THESIS

DOES TRADE CAUSE GROWTH ACROSS TRADING BLOCS?

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WE HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER OUR SUPERVISION BY MICHAEL A MARTURANA ENTITLED “DOES TRADE CAUSE GROWTH ACROSS TRADING BLOCS?” BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS.

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ABSTRACT OF THESIS

DOES TRADE CAUSE GROWTH ACROSS TRADING BLOCS?

Does international trade influence the growth rate of income per capita across trading blocs? Many empirical studies have been conducted to analyze the effect of international trade on economic growth. This paper investigates the growth effects from trade, on income per capita, across the four trading blocs of the Association of Southeast Asian Nations, the European Union, the North American Free Trade Agreement, and the Southern Common Market from 1970 through 2004. Using an autoregressive process of one lag, the model yielded results consistent with economic theory—exports positively influence the growth rate of income per capita while imports reduce said rate. Furthermore, these variables are statistically significant at standard levels. The model also controls for membership in a particular trading bloc and finds intra-bloc economic growth rates to differ substantially. Other variable estimates from the model however, are not consistent with theory which implies some degree of model misspecification and suggests further research is needed.

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Introduction

Assessing the effect of international trade on income per capita has been the topic of many studies. Standard trade theory predicts that international trade can mutually benefit countries through the exploitation of comparative advantage. Recent research suggests that the increased outsourcing of intermediate goods leads to income divergence between countries but empirical data shows mixed conclusions regarding the impact of trade on individual countries' economic growth. This is a common finding in the papers reviewed in the empirical literature section. The results section of this paper discusses findings consistent with economic theoretical prediction. Much of the previous work in this area investigates the relationship of trade on a country-by-country level. This paper analyzes the relationship between the growth rate of income per capita and international trade, defined in economic theory as exports minus imports, across the four major trading blocs of the European Union, the Southern Common Market (Latin America), the Association of Southeast Asian Nations, and the North American Free Trade Agreement.

This paper reviews numerous articles regarding trade and economic growth and the findings of said papers. The economic growth theory section discusses basic growth theory (such as capital and technology) for a closed economy. The discussion following this section identifies the countries and data used for the regression model. Based in economic growth theory, a model is developed to measure the impact of international trade on the growth rate of income per capita. This model, as will be discussed, corrects for stationarity in the investment per capita variable. Testing reveals this model to be a process that is autoregressive of one lag (AR(1)) and yields coefficients consistent with economic theory. The imports per capita variable is negative while the coefficient on exports per capita is positive and both values are statistically significant—confirming the hypothesis (and economic theory) that the growth rate of output per capita is positively related to exports and negatively related to imports.

Empirical Literature

David Ricardo's theory of comparative advantage (the country that can produce a good at the lowest opportunity cost should specialize in production of said good) is at the heart of trade theory and pivotal in explaining theoretical gains from trade. The conclusions in past literature regarding empirical benefits from international trade are mixed. Giles and Williams (2000) survey the literature regarding export-led growth and investigate the relationship between trade and economic growth only to find mixed conclusions. Goldberg and Pavcnik (2007) investigate the relationship between international trade and income growth in developing countries and conclude that globalization benefits are "country, time, and case specific" (p78). Rodriguez and Rodrik (2000) analyze the relationship between trade policies, trade volume, and output growth and find no substantial evidence to suggest trade increases economic growth. Jose De Gregorio (1992) uses random effects estimation to analyze economic growth in Latin America. The conclusion that initial conditions affect whether a country will prosper or remain underdeveloped are that of Darity and Davis (2005). Frankel and Romer (1999) as well as Eaton and Kortum (2002) investigate the impact of geography and trade on income growth. Hall and Jones (1998) use the Solow residual to investigate differences in output per worker across countries and find these can be attributed to capital accumulation and productivity, which they attribute to institutional differences.

Export-led growth (ELG, to use Jiles and Williams' term) can essentially be interpreted as an increase in the demand for a country's output. It is this increased demand that causes reallocations of capital and labor across sectors. The relatively inefficient sector (the non-trade good) will lose resources as they are reallocated to the trade sector, and this "productivity change may lead to output growth" (Jiles et al. p3, 2000). Jiles and Williams (2000) note that not all authors support ELG theory because of the vast empirical differences between the growth in the East and Southeast Asian countries and Latin America. Furthermore, there are uncertainties whether markets in advanced developed countries (ADCs) are large and predictable enough to sustain exports from less developed countries (LDCs). Jiles and Williams' survey includes import substitution (promoting domestic industry growth through protective trade policies) studies. They find that the use of import substitution can benefit certain countries under certain conditions, but there many variables. Jiles and Williams (2000) investigate a relationship between trade and output growth and report that Helpman and Krugman (1985) as well as Bhagwati (1998) speculate that an increase in trade will lead to gains in both productivity and income. There is, however, the "potential for no causal relationship between exports and economic growth (and)…unrelated variables (e.g., investment) in the economic system" (Jiles et al. p4, 2000).

The survey conducted by Jiles et al. (2000) utilized both cross-sectional and time series analysis. They report that high levels of export growth are found to be associated economic growth, supporting ELG; however, one problem they identify is the 'accounting identity' effect. This term refers to the fact that net exports are positively related to output; therefore, increased exports will be correlated with a higher gross domestic product. Jiles and Williams (2000) also note that there are numerous (over fifteen) papers reviewed that do not support ELG and speculate that this could be for any number of data, time, or model differences. Another reason for the failure of ELG models, according to Jiles and Williams (2000), is unaccounted endogeneity which many of the "studies fail to distinguish between statistical association and statistical causation" (p5). For the time series analysis, they identify vector autoregressive (VAR) and vector error correction (VECM) models which allow for testing (including cointegration), analyzing impulse response functions, and forecasting error variance decompositions. Jiles and Williams (2000) identify seventy-four studies that utilize a form of a VAR model to explain the relationship between exports and income growth and conclude that most can lead to invalid conclusions for various reasons.

