January 2017

Importance Of Macroeconomic Stability To Developed Nations

Jeffrey Brian Leeson

IMPORTANCE OF MACROECONOMIC STABILITY TO DEVELOPED NATIONS

By

Dr. Jeffrey Leeson
Doctor of Management
Master of Science in Management
Master of Business Administration
University of North Dakota May, 2017

A Thesis

Submitted to the Graduate Faculty

Of the

University of North Dakota

In partial fulfillment of the requirements

for the degree of

Master of Science
Applied Economics

Grand Forks, North Dakota

May
2017

This thesis, submitted by Dr. Jeffrey Leeson in partial fulfillment of the requirements for the Degree of Master of Science in Applied Economics from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

_____
Dr. Chih Ming Tan Chairperson

_____
Dr. Daniel Biederman

_____
Dr. David Flynn

This thesis is being submitted by the advisory committee as having met all of the requirements of the School of Graduate Studies at the University of North Dakota and is hereby approved.

_____
Dr. Grant McGimpsey
Dean of the Graduate School

_____
Date

PERMISSION

Title Importance of Macroeconomic Stability to Developed Nations

Department Economics

Degree Master of Science in Applied Economics

In presenting this thesis in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the library of this University shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my thesis work or in her absence by the Chairperson of the department or the dean of the School of Graduate Studies. It is understood that any copying or publication or other use of this thesis or part thereof for financial gain shall not be allowed without written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my thesis.

Signature Jeffrey Brian Leeson
Date 5/13/2017

TABLE OF CONTENTS

LIST OF TABLES

Table Page

ABSTRACT

This research investigates the importance of macroeconomic stability to economic growth of developed nations. For over a decade, many developed nations have experienced slower gross domestic product growth as well as slower gross domestic product per capita growth. Meanwhile, recently developed economies, such as the high-performing East Asian economies, have experienced far higher per capita growth rates. Although this is in line with Solow's (1956) growth model predicting conditional convergence and other researchers attributing the slowdown to sectoral shifts, this offers little solace to the citizens of those developed nations witnessing slower growth. The purpose of this research is to increase governmental leaders' focus on better managing macroeconomic stability. A combination of correlation, multiple regression, and Bayesian model averaging was used with gross domestic product per capita growth as the dependent variable. Independent variables used were those found in traditional growth research, with a focus on macroeconomic stability variables. It was determined that a developed country's inflation rate is the only macroeconomic stability variable tested, which enhances the predictability of gross domestic product per capita growth at a 99% confidence level, while the country's debt share of GDP and deficits were significant at the 90% and 95% level respectively, albeit with opposing signs. Surprisingly, during the research, it was also determined that Levine and Renelt's (1992) research on robust growth variables did not equally apply in the sampled 72 developed nations. Although the methodology was applied to a broad sample, specific mention of the United States' experience was made, as it is the largest of the developed nations.

SECTION 1

INTRODUCTION AND LITERATURE REVIEW

This research study assessed whether the importance of macroeconomic stability variables (MSV) to developing nations' gross domestic product per capita (GDPPC) growth rates were similar to already developed nations. This is important to the citizenry of developed nations because if recent GDPPC growth trends covering several decades are extrapolated into the future, economic growth itself may become obsolete.

Developed Nations Moribund Growth

This paper focused on GDPPC growth with comparisons to prior research that revealed the majority using GDPPC growth as the dependent variable. This metric may be ideal to measure a country's wealth because it is not distorted by GDP size. Although a slowing growth convergence may be in line with Solow's (1956) and Barro's (1991, 1996) research and both Kuznets' (1968) and Echevarria's (1997) attribution of slowing growth to sectoral composition changes, these explanations are of little comfort to developed country populations. Toward this end, this research study focused specifically on whether certain macroeconomic policies found to be important to the more recently developed nations can be applied to reviving economic growth in nations considered already developed decades ago. In other words, the central question explored was as follows: Is macroeconomic stability deemed important to recently developed nation growth also important to already developed nation growth?

The limitations of this study primarily center on accuracy, measurement consistency, and completeness of raw data available across four decades for 72 nations covering over 25

independent variables. Delimitations imposed included the selection of both the dependent and independent variables. For the most part, prior research guided variable selection.

Macroeconomic Stability Importance

The World Bank's (1993) report *The East Asian Miracle: Economic Growth and Public Policy* cited a number of necessary conditions for the remarkable growth of several high-performing Asian economies, which needed to be supplemented with a number of other sufficient conditions. Primary among the necessary conditions was what the World Bank referred to as "macroeconomic stability." This was more recently echoed in the World Economic Forum's (2006) *The Global Competitiveness Report 2006–2007*, which reported, "There is overwhelming evidence that in the absence of ... macroeconomic stability, growth will be anemic ... or, at best, volatile" (p. 4, section 1.1). Thus, this study's research conclusions will be beneficial to both developing nations still in their infancy as well as the potential to give more advanced economies information that may re-catalyze what has become stagnant growth.

In addition to macroeconomic stability, the World Bank (1993) report cited other necessary conditions, to include investment in human and physical capital and openness to trade both in domestic and international markets. Assuming these conditions are present, this could further enhance a country's growth prospects, including democratic institutions, rule of law and property rights, and income equality. Although no research shortage exists with this wide array of independent variables, this current research is targeted specifically at the macroeconomic stability variables and their importance compared to other factors, vis-à-vis a developed nation's GDPPC growth rate.

Meaning of Macroeconomic Stability

Although not identical, the list of macroeconomic stability variables presented herein is effectively a subset of those used as European Union (EU) entrance criteria listed in the Maastricht Accords (Castro & Soukiazis, 2007). The Maastricht Accords listed five macroeconomic indicator benchmarks upon which new entry into the EU are now based (Castro & Soukiazis, 2007). The indicators used in the Accords, which were also used in this research, were not all absolute values, as some were relative indicator levels. For example, one Maastricht requirement is that the new entrant's long-term interest rates should be no more than two percentage points above the rate of the three EU countries with the greatest price stability over the previous year (European Central Bank, 2017). The absolute and/or relative level requirements of five MSVs for new entry into the EU include the following: debt as a percent of GDP; deficit as a percent of GD; inflation rate; exchange rate variability; and interest rate (Castro & Soukiazis, 2007). In the first two cases, absolute maximum variable levels were a requirement. In the latter three cases, a maximum difference between the new entrants' variable level and existing EU countries were the criteria for entrance.

Prior Research on MSV Importance

The World Bank (1993) report studied 113 countries that contained a list of both specific countries and groups of countries by region (p. xvi). The majority of these were least developed countries (LDC). In one of the regression results, the report demonstrated a positive impact to growth of the high-performing East Asian economies' regional dummy variable as compared to other regional group dummy variables created for Latin America and Africa. The report (World Bank, 1993, p. 51) also confirmed the strength of often studied base-year GDPPC variables, one of several human capital variables, population growth, and investment as a share of GDP, all in

line with Levine and Renelt's (1992) seminal research on robustness of independent variables. Unfortunately, while extensive comparison data was presented on macroeconomic stability, including inflation, debt, deficits, and exchange rate stability, none of them were included in any regression analysis. Instead the report's conclusion about the importance of macroeconomic stability was based on comparing levels of these variables to other LDCs and reaching conclusions based on that (World Bank, 1993, p. 105–156). More recent research on the importance of MSVs to economic growth has used both multiple regressions and Bayesian model averaging (BMA) analysis.

