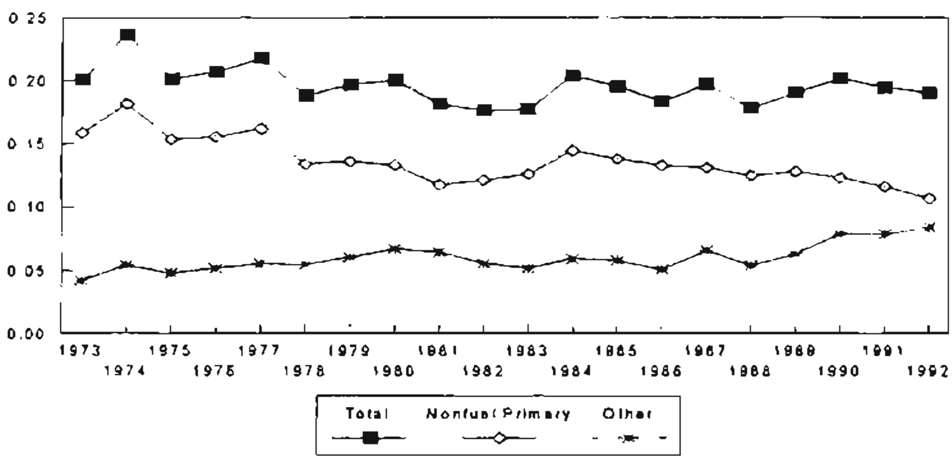


Figure 15. Africa, Imports to GDP Ratio by Category

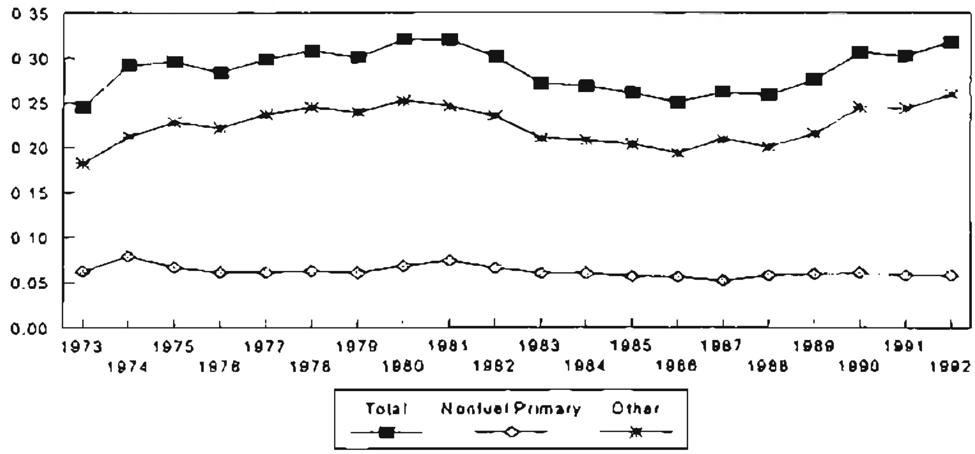


Figure 16. Asia, Export plus Imports to GDP Ratio by Category

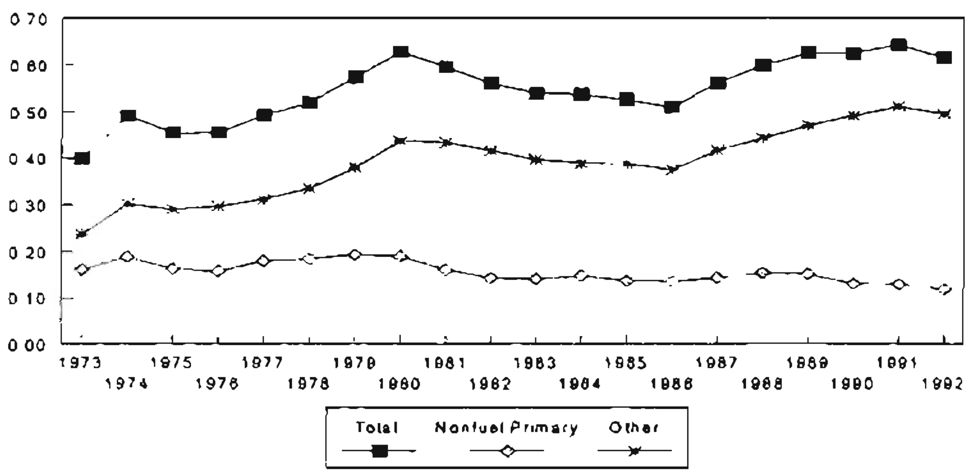


Figure 17. Asia, Export to GDP Ratio by Category

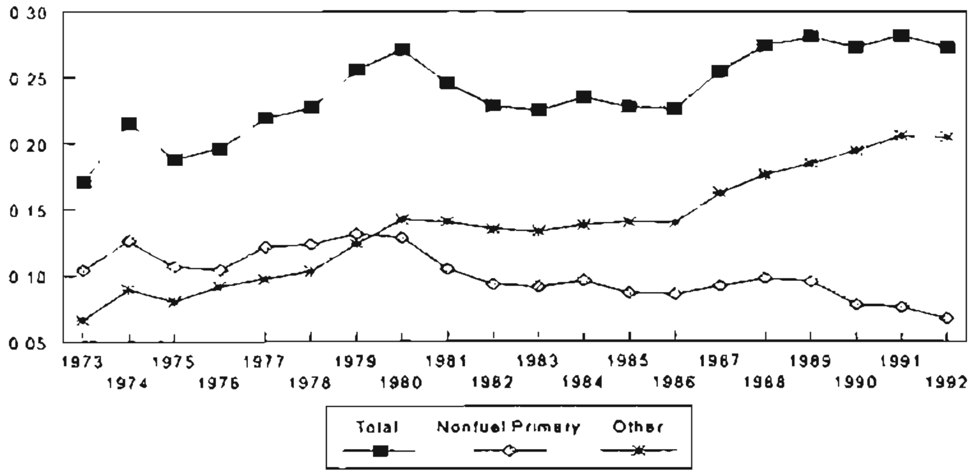