The relationship between trade and income growth, as investigated by Jiles and Williams (2000), has a similar conclusion to that of Goldberg and Pavcnik (2007): it depends. They find no common agreement on the ELG hypothesis and highlight flaws in both methods of measurement (cross-sectional and time series) that produce major inconsistencies between the over one hundred fifty studies surveyed. A final observation by Jiles and Williams (2000) is that most of the papers surveyed used broad, macro level data; there were five studies noted in which decomposing sectors yielded different results than the macro level. They "believe that much could be learned about the export-led growth question by assessing micro-based data" (Jiles and Williams p17, 2000).

Goldberg and Pavcnik (2007) investigate, as the title of their paper aptly describes, "Distributional Effects of Globalization in Developing Countries." They use the term 'globalization' to describe an increase trade openness and economic interdependence. They used two methods to measure trade effects on LDCs: general equilibrium and differential exposure. Goldberg and Pavcnik (2007) describe the former approach as being problematic because it assumes values for variables that are difficult to measure and that are not usually known. The differential exposure approach studies trade policy across different industries within an economy. These papers (using the differential exposure approach) reviewed use inherently weaker assumptions, cannot accurately describe the trend in trade openness (as trade policy is endogenous), and are based on nominal, as opposed to real, data (Goldberg and Pavcnik, 2007).

Goldberg and Pavcnik (2007) develop five different 'channels' in an attempt to explain the empirical failures of Heckscher-Ohlin (HO) and Stolper-Samuelson (SS) theorems. HO theory predicts that a country will export the good which uses that country's abundant input (capital or labor) more intensively in production. The Stolper-Samuelson theory predicts that a relative increase in the price of a good will lead to a relative increase in the return to the factor (capital or labor) used relatively more intensively in the production of said good. Developing countries are typically labor abundant, thus according to theory, these types of countries will specialize in the exporting of labor-intensive goods. Goldberg and Pavcnik (2007) find that labor market rigidity and wage uncertainty are key reasons, or 'channels,' as to the empirical failures of the afore mentioned theories. Goldberg and Pavcnik (2007) also find little support for globalization, or trade openness, benefiting poor countries and conclude that trade effects vary greatly across country and time.

Rodriguez and Rodrik (2000) focus their paper on investigating whether economies with lower trade barriers grow relatively faster than restrictive trade countries.

Their survey consists of three primary papers by David Dollar (1992), Jeffrey Sachs and Andrew Warner (1995), and Sebastian Edwards (1998). Rodriguez and Rodrik (2000) analyze Dollar's (1992) measurements of trade restriction (termed DISTORTION) and exchange rate variability (VARIABILITY) and conclude these variables do not accurately capture the information Dollar intended. In their analysis, Rodriguez and Rodrik (2000) argue that Sachs and Warner's (1995) conclusions, which are based on a 'Sachs-Warner dummy' variable to indicate if a country has a high or low trade barrier, are inaccurate because their trade openness measurement is correlated with other exogenous variables. Therefore, Sachs and Warner's paper "is too risky to draw strong inferences about the effect of openness on growth" (Rodriguez and Rodrik 2000, p 36). Rodriguez and Rodrik (2000) counter Edwards' (1998) paper based on data and econometric problems. Edwards' (1998) data was collected from the IMF; however, Rodriguez and Rodrik (2000) claim that the raw data was flawed. They replicate Edwards' work using newer World Bank data and report findings significantly different from Edwards (1998). Furthermore, Rodriguez and Rodrik highlight that Edwards' (1998) weighting did not account for heteroskedascity and his instrument choices are sensitive to other exogenous variables. Rodriguez and Rodrik (2000) conclude that strong results in the papers surveyed "arise either from obvious misspecification or from the use of measures of openness that are proxies for policy or institutional variables" (p 59). They find no credible evidence that open trade increases economic growth and no reason to believe that restrictive trade inhibits growth.

Gregorio (1992) investigates the determinates of economic growth in Latin America using random effects estimation with a model specification of:

$$y_{i,t} = \alpha_i + \alpha_2 x_{i,t} + u_{i,t}$$

In his model, *y* denotes the growth rate of income per capita and *x* represents a matrix of right hand side variables. Because he used random effects, α_i represents a stochastic variable and allows for the inclusion of time-invariant variables. Gregorio (1992) investigated Latin American economic growth from 1950 to 1985 but—as a variant from this paper—he divided his time period into 5 and 6 year blocks (e.g. 1963-1968, 1969-1974, etc.). From an econometric viewpoint, using multiple time periods of no more than 6 years suggests the use of random effects estimation (opposed to fixed effects). Had he not used these time periods, theory would suggest the use of fixed effects estimation. This type of estimation, as will be discussed later, ignores time-invariant variables whereas random effects estimation does not. Gregorio (1992) thought "it (was) important to estimate the effects of variables that are time-invariant" (p 70) so therefore, his analysis uses random effects estimation. He does not find international trade to have any economically significant impact on the growth rate of per capita income.

Darity and Davis (2005) investigate the relationship between economic growth and trade while focusing on uneven development across countries. Their paper analyses two main growth models: new growth and North-South models. Regardless of the model utilized, they find that cross-country asymmetries and initial conditions account for uneven development across countries. The 'asymmetries' Darity and Davis refer to are the different macroeconomic structures and the variations in culture, policies, religion and, as will be discussed with Hall and Jones (1998), social infrastructure. These asymmetries also lead to varying initial conditions, which new trade theorists have difficultly in explaining. Initial conditions are what dictate whether a country falls “toward and underdevelopment trap or surge(s) toward prosperity” (Darity and Davis 2005, p 165). They also make note that initial conditions are based on exogenous factors and that any positive shocks to physical or human capital, as a movement toward greater growth, are stochastic such that economic growth differences are merely based in ‘luck’.