Numerous researchers using multiple regressions, rather than looking at broad MSVs, instead have disaggregated those policies to observe the more specific policy impacts. As such, these researchers have assessed more specific fiscal policy choices that country central governments might make. This research is important as countervailing forces at work might distort our own analysis conclusions on the broader measures (Kneller, Bleaney, & Gemmel, 1999). Focusing on fiscal policy components, Kneller et al. (1999) separated government spending into productive versus non-productive expenditures, which they defined respectively as whether or not these expenditures would appear in the private sector's production function in a positive manner (p. 173). Similarly, they separated government revenue sources as either distortionary versus non-distortionary, which they defined as those positively impacting physical or human capital investment decisions and those that do not (Kneller et al., 1999). The Kneller et al. (1999) study of 22 developed Organization of Economic Cooperation and Development (OECD) countries used the international monetary funds' functional classification of government activity. This classification showed that taxation on income and profits was distortionary while taxation on goods and services purchases was non-distortionary. Conversely, government

spending on welfare and social security was considered to be non-productive investment, while spending on education, health, and housing were productive expenditures (Kneller et al., 1999). Classifying the sampled countries' spending and taxation into these classifications was then used in a number of regressions. The results demonstrated statistically significant distortionary taxation and productive expenditures but insignificant statistical results for non-distortionary taxation and non-productive expenditures (Kneller et al., 1999).

Still more recently, Durlauf, Kourtellos, and Tan (2008) performed research using BMA. Their research showed the relevance of the broad category of macroeconomic policy models to growth. In particular, they showed inflation and deficits to be robust and have a strong negative impact on GDPPC growth (Durlauf et al., 2008).

A key issue in our research was whether it was even valid to compare factors affecting developing nations' growth to factors affecting developed nations' growth. This was crucial as our statistical analysis began with the robust results from Levine and Renelt (1992). Writing in the *Banca Nazionale del Lavoro Quarterly Review*, Nayyar (2007) outlined six areas making causal comparisons between developed nations and LDC's growth questionable (2007). Although Nayyar (2007) wrote from the direction of how LDCs could apply macroeconomic concepts learned from developed nations, we took the six factors and considered them from the opposite perspective.

Nayyar (2007) identified six differences between LDCs and developed nations. These six factors explain what may apply to LDCs that may not apply to already developed industrialized nations. Thus, these six factors identified the differences in the following areas: institutional setting, structural differences, objectives and policies, trade-offs and adjustments, and, finally, different growth constraints.

Macroeconomic Stability Variable Linkage to Investment

A number or researchers have linked economic growth to economic stability and, specifically, through the mechanism of MSVs affecting the level of investment. As far back as the Solow model and reinforced in research by Levine and Renelt (1992), Barro (1991), and Mankiw, Romer, and Weil (1992), investment is a consistently cited key growth determinant. Levine and Renelt (1992) also identified investment as one of the few robust variables in their results. One mechanism through which macroeconomic stability affects investment can be described by considering the impact of uncertainty on business investment. Uncertainty of price levels as measured by inflation, uncertainty of interest rates affected by both deficits and debt, and uncertainty of exchange rates affecting both costs and revenues as measured by the variation in exchange rates all tend to diminish investment on a ceteris paribus basis.

Growth Models

A number of economic growth models exist for which the pattern of developed nations' slowing growth might be explained. These include models espoused by Solow (1956), Barro (1991), Mankiw et al. (1992), Kuznets (1968), Echevarria (1997), and Rostow (1971). The work of Barro (1991) and Mankiw et al. (1992) are both extensions of Solow's (1956) exogenous growth model with Barro (1991) concluding that a better model fit results from conditional convergence, based on relative GDPPC levels versus the absolute convergence postulated by Solow (1956). Solow's (1956) exogenous model of economic growth showed that effective human capital growth manifested by a nation's population or workforce growth and growth of technology were both the main economic growth determinants. Subsequently, Mankiw et al. (1992) created their augmented Solow (1956) model by including a human capital component. However, the prediction of faster growth was solely confined to the transition period, i.e., when a

country is moving from one steady state to another higher steady state. Given the development duration of now developed nations, we questioned whether most industrialized nations were in the transition period from one steady state to another steady state. If anything, they might be moving from higher to lower steady state conditions. A calculation of actual versus steady state U.S. GDPPC confirms GDPPC should be slowing (Hoover, 2012). Solow's (1956) growth theory can be contrasted to endogenous growth theory, first espoused by Romer (1990), which assumes no diminishing returns to capital exist, a basis for the Solow (1956) model. Romer's (1990) theory implied that continued growth is possible as long as investments in human and physical capital can continue. This alternative to Solow's (1956) exogenous theory said that human and physical capital investments are better variables to predict and affect economic growth. Still another alternative group of growth models could be classified as being "sectoral dependent."

In the earlier cited papers, Kuznets (1968) and Echevarria (1997) considered trends in GDPPC growth as being dependent on sectoral composition, meaning how the relative size of the three economic sectors has evolved. Echevarria (1997) claimed that the phenomenon of two-way causality between economic growth and sectoral composition was caused by a combination of the shifting from a predominantly low total factor productivity sector (primary sector) to the higher total factor productivity secondary sector. This causality was composed primarily of manufacturing, which caused the upward slope in growth rates. In addition, the subsequent downward slope was caused by more developed nations moving to a greater share of GDP coming from an increase in the lower productivity tertiary or services sector. Although a decided difference exists in the rate of GDP growth between the goods producing and service sectors, the proportion of the economy represented by the service sector has also been growing in the United

States (van Biema & Greenwald, 1997). The true impact of the growing service sector on GDP growth is represented by the weighted average of each sector's growth and share of the economy that is detailed in research concerning the importance of the manufacturing sector to GDP growth versus the service sector (Leeson, 2013).

Kuznets' (1968) conclusions echo the same sectoral shift impact, although he groups services and manufacturing as being higher productivity than agriculture, and while the shift from the primary sector to secondary and tertiary sectors explain the increase, an eventual decrease in productivity occurs as manufacturing shrinks relative to services, explaining the decrease in growth.

Prior Developing Nation Research on the Importance of MSV

We found a paucity of empirical growth research on developed nations, with the notable exception of EU nations and their implementation of the Maastricht Accords. Some clarity on what qualified a nation as developed or as a LDC must be explained. Thus, advanced and developed countries as well as LDCs are classified by the World Bank (2015) based on income level cut-offs, which in 2015 were $12,736 for high income economies while lower-middle-income and upper-middle-income economies were separated at a GNI per capita of $4,125.

For LDCs, Bleaney (1997) researched 40 LDCs in the 1980-1990 period to assess the importance of macroeconomic stability variables. He used the widely accepted Levine and Renelt (1992) I variables, or reasonable proxies, of human capital, base-year GDPPC, population growth, and investment as his independent variables. For his sample of LDCs, he first confirmed the statistical significance of the four Levine and Renelt (1992) variables, as we did in our own initial modeling of developed nations. He then performed the research from two directions, including investment as an independent variable along with macroeconomic stability variables,

and then repeating the modeling using investment itself as the dependent variable. Using GDPPC growth as the dependent variable, he cited robustness from a sampled time period perspective, even though his coefficients had poor t-statistics for the macroeconomic stability variables of deficits and standard deviation of exchange rates, inflation, and debt. The best t-statistic using GDPPC as the dependent variable was only 1.78; the rest were <1.29. This contradicted the World Bank's (1993) report that showed MSVs are paramount to developing a nation's growth. His modeling using investment as the dependent variable also showed poor t-stats for the MSV but did show a statistically significant impact of several trade variables, in line with Levine and Renelt (1992), which we then also used in our analysis. Among them were base-year exports as a percent of GDP and growth in the exports to GDP ratio.