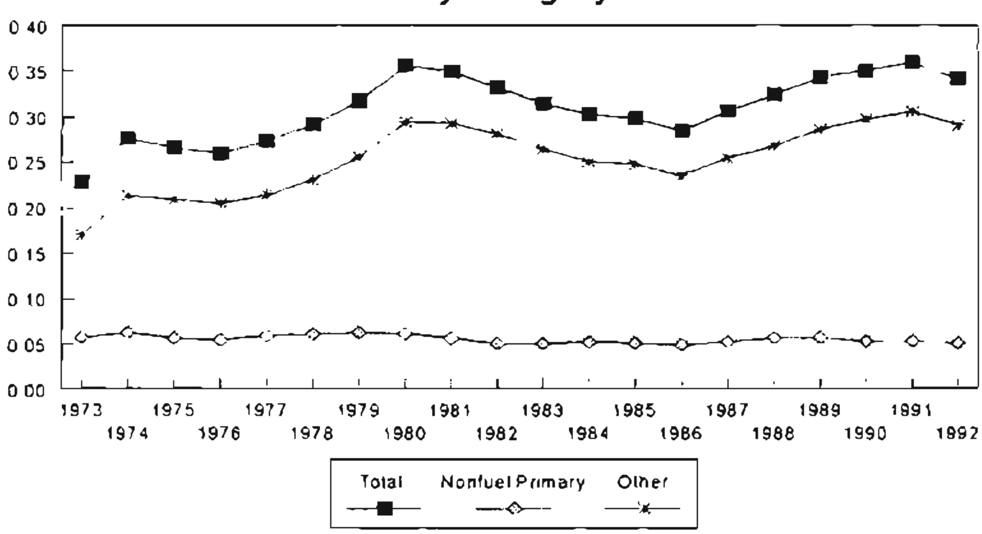
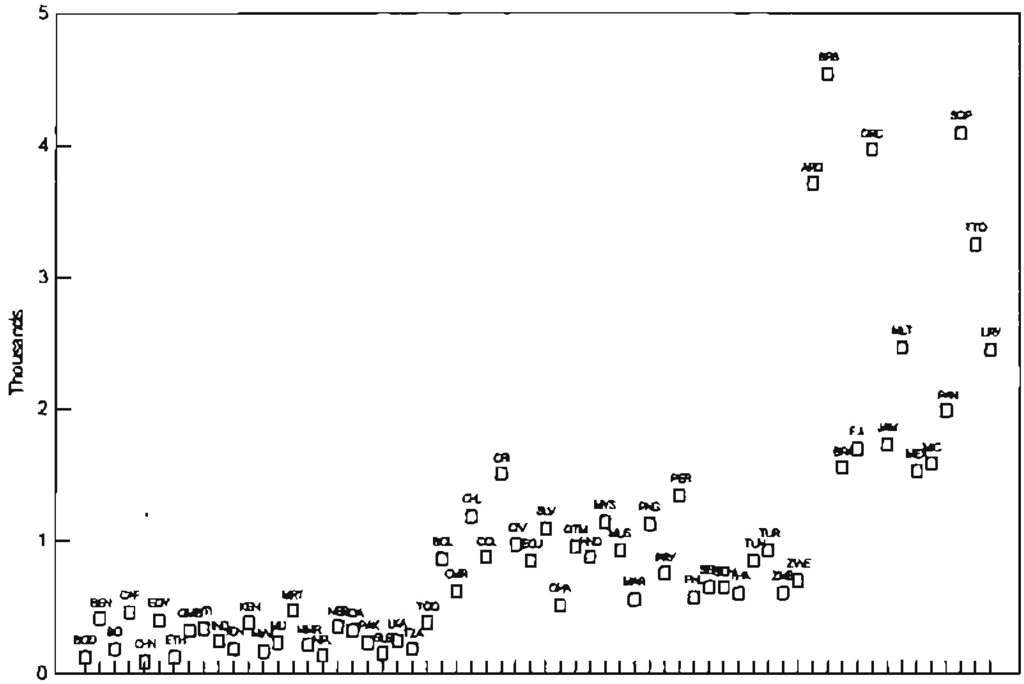


Figure 18. Asia, Imports to GDP Ratio by Category



Graph 19. Real Per Capita Income in 1987 US Dollars
for the Year 1973, Sample of Developing Countries



VITA

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