Darity and Davis (2005) survey the North-South literature and briefly discuss various contributions from authors. A North-South model compares two regions or countries and examines the goods produced and exported to understand the differences in economic growth. Darity and Davis use the example of the American North producing and exporting steel while the South exports coffee. Because of the differences in embodied productivity in these goods, the South will have difficulty growing if their export is coffee. Theorists of this model fix initial conditions and attribute growth differences to economic structural differences. To these modelers, history shapes the differences in the economic structures of various countries; they conclude that colonialism and slavery had a vast impact on these structural differences. Darity and Davis make note that research in the area of North-South models is not complete and typically does not account for governmental policy or the financial market (allowing for capital flows).

Frankel and Romer (1999) examine the causation between trade, geography, and income growth while Eaton and Kortum (2002) develop and analyze a model using variables accounting for geographical features and technology. To estimate trade’s effect on per capita income, Frankel and Romer (1999) a model specification of:

$$\ln Y_i = \alpha_1 + \alpha_2 T_i + \alpha_3 \ln N_i + \alpha_4 A_i + u_i$$

where *Y* is per capita income, *T* is a country's trade openness (the same measure used later in this paper as *Open*—exports plus imports divided by GDP), and *N* and *A* are population and area, respectively. Their ordinary least squares (OLS) results find trade to have a positive and statistically significant impact on a country's income per capita and conclude that trade raises income by increasing physical and human capital. Frankel and Romer's (1999) results suggest that geography-based differences are relatively large but they also caution that their estimates are not of great precision for various reasons.

Eaton and Kortum (2002) follow a general equilibrium approach and use three simultaneous equations in their model. They use data on trade flows, prices, and geography to estimate the impact of geography on international trade. Eaton and Kortum's results are consistent with gravity theory and find that, as the distance between two countries increases, bilateral trade decreases. They note that literature explains the importance of geographic barriers in international trade, but that it is ignored in most formal models. Their model also implies that technology *and* geographic barriers determine a country's specialization, and that deviations from the law of one price can be attributed to geographic barriers.

Hall and Jones' (1998) research focuses on the reasons why output per worker varies so greatly across countries. Theory and past research find that vast differences in output per worker are related to differences in physical capital, education, and productivity; however, this does not fully account for the differences in worker output. Hall and Jones find that, in addition to the afore mentioned variables, a term they call 'social infrastructure' (accounting for institutions, governmental differences, etc.) has a large impact on output per worker. They developed a model that treats social infrastructure as endogenous and as function of logged output per worker and a matrix of, what they merely term, ‘other variables.’ Using four different estimation techniques, they found social infrastructure to have an economically large impact on output per worker. Using their estimates, “a difference of 0.01 in (the) measure of social infrastructure is associated with a 5.14 percent difference in output per worker” (Hall and Jones 1998, p 26).

The literature on the effect of trade on economic growth has no common interpretation. The most common results are that trade’s impact on growth must be analyzed on a case by case basis and treated as such with no blanket comment.

Economic Growth Theory

This section discusses the theoretical reasoning behind the non-trade variables used in the Empirical Model Section. According to the Solow Model, country *i*’s output (*Y*) for period *t* is a function of capital (*K*) and labor augmenting technology (*A*) multiplied by labor (*L*), such that (ignoring the Cobb-Douglass assumption with respect to the exponents):

$$Y_{i,t} = f(K_{i,t}, A_{i,t}L_{i,t}) \tag{1}$$

Dividing each term by a country’s labor force transforms the output and capital variables into per worker terms and simply cancels labor from the $A_{i,t}L_{i,t}$ term. This allows the technology term to be moved outside of the function operator, as in equation 2. Because this paper is concerned with output per capita, not per worker, dividing by population—as opposed to the labor force—yields output per capita (*y*) and capital per capita (*k*), as shown.

$$y_{i,t} = A_{i,t} f(k_{i,t}) \tag{2}$$

Equation 2 shows that output per capita as some function of capital per capita multiplied by technology, or labor productivity.

In the Solow Model, change in capital is equal to gross investment (*i*) minus capital depreciation. Dividing all these variables by population yields changes in capital in per capita terms as:

$$\Delta k_{i,t} = i_{Gross,i,t} - \mu_i k_{i,t} \tag{3}$$

The μ_i in equation 3 represents some depreciation coefficient such that $\mu_i k_{i,t}$ measures deprecation per capita in country *i* during period *t*. The depreciation coefficient can vary over time but, as will be discussed below, this value is irrelevant because this paper will use gross investment as a proxy for capital. If gross investment is equal to current depreciation, then new gross investment merely replaces current capital that is depreciated in period *t*. If gross investment is greater than depreciation, then there will be an overall increase in capital per capita.

For the purposes of this paper, depreciation is assumed to be zero. This assumption is not completely realistic, but is necessary for the regression models. The data used in the paper is based on annual investment for all countries of interest, not changes in capital. Investment per capita is used a gross measure of capital. A fallacy of this assumption is that, as long as there some investment, a country's capital can increase infinitely.

The $A_{i,t}$ term from equation 2 represents technology in country *i* for time period *t*. Like changes in capital from equation 3, technology is difficult to directly measure. Labor productivity, measured as output per unit of labor, is used in this paper as a substitute for technology. Because labor force data is readily available, GDP divided by the labor force serves as a gross measure of labor productivity—used in the empirical model section below as a proxy for technology.

The conclusion that capital and technology are the two key drivers in output growth, are the same when surveying other growth models. The Ramsey-Cass-Koopmans (RCK) Model is similar to the Solow Model; however, savings in the RCK Model is endogenous, as opposed to exogenous as in the Solow Model. The RCK Model builds upon the Solow Model by incorporating government spending and household optimization through consumption and risk. Both of these models have the same implications once in the steady state: the growth rates of output, capital, savings, and consumption, all in per worker terms, grow at the rate of technological progress. The growth rate of output per worker grows at the same rate as technological progress, $a_{i,t}$, which also grows with capital per worker. The Solow and RCK Models assume technology as exogenous. An increase in technology causes an increase in the marginal productivity of capital that leads to an increase in investment. A higher level of investment (from this increase in the marginal productivity of capital) increases the capital stock of an economy.