Fischer's (1991) research, completed earlier than Bleaney's (1996, 1997), had the similar objective of trying to establish the importance of macroeconomic stability variables. In addition, he specifically studied whether these variables had an independent impact on growth or if their effect was through their impact on investment. In his study of 101 nations across the regions of Africa, Asia, and Latin America, he demonstrated that the faster growing nations had higher levels of investment and government consumption spending, higher levels of exports, higher levels of education, and, as applicable to our research, far lower inflation levels. From a model perspective, MSVs found to be statistically significant included inflation, debt, and deficits. We had hoped his research encompassed mostly developed nations, more applicable to our research, but it was unclear of what Fischer's (1991) sample consisted. Given the large sample size, it is likely he used more LDCs than developed nations, reinforced by comments stating he excluded any countries with a GDP was higher than Italy's in 1970 (Fischer, 1991, p. 339).

Maastricht Accords and OECD Natural Experiment

We had the opportunity to review the results of a real experiment concerning the impact of macroeconomic stability on the growth of developed nations when we studied EU nations and the Maastricht Accords' implementation results. Specifically, in terms of macroeconomic stability concerning the EU formation, and the subsequent Maastricht Accords promulgated via the Stability and Growth Pact, this provides a real experiment. This is because growth results prior to the Stability Pact could be compared since those stability criteria were put in place. What are referred to as the Maastricht Accords is a group of supposed requirements for new entrants to the EU. These are not only requirements for accession into the EU by new entrants, but act as time-specific goals for existing EU members. These Accords had an effective date of 1997. It should be noted that there was very little compliance with the Accords by then current EU members. Only five of the nations met the inflation target, and only three met the maximum debt to GDP ratio target (Kahrs, 2002, p. 47).

Castro and Soukiazis (2007) used just that kind of research for the period prior to imposition of the Maastricht criteria and the 10 years following. Their research covered 15 EU nations and considered the pre-Maastricht Accords time period of 1980–1991 and post Maastricht from 1992 to 2001 (p. 44–50). They also compared results of EU countries to non-EU members. As a result, the study concluded that "higher fiscal discipline after Maastricht did not benefit the growth of real output" (Castro & Soukiazis, 2007). Thus while reduced deficits and reduced exchange rate stability both negatively affected growth, better control over inflation has enhanced GDPPC growth, in line with our own research. In terms of unemployment, which typically follows the business cycle, they found that the degree of unemployment improvement through the business cycle was less post-Maastricht than prior.

Another study of the same nature was conducted on a difference in differences basis (Baskaran, 2009). A key assumption to make this analysis valid is known as the parallel trend assumption, which posits that if no treatment has been applied, the trend in the outcome variable for both control and treatment subjects will be similar. Toward this end, using all EU countries as the control group helped satisfy this requirement. In Baskaran's (2009) case, the "treatment group" countries were the EU nations subject to the Maastricht Accords, all of which would have followed similar Maastricht requirements. His results showed improvement in deficits, inflation, and interest rates from the pre- to post-Maastricht Accords imposition. However, similar results were observed for non-EU members implying from a difference in differences basis that the treatment had little effect. Therefore, we cannot conclude from this prior research any clear attribution of growth being tied to the imposition of the Maastricht Accords based on what could be considered a real experiment. For some MSVs, a direct impact on growth existed while for others this was not apparent.

The rest of this thesis study is organized as follows: Chapter Two describes the methodology, sample, and variables employed; Chapter Three presents and discusses the results; and Chapter Four includes a conclusion as well as recommended areas for future research.

SECTION II

METHODS

Introduction

The majority of growth research examined used multiple regressions and correlational studies for developing growth models. Robust checks frequently cited used instrumental variables, variations in the sampled population, and variations in time periods covered. With the advent of faster and cheaper computing power, BMA was developed to address model uncertainty. It simultaneously tests for both statistically significant variables in models while at the same time is able to determine the best model to choose from in terms of independent variable selection. Our research used a combination of all these analysis tools. Toward this end, our methodology section begins with a brief review of Levine and Renelt's (1991, 1992) research. Their seminal research, using extreme bounds analysis, assessed the robustness of certain independent variables, both from the perspectives of the time period chosen as well as from the model that was chosen. They concluded that base-year GDPPC, a human capital variable, an investment share variable, and population growth were all robust for their sampled countries. However, as importantly as what they determined to be robust were those variables they could not prove in this regard. Most notably, for our research no comparable MSVs were deemed robust in Levine and Renelt's (1992) research. This was relevant in the choice of variables in our BMA analysis.

Bayesian Model Averaging

BMA is a statistical method to address model uncertainty. In typical regression analysis, the researcher chooses the independent variables believed to be significant predictors of changes in the dependent variable. Although it is possible that these independent variables will represent the true model that best fits the phenomenon, it is also possible that an improved model could better reflect the relationship. This could be due to an improved selection of independent variables. BMA addresses this model uncertainty by studying real data and determining the probability of an independent variable being part of the true model based on that previously collected data. BMA can include a "kitchen sink" approach (Durlauf et al., 2008), whereby numerous independent variables from various theories can be used. In this case, these "priors" are selected based on prior research and theory. For example, these same authors used BMA to not only assess the evidence of one GDPPC growth theoretical model versus another but to also apply the same methodology to each theory's component variables (Durlauf et al., 2008). An alternative approach to model selection is to use a constant only, whereby no priors are considered. This gives a truer model as no arbitrarily chosen "priors" from theory or other research is involved.

In our own analysis, some BMA variable selections had as many as 2.2 billion iterations and required 60 hours of continuous computer time. Although there is an algorithm that can substantially reduce the number of models to consider, our STATA13 software did not make use of this Occam's Razor algorithm (Raftery, Madigan, & Hoeting, 1997). Instead our BMA conclusions were based on the limitations of the STATA output. R software, which delivers the best model and is referred to as the posterior mode model, bases the strength of evidence concerning this posterior mode model as the best model per Raftery's criteria (Raftery, 1995).

This criteria states that a posterior probability >0.99 indicates very strong evidence of the posterior mode model being the best model; values between 95%-99% indicates strong evidence; and values between 75%-95% indicates just positive evidence. On the other hand, our STATA output delivered posterior inclusion probabilities (PIP) of individual independent variables. For these PIP values, we used a .5 or 50% probability cutoff to assess which variables belonged in the best model and then entered those into a multiple regression model.

The starting point for choosing our BMA "prior" variables (De Luca & Magnus, 2011), referred to as K1 variables in STATA's BMA command, were the I variables identified in Levine and Renelt's (1992) research. These four I variables, in addition to being robust in Levine and Renelt's (1992) research, are also found in varying forms in the models of Solow (1956), Barro (1996), and Mankiw et al. (1992). These K1 variables were used in all models considered in our BMA by assumption, except for the constant only model.