The Diamond Model assumes workers live for two periods where they work in the first period (t) and save enough to finance their retirement in period $t+1$. Unlike the afore mentioned models, the Diamond Model may or may not have a balanced growth path; however, if such a path does exist for an economy, the properties are the same as that of both the Solow and RCK Models. Technology and capital—and the growth rates of both—remain key in output growth for the Solow, RCK, and Diamond Models.

New Growth Theory, or Endogenous Growth models, assume technology to be endogenous. This alters equation 1 such that:

$$Y_{i,t} = f(K_{i,t}, A_{i,t}, L_{i,t}) \tag{4}$$

Dividing equation 4 by the labor force, or population as above, yields slightly different steady state results from above. Research and development, which leads to increases in technology, is dependant on capital. Capital, as previously mentioned, grows at the rate of technological process. New Growth Theory incorporates this 'feedback loop' of technological growth affecting the growth rate of capital, which affects technological advancements.

The economic significance of technology or as a proxy, labor productivity, and capital (or as gross measure, investment per capita) has been established. The growth rate of income per capita also depends on the previous periods' level of GDP and is typically an autoregressive process of one lag. Combining the variables discussed thus far yield:

$$y_t = \tau_1 + \tau_2 GDP_{t-1} + \tau_3 I_{t-1} + \tau_4 LP_{t-1} \tag{5}$$

Income per capita, y_t, is dependent on some constant, τ_1, plus some linear combination of income per capita (GDP_{t-1}), investment per capita (I_{t-1}), and labor productivity (LP_{t-1}), all lagged one period. (The reasons behind using one period lagged right hand side variables will be discussed later with tests that prove there is an AR(1) process present.) Equation 5 is not the complete model, and therefore, does not contain any error term.

Equation 5 is the theoretical model to calculate income per capita for one country at time *t* with a closed economy. The following data section discusses how to calculate the labor productivity variable, *LP*. The purpose of this paper is to analyze the effects of trade across four various trading blocs. The data section also contains the development of the trade openness variable and defines the dummy variables for each trading bloc. The Empirical Model section develops additional right hand side variables and discusses time dummies. All of these additional variables mentioned, and an error term, are added to equation 5 to define the empirical model.

Data

As previously mentioned, there are four trading blocs of interest: the European Union (EU), the North American Free Trade Agreement (NAFTA), the Southern Common Market (SCM), and the Association of Southeast Asian Nations (ASEAN). Japan is also included in the dataset but is not a member of any mentioned trading bloc. Post World War II, West Germany, France, Italy, Belgium, the Netherlands, and Luxembourg formed the beginning of what is today known as the EU. Today it consists of Austria, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. The United States, Canada, and Mexico comprise NAFTA, which was formed in 1994. The Southern Common Market was officially founded by Argentina, Brazil, Paraguay, and Uruguay in 1991. Bolivia, Chile, Colombia, Ecuador, and Peru are currently associate members while Venezuela is becoming a full member. Indonesia, Malaysia, the Philippines, Singapore, and Thailand founded the ASEAN in 1967. Brunei Darussalam, Vietnam, Laos (or the People's Democratic Republic of Lao), Myanmar, and Cambodia joined the ASEAN from the mid 1980s through 1999.

Acknowledging what year each above country joined their respective trading allows for the creation of trading bloc dummy variables for the EU, SCM, and the ASEAN (a dummy for Japan was dropped due to collinearity). These dummy variables account for pre and post trading block membership differences. For instance, Sweden did not join the European Union until 1995 so the EU variable for this country is a column of zeros from 1970 through 1994 and becomes a vector of ones from 1995 to 2004. This method applies for all countries across all trading blocs. If a country did not become a member of a trading bloc until 2005 or later, said country was dropped from the data. As an example, Bulgaria did not join the EU until 2007; therefore, this country is omitted from the data. The other dropped countries are Bolivia, Colombia, and Ecuador.

The dataset contains information on population, gross domestic product (GDP), investment, trade openness, and countries' labor force from 1970 to 2004. The data for GDP, investment, trade openness, and population is from the Penn World Tables at the University of Pennsylvania. The raw data for national output and investment were calculated using purchasing power parity (PPP) with the base year of 2000 in US dollars. Countries' labor force information was taken from Laborsta at the International Labor Organization (ILO). The World Bank provided import and export data as a percentage of countries' GDP. Data from the US Federal Reserve Bank of St. Louis regarding the consumer price index was used to convert all US currency values to 2004.

The data collection described above is summarized in Table 1 below.

Table 1
Summary of data sources

	Units	Source
Data Series		
GDP	per capita, 2000 US dollars, PPP	Penn World Table
Investment		
Population	NA	
Trade Openness	NA	
Imports	Percent of Countries' GDP for year *i*	World Bank
Exports		
Labor Force	NA	International Labor Organization
CPI	NA	Federal Reserve Bank of St. Louis

Data collection from the above sources yields the variables of income—or GDP—per capita (*GDP*), investment per capita (*I*), imports per capita (*IM*), exports per capita (*EX*), labor productivity (*LP*), and trading bloc dummies. Income and investment data from in the Penn World Tables were already in per capita terms. The calculations required for these variables were only to standardize (discount) to 2004 dollars. Imports and exports were provided as a percentage of a country's GDP. In order calculate imports and exports per capita for year *t*, the percentage of imports, or exports, simply is multiplied by GDP per capita for year *t*. The trade openness variable (*Open*) is calculated by adding a country *i*'s imports and exports and dividing that value by GDP, represented below:

$$Open_{i,t} = \frac{Exports_{i,t} + \mathrm{Im}\, ports_{i,t}}{GDP_{i,t}} \qquad (6)$$

Unlike using net exports, adding exports and imports gives a magnitude of trade with respect to a country's GDP. Trade openness is used in modifying bloc dummy variables, as discusses in the empirical model section. Net exports does not capture a magnitude because of subtraction—a country could be conducting a large amount of international trade, but if they have balanced trade, the value of net exports would be zero. Model A, as will be discussed, incorporates imports and exports—opposed to net exports. The net export variable is only used in one model but the results are not directly reported in this paper.