As our research was trying to assess whether macroeconomic stability is important to a developed country's growth, the choice of whether to use Levine and Renelt's robust variables for our BMA focus variables was of paramount importance. Levine and Renelt's prior 1991 research was the precursor for their 1992 conclusions (Levine & Renelt, 1992). Their 1992 paper cited the selection of their four I variables as being based on 41 prior research papers. Investigating the data and sampled populations from this prior research revealed that of the 41, one was identified as being from a developed nation, 23 were identified from developing nations, and 17 were not identified as to the development level of the sampled countries (Levine & Renelt, 1991). Levine and Renelt used both a 76-country data set and a 118-country data set in their 1992 research. Of the broader data set, 47 of the 118 overlapped with our 72-nation sample. Their sample excluded nations such as China, Poland, Venezuela, and the Czech Republic

(California State University, n.d.). Keeping in mind the different time frames of Levine and Renelt and our own analyses, we concluded that their data set was more biased towards LDCs than our own that focused on developed nations. The striking conclusion here was that beginning BMA analysis with Levine and Renelt's (1992) four I variables might distort the BMA results. This is a fact we observed in the actual research results shown in Section III.

Our initial methodology began with two-way correlations. Table 3 reduces the universe of two-way results to just the largest and smallest correlations of independent variables solely with the chosen dependent variable GDPPC growth. Our research then moved to multiple regressions. Although the focal point of our analysis was the BMA analysis to follow, we performed this initial multiple regression to assess if the significance of our MSVs as the independent variables were in line with prior LDC research. It was during this multiple regression that we discovered the greater significance of squared values concerning certain MSVs versus untransformed values indicating the possibility of a non-linear relationship among some of the MSVs and GDPPC growth. We then moved to BMA, a method of addressing model uncertainty making use of Bayes' theorem. Tables 4 through 12 show the results of this analysis. We began with BMA results using all independent variables including squared MSVs described earlier. Only variables with PIP equal to or greater than .05 are shown.

Dependent Variable Chosen

When multiple regression or BMA is used to assess factors that best predict economic growth, most research uses one of two dependent variables. In general, when economic growth is being studied, the level of GDPPC growth is the most frequently used dependent variable (see Levine and Renelt (1991) for a survey of dependent variables used in often cited growth research). Accordingly, our research used this dependent variable as well.

Independent Variables Chosen

The starting point for independent variable selection were the I variables in Levine and Renelt's (1992) research. These included base-year GDPPC, a human capital metric, an investment metric, and a population growth metric. Levine and Renelt identified these as being robust to changes in both chosen time periods and other variables entered into the modeling. These four variables represented the first group of variables used in all BMA analysis. The second group of independent variables chosen were primarily those reflecting MSVs as outlined in the Maastricht Accords and described as being necessary to the high-performing East Asian economies' nation growth performance (World Bank, 1993). Several other frequently used economic growth research variables were considered, including metrics of trade openness (Levine & Renelt, 1992). STATA refers to the independent variables chosen other than the K1 variables as K2 variables when using the BMA command.

Along with all other variables chosen, Table 1 lists and describes the MSVs used. These include debt as a percent of GDP, deficit as a percent of GDP, the nation's average inflation rate, average real interest rates, and the standard deviation of the exchange rate movements using the United States as the base currency. The change in the exchange rate can alter a country's exports, imports, and international competitiveness (Chinn, 2005). Based on other research, rather than the absolute level of the foreign exchange variable, the five-year standard deviation of these figures was, therefore, used. Based on initial multiple regression, it was found that several MSVs, if transformed, provided a better fit to the data. The square of each MSV was, therefore, used in our BMA analysis indicating non-linear relationships.

Regarding the importance of trade variables and whether to include them in our K1 variables, research conclusions were mixed. The World Bank (1993) report cited high-

performing East Asian economies' openness as one of the necessary conditions of their higher growth, whereby openness refers to both open domestic markets as well as international trade levels. Levine and Renelt's (1992) research concluded a lack of robustness regardless of choosing from any number of international trade metrics. Bleaney's (1996, 1997) research on LDCs included two trade variables: base-year exports as a percent of GDP and the growth rate of this same variable. These two variables were included in our analysis. Levine and Renelt's (1992) conclusion on trade openness can be compared to Sachs and Warner (1995) who measured trade openness as an accumulated score of a number of separate variables, including relative tariff levels, non-tariff barriers, type of economic system, and the degree of black market premiums that existed across countries. Their study provided an explanation for the majority of convergence or lack of convergence among countries' GDPPC. Subsequently, Rodriguez and Rodrik (1999) reassessed the robustness of both Sachs and Warner's (1995) data, along with several other studies, and determined that the black market premium differences accounted for the majority of the variation in Sachs and Warner's (1995) study, as opposed to the numerous other factors that created their openness score. Contrary to Sachs and Warner (1995), Levine and Renelt's (1992) research on variable robustness specifically cited a lack of robustness for any of a number of trade metrics.

Population and Sample

The population for our research first took all 34 countries in the Organization of Economic Cooperation and Development (OECD). These were then supplemented with developed nations using the income criteria described earlier. To attain the rest of our sample, we took the World Bank's (2016) list of all countries ordered by decreasing GDPPC in 2015 and chose the top non-OECD countries, excluding the former USSR countries now referred to as the

Commonwealth of Independent States (due to lack of data points). The lowest GDPPC country in our sample was Indonesia with a GDPPC of $10,500. We ended with a sample of 72 countries with the complete sample list and their corresponding categories available in Appendix 1.

Categorical Variables

In addition to eight five-year time period dummy variables, four other pairs of categorical variables were created to assist in analysis. The first was to separate OECD nations (Dummy=1), from non-OECD nations (Dummy=0). Another set was based on how large the size of the nation. For the largest half of the nations, the dummy variable=1 while the dummy=2 for countries was in the bottom half of GDP size. A third pair of dummy variables was used based on whether they were in the upper half of GDPPC growth nations on a 40-year average basis or the slower growing half. The dummy=1 for countries in the top half of country GDPPC growth and dummy=2 for countries in the bottom half of GDPPC growth. A fourth categorical variable was set up for countries with a GDP heavily dependent on oil revenues such as OPEC nations.

The BMA using a categorical variable was only performed for interaction of the OECD dummy variable with each MSV. Due to the extraordinary computer time needed for BMA, this was not performed using the other three categorical variables: GDP size, GDPPC growth, or oil versus non-oil dependent nations. Although we initially planned to also separate large oil producing versus non-oil producing countries' analyses, this was abandoned as the number of countries whose GDP was dominated by the oil sector was too small.

SECTION III

RESULTS

The results of the methodology outlined in Section II Methods are shown in Tables 3 through 15 and are separated into correlation results, BMA results, and regression results for the best model.

Correlation

Table 3 shows the largest two-way Pearson correlations among just the dependent variable and the 37 independent variables. Overall, no variables show correlation >.26. Among the largest correlations, along with their signs, were the Levine and Renelt (1992) I variables. The Human Capital Index (HCI) correlation and sign was -.1, base-year GDPPC, -.22, population growth, -.15, and investment share of GDP, +.26. The signs of three of the four Levine and Renelt (1992) I variables were, therefore, as expected. But the HCI negative coefficient did not agree with Levine and Renelt's (1992) expected sign or the work of Mankiw et al. (1992). Regarding the MSVs, interest rates had a small positive coefficient of 0.1 while deficits, deficits squared, and exchange rate variability had very low coefficients of <|.01|. The remaining MSVs all had negative coefficients between -.1 to -.18. Overall the negative signs of seven of our nine MSVs supported the counterfactual that macroeconomic stability in general is an important growth predictor.

BMA Results

Tables 4-12 display the BMA results. Table 4 displays BMA results using all our independent variables. K1 variables are Levine and Renelt's (1992) four I variables of population

growth, investment share of GDP, base-year GDPPC, and a human capital index. K2 variables are the remaining 30+ independent variables, including the eight time dummies. Other than the K1 variables, and one-time dummy, no other variables demonstrated Raftery's (1995) "very strong evidence" for inclusion. However, results did show positive evidence for inclusion with PIP>0.75 for deficits squared (PIP=.81) and inflation (PIP=.76).

Table 5 shows the BMA analysis when all the independent variables are treated as auxiliary variables, or a constant only analysis. Inflation was the one MSV showing positive evidence for inclusion. One surprising result was that only two of Levine and Renelt's (1992) I variables had PIP>0.75 indicating positive evidence for inclusion: investment share and population growth, both with the expected signs. Notably, base-year GDPPC and HCI, both Levine and Renelt's I variables, did not have PIP>0.75. This was a striking result as it contradicted Mankiw et al. (1992), Barro (1991), and Levine and Renelt (1992). From this, we concluded that base-year GDPPC and a human capital metric were of far less importance to developed nation growth than in LDCs.

Table 6 and 7 separate the sample into OECD versus non-OECD nations and demonstrated that for OECD nations, only inflation, investment share, and population growth had PIP>0.75. None of the non-OECD nations had any variables with PIP>.75. We believe OECD nations, generally, had greater degrees of industrialization than non-OECD nations regardless of GDPPC. Under this assumption and from this sort of 72 nations in our sample into 34 OECD and 38 non-OECD, the results indicated that in the more industrialized OECD nations, MSV are more important than in less industrialized nations.

Table 8 and 9 split the 72 countries in the sample into the half of nations having the largest GDP and the half with the smaller GDP. Only variables with PIP>.05 are shown. For the

larger half of countries sampled, independent variables with PIP>0.75 included inflation (PIP=1.0), inflation squared (.91) and deficits (.83). For the smaller half of countries sampled, there were no independent variables with PIP>0.5. These comparative results indicated certain MSVs are a better predictor of growth in larger developed economies than for smaller developed economies.

Table 10 and 11 split the 72 countries in the sample into the top half in terms of their 40-year average GDPPC growth and those in the bottom half of GDPPC growth. This table shows that for the fast growers, only deficit (PIP=.74) showed a marginally positive evidence for inclusion; for the slower growers, only deficits squared (.70) showed this same marginally positive evidence. We concluded that regardless of growth rate, only deficit and deficits squared, two of our nine MSVs, showed marginally positive evidence for inclusion.

Table 12 shows BMA results using the OECD nation versus non-OECD nation categorical variable to create a complete set in interaction variables for each of our MSVs and the categorical variable. Only variables with PIP>.05 are shown. Other than the four Levine and Renelt (1992) variables, the only variables with PIP>0.75 were the interactions of the categorical variable and deficit (PIP=.84).

Table 13 shows our best regression model using independent variables from the constant only BMA results from Table 5, with varying levels of statistical significance noted. Statistically significant variables at the 99% level included investment share, population growth, and inflation, all with their expected sign. Deficit squared was significant at the 95% level, while debt was significant at the 90% level. Notable, Human Capital and Base year GDPPC were not statistically significant at even the 90% level.

SECTION IV

DISCUSSION

Conclusion

The purpose of this research was to assess whether MSVs deemed important to LDC success in prior research were also important for the economic growth of developed nations. Therefore, the primary focus in this discussion was to assess the relationships between growth and macroeconomic stability and the variables used to define this stability. The unexpected result of Levine and Renelt's (1992) seminal research conclusions about variable robustness was also discussed in terms of not being wholly applicable when developed countries are the population.

Our research showed varying degrees of both compelling evidence that certain MSVs have good predictive relationships to GDPPC growth in developed nations, as well as varying degrees of statistical significance in our final model. These MSVs included inflation and debt, each with a negative impact and deficits squared with a positive impact. These results echoed the conclusion of Durlauf et al. (2008) about the validity of an economic growth model based on macroeconomic variables. Their macroeconomic model included inflation, government consumption, and a total trade variable as covariates. Our inflation result also echoed one clear conclusion from a study of the effectiveness of the Maastricht Accords (Castro & Soukiazis, 2007).

Separate from macroeconomic stability, two of the Levine and Renelt's widely accepted I variables, human capital and base-year GDPPC, were not shown to be significant in our developed nation research. Only investment share and population growth showed parallel

significance and sign between our developed nation research and Levine and Renelt's (1992) research.

Most importantly, for developed nations, if we ascribe to Solow's (1956) or Barro's (1991) convergence concepts or the impact on growth of sectoral shifts (Echevarria, 1997; Kuznets, 1968), what options to revive growth do developed nations have at their disposal? Our research showed that a greater focus on inflation and debt reduction might be warranted to positively impact growth.

Recommended Areas for Future Research

Beneficial future research would be to include LDCs and developed nations in the same analysis with the aid of a categorical variable to avoid comparing disparate research using different data sets. A second avenue would be to use GDP growth rather than GDPPC growth as the dependent variable given what politicians can and cannot most directly impact. GDP growth was the dependent variable used in a study on the effectiveness of the Maastricht Accord criteria (Castro & Soukiazis, 2007). A third area for research, in light of contradictory results of Levine and Renelt (1992) and our research, would be to perform threshold regression testing on all four of Levine and Renelt's I variables using a combined LDC and developed nation data set. A final avenue to pursue would be to identify any developed nations for which GDPPC has already peaked and declined, but has subsequently reversed the downward trend in GDPPC growth and to study its MSV and other characteristics.

APPENDICES

Appendix 1 List of Sample Countries and Subgroup Classification

Country	OECD=1	Oil=1
Antigua Barbuda	0	0
Argentina	0	0
Australia	1	0
Austria	1	0
Bahamas	0	0
Bahrain	0	0
Barbados	0	0
Belarus	0	0
Belgium	1	0
Brazil	0	0
Brunei	0	0
Canada	1	0
Chile	1	0
China	0	0
Costa Rica	0	0
Croatia	0	0
Cyprus	0	0
Czech Republic	1	0
Denmark	1	0
Equit. N.G.	0	0
Estonia	1	0
Finland	1	0
France	1	0
Gabon	0	0
Germany	1	0
Greece	1	0
Greenland	0	0
Grenada	0	0
Hong Kong	0	0
Hungary	1	0
Iceland	1	0

Appendix 1 List of Sample Countries and Subgroup Classification (continued)

Country	OECD=1	Oil=1
India	0	0
Indonesia	0	0
Ireland	1	0
Kuwait	0	1
Latvia	0	0
Lithuania	0	0
Luxembourg	1	0
Macao	0	0
Malaysia	0	0
Mexico	1	1
Netherlands	1	0
New Zealand	1	0
Nigeria	0	1
Norway	1	0
Oman	0	1
Palau	0	0
Panama	0	0
Poland	1	0
Portugal	1	0
Qatar	0	1
Romania	0	0
Saint Kitts Nevis	0	0
Saudi Arabia	0	1
Seychelles	0	0
Singapore	0	0
Slovakia	1	0
Slovenia	1	0
South Africa	0	0
Spain	1	0
Sweden	1	0
Switzerland	1	0
Trinidad Tobago	0	0
Turkey	1	0
UAE	0	1
United Kingdom	1	0
United States	1	0
Uruguay	0	0

REFERENCES

Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics, 106*(2), 407–443.