Labor productivity (*LP*) is the other variable requiring additional calculations. Country *i*'s population (*Pop*) in time *t* multiplied by income per capita gives said country's national income. This value divided by the labor force (*L_F*) results in a gross measure of labor productivity, shown as:

$$LP_{i,t} = \frac{Pop_{i,t} \times GDP_{i,t}}{L\_F_{i,t}} \qquad (7)$$

As discussed above, labor productivity is used a proxy for technology, which varies across countries and time.

Table 2 reports the variable means within each trading bloc.

Table 2
Raw data means within each trading bloc

	ASEAN	EU	NAFTA	SCM	Total
Variable					
GDP per capita growth rate (%)	0.07	0.06	0.06	0.05	0.06
GDP per capita ($)	7,636	12,225	14,787	4,965	9,903
Investment per capita ($)	1,747	2,742	3349	805	2,161
Imports per capita ($)	2,390	4,999	3,016	1,055	2,865
Exports per capita ($)	1,005	2,839	1,835	746	1,606
Trade Openness (% of GDP)	0.44	0.64	0.33	0.36	0.45
Labor Productivity	0.34	0.45	0.45	0.35	0.40

Again, the data observed is from 1970 to 2004 and measured in 2004 US dollars. The values of income, investment, imports, and exports are all in per capita terms.

Empirical Model

The goal of this paper is to analyze the effects of trade on the growth rate of income per capita and one model (model A) will be used to investigate these effects. Y_i is the variable denoting the growth rate of income per capita for country ***i***. Because this is a growth rate, it is calculated by first differencing logged GDP per capita, as shown.

$$Y_i = \ln(GDP_{i,t}) - \ln(GDP_{i,t-1}) \tag{8}$$

In this discussion, the model variables are denoted parenthetically. Model A has the independent variables of GDP per capita (*GDP*), investment per capita (*I*), trade openness (*Open*), and labor productivity (*LP*). In the model, dummy variables for the EU (*EU*), the Southern Common Market (*SCM*), the ASEAN (*ASEAN*), and Japan (*Japan*) are included on the right hand side. The NAFTA bloc is the reference group and, therefore, has no dummy variable.

The model also contains additional variables that account for additional trading bloc membership benefits. This is calculated by interacting the term of trade openness with the trading bloc dummy to capture the trade benefits of being a member of a particular bloc. Put simply, these variables are trade openness multiplied by each trading bloc. Some examples of the benefits captured by this variable are freer international trade (within NAFTA, an example is less restrictions on freight trucks crossing borders), greater citizen mobility (European Union citizens move with ease between EU member countries), and a greater access to foreign direct investment. For variable notation, they are denoted by an "O" after each trading bloc i.e. *EUO* denotes the multiplying the EU bloc dummy times openness. Again, there is no NAFTA trading bloc dummy because this is the reference group; however, *NAFTAO* denotes the interaction term to capture the benefits of being a participating country.

Lastly, the model also contains additional dummy variables that control for exogenous shocks in the years over the data observation. These time dummies for each year are indicated in both models as simply {*TD*}.

Model A uses the first difference of investment per capita. The process of first differencing corrects for stationarity. GDP per capita is a non-stationary trend—meaning there is no mean reverting relationship. Differencing, be it first or second, a variable can create a deterministic trend. This is inherently done in calculating growth rates, such as Y_i in equation 8, which makes data estimation more reliable. One of the disadvantages of differencing is that explanatory power is lost in the transformation because the stochastic growth process is removed. For instance, prior to first differencing GDP, the data contains some increasing trend that does not have a constant mean. This increasing trend is removed by the process of first differencing and yields a constant mean trend for GDP. First differencing the data transforms a non-stationary process to one that is stationary and is what is used in the model. Econometrically, these estimates will contain less 'noise' because of first differencing investment.

$Invest_i$, is the first differenced variable of investment per capita for country *i* such that:

$$Invest_{i,t} = I_{i,t} - I_{i,t-1} \qquad (9)$$

The variables of imports, exports, and labor productivity remain in their lagged form and are not first differenced because, from observing the data, they were determined to be a stationary series. Theory predicts that technology (for which labor productivity the gross substitute) grows at a constant rate once an economy is on a balanced growth path-this implies stationarity and does not require first differencing.

Model A is represented as:

$$Y_t = \rho Y_{t-1} + \alpha_1 + \alpha_2 GDP_{i,t-1} + \alpha_3 I_{i,t-1} + \alpha_4 Open_{i,t-1} + \alpha_5 LP_{i,t-1} + \alpha_6 EU_{i,t} + \alpha_7 SCM_{i,t} + \alpha_8 ASEAN_{i,t} + \alpha_9 Japan_t + \alpha_{10} EUO_{i,t} + \alpha_{11} SCMO_{i,t} + \alpha_{12} ASEANO_{i,t} + \alpha_{13} JapanO_{i,t} + \alpha_{14} NAFTAO_{i,t} + \{TD\} + u_i$$

Where ρ represents the weight of the previous period's income per capita growth rate on that of present period and u_t denotes the disturbance term.

When a regression similar to Models A is constructed, it is typical to use the GDP value at the start of the dataset ($GDP_{i,1970}$). The regression output using this variable in place of $GDP_{i,t-1}$ returned results which were contrary to theory and did not pass a F-test with a level greater than 5 percent. Using the above the model with the lagged value of GDP (as written above), the regression is significant at a level of 1 percent.

Performing Durbin-Watson tests on the data revealed the presence of autocorrelation between the growth rate of income per capita, GDP per capita, as well as investment, imports, exports, and labor productivity. Observing the correlograms and conducting Durbin-Watson test on second differences of these series revealed that this autoregressive property is only of only one lag. The DW statistic for imports and exports are both close to the lower bound of the critical value, but still indicate an autoregressive relationship. This autoregressive property in the data is the reason for using an AR(1) estimation.

Fixed effects (FE) with an autoregressive disturbance estimation was identified as a possible method to estimate the model. This technique controls for omitted variables that differ across countries (i.e. natural resources, land size, etc.) but are constant across time and accounts for autoregressive process of one lag (AR(1)) in the disturbance. Eaton and Kortum (2002) find that geographic barriers inhibit trade and note that "...gravity literature has recognized the importance of geographic barriers... (but) formal models of international trade have typically ignored them" (p1775). Because geographic features do not change over time, fixed effects estimation ignores these variables. This type of estimation implies that the effects of the right hand side variables on the dependant variable are the same across countries once one controls for the fixed effect. The differences in the growth rate of income per capita across countries are attributed to the intercept constant, which varies across countries in FE estimation. Theoretically, this makes sense because the intercept constant in FE estimation captures time invariant variables (such as the land size of a country) but can also interpreted as an initial endowment. In 1970 (the beginning of the dataset), countries' initial endowments vary greatly-Argentina's endowment is different from that of the United States, which is different from that of Indonesia and so forth. Fixed effects allows for the initial endowment of each country to be different, but constant over time.

Random effects estimations would be inappropriate for these models because of the sample size-the greater number of time periods in the sample, random effects estimates collapse to fixed effects estimators. Gregorio's (1992) paper utilized random effects estimation over time periods of no more than 6 years. The 35 years of data in this paper is sufficient to use fixed effects estimation.

The error term in the FE model captures the inherent AR(1) process consistent with GDP analysis. Any change in Y_i not accounted for by the variables in the models will be captured by the error term. (On a country level, there are numerous reasons to have a sudden change in the growth rate of income per capita that are not accounted for by the models.)

Because the model analyzes the growth rate of income per capita, fixed effects estimation would yield inaccurate results because, as discussed above, *Y* is a first differenced variable. The process of first differencing means that the growth rate of income per capita will inherently be stationary. This stationarity negates the use of fixed effects because the 'fixed effect' has already been removed from the data. The correct estimation technique is that of an autoregressive process.

An AR(1) process is one that contains a one period lagged value of the dependant variable on the right hand side of the equation. This is shown in the model by the ρY_{t-1} term as independent variable. The ρY_{t-1} denotes the impact of a previous period's income per capita growth rate on that of the present period. For instance, if $\rho = 0.5$ then half of the growth rate of income per capita in period *t-1* will impact that of period *t*.

Results

Prior to regressing data for each the trading blocs, individual country regressions were run to determine the effect of net exports (*NX*), not trade openness, on income per capita under the specification of Model B.

$$Y_i = \delta_i + GDP_{i,t-1} + NX_{i,t-1} + \eta_i \qquad \text{Model B}$$

Where δ_i is the constant intercept and η_i represents the error term, both for country *i*.

These regressions are not reported because no country investigated had a coefficient on net exports that was statistically significant at any level greater than 90%. Many countries' coefficients were significant at a level greater than 80%, but not more than 13. These findings are consistent with the many past empirical studies: there is no statistical relationship between a country's income per capita growth rate and net exports. The 13 countries with a positive and significant coefficient for net exports could be due to the 'accounting identity' effect problem addressed by Jiles and Williams (2000).

Table 3.A below reports the regression results for Model A. Economic theory predicts the coefficients for variables of *GDP*, *Invest*, *EX*, and *LP* to be positive, while *IM* will be negative, and these variables will be significant to the growth rate of income per capita. With the exception of lagged productivity, these variables are all consistent with predictions and theoretical expectations.

Table 3.A
Model A Regression—NAFTA is the reference group

Effects of below variables on the growth rate of per capita income		
	Estimate	Std. Error
Constant	635.22*	376.60
Variable		
Lagged GDP	0.02***	0.003
Invest	0.79***	0.03
Lagged Imports	-0.05***	0.01
Lagged Exports	0.14***	0.04
Lagged Productivity	-0.28	0.23
Variable		
EU	28.25	73.64
SCM	-250.34*	136.15
ASEAN	-157.23*	90.44
Interaction		
EUO	-1.02	0.83
SCMO	2.28	3.05
ASEANO	1.16***	0.41
JapanO	15.31	22.60
NAFTAO	-0.78	1.56
ρ	0.25	
R^2	0.62	
n	810	

Note: time dummies are not reported.
* Significant at the 10% level; ** Significant at the 5% level;
***Significant at the 1% level

The negative sign for the coefficient on productivity is contrary to economic theory. As discussed in the theoretical model section, the labor productivity term serves as a proxy for technology. This variable, according to theory, should positively affect income per capita. As Table 3.A reports that, as technology in period *t-1* increases, this will reduce the growth rate of output per capita. It might be argued that a possible reason for this negative sign is the inherent stationarity in created by computing the growth rate of GDP per capita, *Y*. The negative sign indicates that, as the previous period's labor productivity increases, the growth rate of GDP per capita decreases. These negative signs could merely be capturing mean reverting nature of *Y* because as the growth rate period t increases, it can be expected that in period *t+1*, the growth rate of income per capita will decrease as the series moves towards its mean trend. If this were the case, this growth dampening negative sign would be expected on lagged GDP, not labor productivity. Returning to theory, the growth rate of GDP per capita is positively influenced by technology (labor productivity), which is contrary to empirical findings.

The estimated coefficients for imports and lagged GDP carry statistical significance, but not much economic significance. The statistical significance is evident by the fact that both terms are significant at a 1 percent level. The fact that these values are both close to zero indicates that there is not much economic significance to these variables. As an example, the value for the import coefficient is -0.05—meaning that a 1 dollar increase in imports will, on average, be correlated with a 0.05 percent drop in a country's income per capita growth. Because this value is not much different from zero, it carries little economic significance.