Barro, R. J. (1996). *Determinants of economic growth: A cross-country empirical study* (NBER Working Paper No. 5698). Retrieved from http://www.nber.org/papers/w5698.pd

Baskaran, T. (2009). Did the Maastricht Treaty matter for macroeconomic performance? *Kyklos, 62*(3), 331–358. doi:10.1111/j.1467-6435.2009.00439.x

Bleaney, M. F. (1996). Macroeconomic stability, investment and growth in developing countries. *Journal of Development Economics, 48*(2), 461–477.

Bleaney, M. F. (1997). Is good macroeconomic management important for growth. *Journal of Macroeconomics, 19*(3), 523–537.

California State University. (n.d.). The Levine and Renelt (1992) data set. Retrieved from http://www.csus.edu/indiv/p/perezs/data/lrdatades.pdf

Castro, V., & Soukiazis, E. (2007). An attempt to measure the influence of the Maastricht criteria and the stability pact on growth and unemployment in the European Union. In C. L. Hughes (Ed.), *New research on politics and economics in Europe* (pp. 37–62). New York, NY: Nova Science.

Chinn, M. D. (2005). *A primer on real effective exchange rates: Determinants, overvaluation, and competitive devaluation* (NBER Working Paper No. 11521). Retrieved from http://www.nber.org/papers/w11521.pdf

De Luca, G., & Magnus, J. R. (2011). Bayesian model averaging and weighted-average least squares: Equivariance, stability, and numerical issues. *The Stata Journal, 11*(4), 518–544.

Durlauf, S. N., Kourtellos, A., & Tan, C. M. (2008). Are any growth theories robust. *The Economic Journal, 118*(527), 329–346.

Echevarria, C. (1997). Changes in sectoral composition associated with economic growth. *International Economic Review, 38*(2), 431–452.

European Central Bank. (2016). Convergence Criteria. https://www.ecb.europa.eu/ecb/orga/escb/html/convergence-criteria.en.html

Fischer, S. (1991). Growth, macroeconomics, and development. *NBER Annual 1991, 6,* 329–379.

Hoover, K. D. (2012). *Applied intermediate macroeconomics*. New York, NY: Cambridge University Press.

Inklaar, R., & Timmer, M. P. (2013). Capital, labor, and TFP in PWT8.0. Retrieved from http://www.rug.nl/ggdc/productivity/pwt/related-research-papers/capital_labor_and_tfp_in_pwt80.pdf

International Monetary Fund. (n.d.). Retrieved from https://www.imf.org/external/data.htm

Kahrs, K. H. (2002). Meeting the Maastricht target. *Review of Policy Research, 19*(4), 44–60. doi: 10.1111/j.1541-1338.2002.tb00331.x

Kneller, R., Bleaney, M. F., & Gemmell, N. (1999). Fiscal policy and growth: Evidence from OECD countries. *Journal of Public Economics, 74*(2), 171–190.

Kuznets, S. (1968). *Toward a theory of economic growth*. New York, NY: W.W. Norton.

Leeson, J. (2013). *Assessing the importance of the manufacturing sector to the U.S. economy's overall health* (Doctoral dissertation). Available from ProQuest dissertations and Theses database. (UMI No. 3575151)

Levine, R., & Renelt, D. (1991). Cross-country studies of growth and policy: Methodological, conceptual, and statistical problems. *The World Bank*. Retrieved from http://documents.worldbank.org/curated/en/190721468764716168/pdf/multi0page.pdf

Levine, R., & Renelt, D. (1992). A sensitivity analysis of cross-country growth regressions. *The American Economic Review, 82*(4), 942–963.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics, 107*(2), 407–437. doi: 10.2307/2118477

Nayyar, D. (2007). Macroeconomics in developing countries. *BNL Quarterly Review, 60*(242), 249–269.

Penn World Table 6.3. (n.d.). Retrieved from http://febpwt.webhosting.rug.nl/Dmn/AggregateXs/VariableCodeSelect

Raftery, A. E. (1995). Bayesian model selection in social research. *Sociological Methodology, 25*, 111–163.

Raftery, A. E., Madigan, D., & Hoeting, J. A. (1997). Bayesian model averaging for linear regression models. *Journal of American Statistical Association, 92*(437), 179–191.

Rodriguez, F., & Rodrik, D. (1999). *Trade policy and economic growth: A skeptic's guide to the cross-national evidence* (NBER Working Paper 7081). Retrieved from http://www.nber.org/papers/w7081.pdf

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, *98*(5), S71–S102.

Rostow, W. W. (1971). *The stages of economic growth: A non-communist manifesto* (2nd ed.). Cambridge, United Kingdom: The Press Syndicate.

Sachs, J. D., & Warner, A. (1995). Economic reform and the process of global integration. *Brookings Papers on Economic Activity, 26*(1), 1–118.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70*(1), 65–94.

United Nations. (2016). Main aggregate database. Retrieved from http://unstats.un.org/unsd/snaama/selbasicFast.asp

van Biema, M., & Greenwald, B. (1997). Managing our way to higher service sector productivity. *Harvard Business Review*. Retrieved from https://hbr.org/1997/07/managing-our-way-to-higher-service-sector-productivity

The World Bank. (1993). *The East Asian miracle: Economic growth and public policy*. Retrieved from http://documents.worldbank.org/curated/en/322361469672160172/pdf/123510v20PUB0r00Box371943B00PUBLIC0.pdf

The World Bank. (2015). New country classifications. Retrieved from http://data.worldbank.org/news/new-country-classifications-2015

The World Bank. (2016). Gross domestic product per capita. Retrieved from http://data.worldbank.org/indicator/NY.GDP.PCAP.CD

World Economic Forum. (2006). *The global competitiveness report 2006–2007*. Retrieved from http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2006-07.pdf

LIST OF TABLES

Table 1. Data Description

Variable Acronym	Explanation	Data Sources
Country	72 largest 2010 Constant $ GDPPC	World Bank (2016)
Sev1	Dummy variable=1 for 1970-1974	N/A
Sev2	Dummy variable=1 for 1975-1979	N/A
Eight1	Dummy variable=1 for 1980-1984	N/A
Eight2	Dummy variable=1 for 1985-1989	N/A
Nine1	Dummy variable=1 for 1990-1994	N/A
Nine2	Dummy variable=1 for 1995-1999	N/A
Twothou1	Dummy variable=1 for 2000-2004	N/A
Twothou2	Dummy variable=1 for 2005-2009	N/A
OECD	Dummy variable=1 if country is in OECD; 0 otherwise	N/A
OIL	Dummy variable=1 if OPEC or other countries heavily dependent on oil revenues; 0 otherwise	N/A
ADEP	5-year average depreciation as % GDP	Penn World Tables 6.3
SDX	5-year standard deviation of exchange rate measured as ratio to US	Penn World Tables 6.3
HCI	5-year average human capital index	Penn World Tables 6.3 per new definition (Inklaar & Timmer, 2013)
POPG	5-year growth rate determined using natural logs	Penn World Tables 6.3
INF	5-year average inflation rate	Penn World Tables 6.3
RGDPPCG	5-year average GDPPC determined using natural logs	Penn World Tables 6.3
GCON	5-year average central government spending as % GDP	Penn World Tables 6.3