The estimated constant is crucial in interpreting the coefficients for the trading blocs. NAFTA member countries, on average, have the growth rate of their income per capita 635 percent greater than that of the average country in the dataset. This increased growth only comes after 1994, when NAFTA was created. Becoming a member of the European Union is correlated with a roughly 663 percent increase in a countries' income per capita growth rate. Hungary joined the EU in 2004; this does not mean that in 2004 the growth rate of their income per capita suddenly jumped 663 percent. This value is interpreted that, on average, countries that joined the EU are correlated with an increased economic growth rate. This 0.04 percent discrepancy between NAFTA countries and EU members is understandable because these blocs are both similar. For the most part, member countries of both blocs are developed countries with similar, relatively stable, political structures. It must be noted that the EU coefficient carries economic significance (as discussed above), but is not statistically significant. (This lack of statistical significance can be attributed to the fact that NAFTA is the reference group and the similarities between NAFTA and the EU nations.)

The Southern Common Market (Latin America) does not carry the same characteristics as member countries of NAFTA or the EU. These countries have historically unstable political regimes and initial conditions much less than those of NAFTA (ignoring Mexico) and many EU member countries. These differences are captured by the *SCM* coefficient above. Of the Latin American countries in the dataset, their GDP per capita growth rate is, on average, roughly 39 percent less than that of NAFTA or EU member countries.

Over the past 30 years, the ASEAN and their Newly Industrializing Economies (NIEs) have experienced tremendous growth due to various policies discussed in Table 4. This growth is not captured shown in Table 3.A because, according to the calculated coefficients, ASEAN countries' income per capita growth rate being roughly a quarter less than NAFTA member nations. One would expect this variable growth variable to be greater due to their governmental programs, institutional differences, NIEs, and other regional specific differences. The data does not support the 'catch-up' effect in the ASEAN countries surveyed. There is, however, different evidence when examining the *ASEANO* coefficient.

The interaction terms control for other benefits (i.e. availability of foreign direct investment) of membership in a particular trading bloc that are not accounted or elsewhere in the models. The coefficient for *EUO* is negative indicating that, according to the data and model, as an EU member country increases their trade openness, the growth rate of their income per capita will decrease by roughly 1 percent. (This coefficient, however, is not statistically significant.) The *EU* variable accounts for the level effects of being a member of the European Union where the *EUO* interaction variable captures benefits of trade while being a member country. Interpreting the difference in these variables for the EU shows that simply being an EU member has a positive influence on Y_{EU}, while the trade benefits of such membership inhibit the growth rate of income per capita. This however is counter to theory; with an organization as large as the European Union, there should be gains from joining.

Latin American countries experience the opposite interpretation from that of the EU. Being a Southern Common Market member has a large negative effect on those countries' income per capita growth rate—as shown through the coefficient on *SCM*. There are, however, large benefits of being a member of the SCM, which is shown by the *SCMO* coefficient being over double that of the EU. In addition to the afore mentioned access to foreign direct investment, oil could be attributed to this growth increase. Brazil, Colombia, Ecuador, and Venezuela are all oil producing countries that benefits their terms of trade and this change would be captured in the *SCMO* variable. Furthermore, Ecuador and Venezuela are both member countries of OPEC (Organization of the Petroleum Exporting Countries), which might have spillover effects that increase the *SCMO* coefficient. Like the *EUO* coefficient, *SCMO* also lacks statistical significance at standard levels.

Comparing the differences in the *ASEAN* and *ASEANO* variables reaffirm that their growth is mostly due to intra bloc (or country) programs. The *ASEANO* coefficient indicates that just over a 1 percent increase in income per capita can be attributed to external benefits from trade. This coefficient is the only interaction term that is statistically significant at level of 1 percent. Because the coefficient itself is small, it merely indicates that trade *does* benefit ASEAN nations, but only to a small extent.

The *NAFTAO* variable attributes negative income growth in NAFTA countries to bloc 'benefits'. This means that NAFTA member countries' growth is inhibited by this treaty. As will all other interaction terms (except *ASEANO*), the *NAFTAO* coefficient is not statistically significant at any level.

When surveying the interaction terms in Model A, there is not much significant economic difference between the estimates of *EUO*, *NAFTAO*, *SCMO*, and *ASEANO*. The *JapanO* variable, however, is drastically different. Japan is a special case because it is not a formal member of any trading bloc, but is a member of the G7 and a large economic driver in the global economy. In Model A, the *Japan* coefficient was dropped due to collinearity. This is because the dataset contains 43 countries and the dummy for Japan was a vector of zeros for 42 countries. Japan could have been the reference group to prevent this; however, it is more reasonable to have NAFTA as the reference group—point of reference being The United States. The *JapanO* coefficient indicates that Japan gains approximately 15 percent of their GDP growth, essentially, because of their terms of trade. Because it is one country, there are no 'benefits' per say for their direct trading partners, only Japan's terms of trade with the rest of the world. Because of Japan's lack of collective bargaining power—such would be inherent with trading blocs—it would be reasonable to predict sign on the *JapanO* variable to be negative. Based on the model above, the opposite is true—the income per capita growth in Japan is increased due to their terms of trade. It must be noted that this coefficient does not carry any statistical significance.

In addition to the reported estimates in Table 3.A, the model also included time dummies to control for exogenous shocks that happened in a given year (from 1970 to 2004). All of the 35 coefficients—one for each year—were negative and ranged from negative 740 to negative 41. Of these estimates, only seven were statistically significant at standard levels: 1992-93, 1998, and 2001-04. The United States experienced some sort of economic downturn during or around these times, but it must be noted that these time dummies report exogenous economic changes across all the countries in the dataset. The negative sign for these years, coupled with statistical significance, illustrate economic interdependence and global economic integration—or at least the weight of The United States on the global economy.