Table 1	Data Description (Continued)	
Variable Acronym	Explanation	Data Source
INVS	5-year average gross investment % GDP	United Nations (2016)
EXS	5-year average exports as % GDP	United Nations (2016)
IMPS	5-year average imports as % GDP	United Nations (2016)
INT	5-year average real interest rates	Penn World Table 6.3
GREV	5-year average central government revenues as % GDP	IMF
GEXP	5-year average central government expenditures as % GDP	IMF
DEBTS	Central government gross debt as % GDP	IMF
BYGDPPC	Base-year (1970) GDPPC measured in constant $2005	World Bank (2016)
EXSG	Growth rate of exports as a % GDP, measured in natural logs	Calculated from United Nations (2016)
BYEXPS	Base-year (1970) export share of GDP growth rate measured in natural logs	Calculated from United Nations (2016)
GDPQ	Dummy variable 1[largest] to 4[smallest] quartiles of country GDP	World Bank (2016)
LHGDP	Dummy variable 1[largest half] or 2[smallest half] of countries by GDP	World Bank (2016)
APCG	40-year average GDPPC growth rate measured in natural logs	Calculated from Penn World Table 6.3
FHGR	Dummy variable 1(fastest half) or 2 (slowest half) of countries by GDPPC growth	World Bank (2016)
EXSQ	Square of SDX	Calculated from Penn World Table 6.3
INFSQ	Square of INF	Calculated from Penn World Table 6.3
INTSQ	Square of INT	Calculated from Penn World Table 6.3
DEBTSQ	Square of DEBTS	Calculated from IMF
DEFICIT	GREV-GEXP	IMF
DEFICITSQ	Square of DEFICIT	Calculated from IMF

Table 2. Data Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Sev1	576	0.13	0.33	0.00	1.00
Sev2	576	0.13	0.33	0.00	1.00
Eight1	576	0.13	0.33	0.00	1.00
Eight2	576	0.13	0.33	0.00	1.00
Nine1	576	0.13	0.33	0.00	1.00
Nine2	576	0.13	0.33	0.00	1.00
Twothou1	576	0.13	0.33	0.00	1.00
Twothou2	576	0.13	0.33	0.00	1.00
OECD	576	0.47	0.50	0.00	1.00
OIL	576	0.10	0.30	0.00	1.00
ADEP	504	0.04	0.01	0.03	0.07
SDX	504	17.25	169.26	0.00	3614.74
HCI	444	2.56	0.48	1.26	3.59
POPG	504	0.01	0.01	-0.04	0.13
INF	504	0.58	0.31	0.06	1.61
RGDPPCG	504	0.02	0.03	-0.11	0.24
GCON	504	0.19	0.09	0.04	0.76
INVS	504	0.24	0.09	0.03	0.77
EXS	504	0.35	0.30	0.01	1.93
IMPS	504	-0.38	0.31	-2.19	-0.01
INT	352	5.45	9.20	-86.48	70.03
GREV	287	35.37	11.58	11.12	66.53
GEXP	287	39.06	26.22	12.28	371.67
DEBTS	256	52.49	36.25	0.00	229.04
BYGDPPC	472	16422.56	27269.11	492.96	157826.80
EXSG	504	0.01	0.08	-0.44	0.43
BYEXPS	472	0.26	0.24	0.01	0.96
GDPQ	536	2.48	1.11	1.00	4.00
LHGDP	536	1.49	0.50	1.00	2.00
APCG	472	0.02	0.02	-0.02	0.08
FHGR	472	1.51	0.50	1.00	2.00
EXSQ	504	28889.69	582658.70	0.00	13100000.00
INFSQ	504	0.44	0.44	0.00	2.59
INTSQ	352	114.03	520.65	0.00	7479.63
DEBTSQ	256	4064.18	6135.34	0.00	52458.41
DEFICIT	287	-3.69	23.84	-331.79	32.00
DEFSQ	287	579.98	6755.88	0.00	110086.90
COUNTRY	576	36.50	20.80	1.00	72.00

Table 3. Correlations with Dependent Variable GDPPC Growth

Variable	Coefficient
INVESTMENT SHARE OF GDP	0.26
GROWTH OF EXPORT SHARE OF GDP	0.15
TIME DUMMY 1970-1974	0.15
TIME DUMMY 1974-1979	0.14
INTEREST RATE	0.11
TIME DUMMY 1995-1999	0.08
TIME DUMMY 2000-2004	0.07
EXPORT SHARE OF GDP	0.05
DEFICIT	0.01
TIME DUMMY 1980-1984	0
DEFICIT PERCENT SQUARED	0
STANDARD DEVIATION OF EXCHANGE RATE	0
PERCENT GOVERNMENT CONSUMPTION	-0.03
EXPORT SHARE OF GDP SQUARED	-0.04
BASE YEAR EXPORT SHARE	-0.08
TIME DUMMY 2005-2009	-0.09
HUMAN CAPITAL INDEX	-0.1
IMPORT SHARE OF GDP	-0.11
INTEREST RATE SQUARED	-0.12
DEBT SHARE OF GDP	-0.13
DEBT SHARE OF GDP SQUARED	-0.15
POPULATION GROWTH RATE	-0.15
TIME DUMMY 1990-1994	-0.16
TIME DUMMY 1980-1984	-0.17
INFLATION RATE SQUARED	-0.18
INFLATION RATE	-0.18
BASE YEAR GDPPC	-0.22

Table 4. BMA with All Independent Variables and for which PIP>.05

REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	4.43E-02	3.56	1
HUMAN CAPITAL INDEX	-5.87E-03	-1.33	1
POPULATION GROWTH	-3.96E-01	-2.9	1
INVESTMENT SHARE OF GDP	6.62E-02	3.06	1
BASE YEAR GDPPC	-1.58E-07	-1.48	1
TIME DUMMY 1980-1984	-1.93E-02	-2.98	0.97
DEFICIT SQUARED	2.26E-05	1.63	0.81
INFLATION RATE	-1.96E-02	-1.5	0.76
DEBT SHARE	-6.51E-05	-0.94	0.55
TIME DUMMY 1995-1999	3.68E-03	0.86	0.5
INFLATION RATE SQUARED	-2.77E-03	-0.43	0.28
DEBT SHARE SQUARED	-1.50E-07	-0.44	0.25
TIME DUMMY 1990-1994	-1.73E-03	-0.48	0.24
INTEREST RATE SQUARED	-1.59E-06	-0.38	0.18
INTEREST RATE	-5.03E-05	-0.32	0.15
DEFICIT	6.18E-05	0.34	0.15
EXPORT SHARE OF GDP	7.14E-04	0.21	0.1
TIME DUMMY 2000-2004	2.29E-04	0.17	0.08
GOVERNMENT CONSUMPTION PERCENT OF GDP	2.14E-03	0.19	0.08
TIME DUMMY 1985-1989	-1.05E-04	-0.07	0.06
IMPORT SHARE OF GDP	2.53E-04	0.09	0.06
BASE YEAR EXPORT SHARE OF GDP	2.41E-04	0.11	0.06
STANDARD DEVIATION OF EXCHANGE RATE	-3.29E-07	-0.06	0.05
EXPORT SHARE GROWTH RATE	4.84E-04	0.1	0.05
EXPORT SHARE SQUARED	-4.74E-10	-0.06	0.05