The United States provides aid to Mexico, which is not captured in the model or any variables. The trading bloc dummy, e.g. *EU* and *SCM*, captures the gains associated with each bloc. The interaction variable captures inter bloc benefits, not intra trading bloc benefits. Mexican membership in NAFTA benefits that country greatly from the proximity to the United States and this not reported in the *NAFTAO* variable. There are gains and losses associated within each trading bloc that are not captured in the model.

Table 4 below provides brief highlights of each trading bloc. With the exception of the ASEAN, the trade agreements below focus simply on free trade and reduced—if not eliminated—tariffs. The ASEAN trade agreement is the most comprehensive treaty of the four trading blocs. The institutions within these countries are the cause for many programs for family, elders, timber, energy, tourist, etc., all added to trade mobility within the agreement.

Table 4
Intra-bloc trade agreements highlights.
The year a country signed a trade treaty is indicated parenthetically.

Trade Agreement:	The Association of Southeast Asian Nations (ASEAN)
Date Founded:	8 August 1967
Founding Nations:	Indonesia, Malaysia, Philippines, Singapore, Thailand
Member Countries:	Brunei Darussalam (1984), Vietnam (1995), People's Democratic Republic of Lao and Myanmar (1997), and Cambodia (1999)
Key Treaty Agreements:	- Mutual respect and non-interference between members - Multiple peace treaties - Increase labor and capital mobility - 99% of tariffs are not greater than 5% - 60% of products have no tariff - Expedite economic disputes - Intra region transportation and energy network - Various social networks for youth, the elderly, education,

	HIV/AIDS, and families - Facilitate talks with other regional countries and organizations - Specialized sub-committees (e.g. tourism, timber, earthquake information, etc.) to benefit member countries
Trade Agreement:	The European Union (EU)
Date Founded:	18 April 1951 (European Steel and Coal Community)
Founding Nations:	Belgium, France, Italy, Luxemburg, the Netherlands, and West Germany
Member Countries:	Austria (1995), Cyprus and Czech Republic (2004), Denmark (1973), Estonia (2004), Finland (1995), Greece (1981), Hungary (2004), Ireland (1973), Latvia, Lithuania, Malta, and Poland (2004), Portugal (1986), Slovakia and Slovenia (2004), Spain (1986), Sweden (1995), and the United Kingdom (1973)
Key Treaty Agreements:	- Single Market (free mobility of good, services, and factors of production across borders) - Free mobility of EU citizens across borders - Greater inherent stability in the Euro - Set health, environmental, safety, and education standards
Trade Agreement:	The North American Free Trade Agreement (NAFTA)
Date Founded:	1 January 1994
Founding Nations:	Canada, Mexico, and the United States
Key Treaty Agreements:	- Tariff and trade barrier reduction - Phase out of tariffs by 2008 for many goods - Set health, safety, and industrial standards to that of the US and Canada - Established labor and environmental commissions - Greater intellectual property rights within Mexico - Increased domestic firms' ability to bid on foreign government contracts
Trade Agreement:	The Southern Common Market (SCM)
Date Founded:	26 March 1991
Founding Nations:	Argentina, Brazil, Paraguay, and Uruguay
Associate Countries:	Bolivia, Chile, Colombia, Ecuador and Peru (Venezuela is in the process of becoming a full member)
Key Treaty Agreements:	- Free mobility of goods and services as well as factors of production - Instituting a common tariff for non-members - Macroeconomic policy coordination

Further Discussion

One possible explanation for the lack of statistical significance for the interaction coefficients is a lack of homogeneity in the EU and NAFTA. The largest trading bloc (as far as number of member countries) is the European Union. There is a vast difference between the data reported for both Britain and Lithuania. The EU and NAFTA are relatively more heterogeneous compared to the Southern Common Market and the Association of Southeast Asian Nations. This could also be an explanation for the lack of statistical significance on the *EU* dummy—because the SCM and ASEAN are more homogeneous, their dummies (*SCM* and *ASEAN*) are therefore significant. Regardless of the reasoning for the lack of statistical significance in these dummy variables, there is economic significance. These findings are somewhat consistent with previous research conclusions that trade does have an effect on economic growth (shown in the *IM* and *EX* variables), but the specifics across trading blocs are less clear (reported in the lack of statistical significance in the dummy variables).

One key omitted growth variable is education. According Jones (2002), roughly one third of US economic growth can be attributed to educational attainment. This large portion of per capita income growth is merely ignored in this paper. This could lead to model misspecification and incorrect conclusions. Furthermore, Romer (2006) believes per capita, as opposed to per worker, terms to be more appropriate when controlling for education. This paper does not control for education but utilizes per capita terms, which could cause further misspecification.

Another way the models in the paper could be incorrectly specified is a lack of control for trade endogeneity. There are no instruments the in above models to control from an inherent trade endogeneity. A simple and effective instrument, based in the Gravity Equation, could be the use of geography (or distance) as a control.

Conclusion

The question of the impact of trade on economic growth has been addressed by many different authors with varying conclusions because there is no consistency between economic theory and empirical findings. This paper analyzed the effects of trade or, more specifically imports and exports, and trading bloc membership on the growth rate of per capita income. The model employed theoretically standard growth variables with imports and exports as well dummies for trading bloc membership and time. The regression estimates econometrically show that international trade does affect economic growth within a trading bloc. The countries in the ASEAN have experienced unique economic growth due to institutional differences, which is captured in the results of the models by the statistical significance of said variables. However, the values of said estimates are not consistent with expectations based on historical growth. The estimates of the model support economic theory by finding a positive correlation between exports and economic growth and a negative correlation between imports and growth—both variables are significant at standard levels. Examining the whole model (including the dummies), this paper finds that trade does influence economic growth. These conclusions must be taken at 'face value' because additional research is required with the inclusion of previously discussed omitted variables.

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