Table 5. BMA Constant Only

REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	3.23E-02	3.63	1
TIME DUMMY 1980-1984	-1.84E-02	-2.22	0.9
INFLATION RATE	-2.70E-02	-2.06	0.88
INVESTMENT SHARE OF GDP	6.65E-02	1.93	0.85
POPULATION GROWTH RATE	-4.01E-01	-1.89	0.84
DEFICIT PERCENT SQUARED	1.42E-05	0.79	0.52
TIME DUMMY 1995-1999	3.26E-03	0.75	0.43
DEBT SHARE OF GDP	-4.68E-05	-0.75	0.43
BASE YEAR GDPPC	-7.68E-08	-0.58	0.31
DEBT SHARE OF GDP SQUARED	-1.35E-07	-0.43	0.23
INFLATION RATE SQUARED	-1.11E-03	-0.18	0.17
INTEREST RATE SQUARED	-9.50E-07	-0.3	0.12
TIME DUMMY 1990-1994	-6.26E-04	-0.29	0.11
HUMAN CAPITAL INDEX	-6.18E-04	-0.27	0.1
INTEREST RATE	-2.96E-05	-0.24	0.1
DEFICIT	3.18E-05	0.23	0.09
EXPORT SHARE OF GDP	4.98E-04	0.2	0.08
TIME DUMMY 1985-1989	4.87E-06	0	0.06
GOVERNMENT CONSUMPTION SHARE OF GDP	1.53E-03	0.17	0.06
BASE YEAR EXPORT SHARE OF GDP	1.29E-04	0.06	0.06
TIME DUMMY 2000-2004	9.09E-05	0.09	0.05
IMPORT SHARE OF GDP	6.29E-06	0	0.05

Table 6. BMA for OECD Nations Only

REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	3.23E-02	3.63	1
TIME DUMMY 1980-1984	-1.84E-02	-2.22	0.9
INFLATION RATE	-2.70E-02	-2.06	0.88
INVESTMENT SHARE OF GDP	6.65E-02	1.93	0.85
POPULATION GROWTH RATE	-4.01E-01	-1.89	0.84
DEFICIT PERCENT SQUARED	1.42E-05	0.79	0.52
TIME DUMMY 1995-1999	3.26E-03	0.75	0.43
DEBT SHARE OF GDP	-4.68E-05	-0.75	0.43
BASE YEAR GDPPC	-7.68E-08	-0.58	0.31
DEBT SHARE OF GDP SQUARED	-1.35E-07	-0.43	0.23
INFLATION RATE SQUARED	-1.11E-03	-0.18	0.17
INTEREST RATE SQUARED	-9.50E-07	-0.3	0.12
TIME DUMMY 1990-1994	-6.26E-04	-0.29	0.11
HUMAN CAPITAL INDEX	-6.18E-04	-0.27	0.1
INTEREST RATE	-2.96E-05	-0.24	0.1
DEFICIT	3.18E-05	0.23	0.09
EXPORT SHARE OF GDP	4.98E-04	0.2	0.08
TIME DUMMY 1985-1989	4.87E-06	0	0.06
GOVERNMENT CONSUMPTION SHARE OF GDP	1.53E-03	0.17	0.06
BASE YEAR EXPORT SHARE OF GDP	1.29E-04	0.06	0.06
TIME DUMMY 2000-2004	9.09E-05	0.09	0.05
IMPORT SHARE OF GDP	6.29E-06	0	0.05

Table 7. BMA for non-OECD Nations Only

Non-OECD Nations REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	7.26E-02	2.59	1
HUMAN CAPITAL INDEX	-2.06E-02	-2.08	1
POPULATION GROWTH RATE	-6.93E-01	-4.02	1
INVESTMENT SHARE OF GDP	1.05E-01	3.05	1
BASE YEAR GDPPC	-7.39E-08	-0.63	1
DEBT SHARE SQUARED	-1.17E-06	-0.66	0.39
DEBT SHARE	-7.69E-05	-0.52	0.3
BASE YEAR EXPORT SHARE	-6.17E-03	-0.45	0.23
INTEREST RATE SQUARED	-2.38E-06	-0.39	0.19
DEFICIT SQUARED	3.97E-06	0.39	0.18
DEFICIT	-8.35E-05	-0.35	0.16
INTEREST RATE	-7.01E-05	-0.28	0.15
GOVERNMENT CONSUMPTION SHARE OF GDP	7.53E-03	0.27	0.11
IMPORT SHARE OF GDP	7.96E-04	0.2	0.1
EXPORT SHARE GROWTH RATE	2.36E-03	0.22	0.09
EXPORT SHARE OF GDP	2.86E-05	0.01	0.08
TIME DUMMY 1995-1999	-3.29E-04	-0.16	0.07
STANDARD DEVIATION OF EXCHANGE RATE	-1.32E-06	-0.11	0.07
EXPORT SHARE SQUARED	-1.61E-09	-0.1	0.07
TIME DUMMY 1990-1994	1.63E-05	0.01	0.06
TIME DUMMY 2000-2004	1.78E-04	0.11	0.06
INFLATION RATE	-2.51E-04	-0.04	0.06
INFLATION RATE SQUARED	-2.17E-04	-0.04	0.06

Table 8. BMA Larger Nations Only

Larger nations			
REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	5.02E-02	3.57	1
HUMAN CAPITAL INDEX	-1.13E-03	-0.27	1
POPULATION GROWTH	-1.33E+00	-4.41	1
INVESTMENT SHARE	9.49E-02	4.4	1
BASE YEAR GDPPC	7.61E-08	0.29	1
TIME DUMMY 1980-1984	-2.18E-02	-4.81	1
INFLATION RATE	-9.55E-02	-3.38	1
INFLATION RATE SQUARED	3.29E-02	2.15	0.91
DEFICIT	9.10E-04	1.78	0.83
GOVERNMENT CONSUMPTION SHARE OF GDP	5.89E-02	1.29	0.71
TIME DUMMY 1995-1999	3.51E-03	0.99	0.57
EXPORT SHARE OF GDP GROWTH	-1.95E-02	-0.54	0.28
DEFICITS SQUARED	-1.17E-05	-0.44	0.21
DEBT SHARE SQUARED	-8.71E-08	-0.4	0.19
DEBT SHARE OF GDP	-1.28E-05	-0.36	0.17
TIME DUMMY 2000-2004	-4.24E-04	-0.27	0.12
IMPORT SHARE OF GDP	1.40E-03	0.17	0.08
TIME DUMMY 1985-1989	-2.71E-04	-0.17	0.07
TIME DUMMY 1990-1994	-2.16E-04	-0.17	0.07
EXPORT SHARE OF GDP	1.03E-03	0.13	0.07
BASE YEAR EXPORT SHARE OF GDP	4.08E-04	0.1	0.07
STANDARD DEVIATION OF EXCHANGE RATES	-4.16E-07	-0.08	0.06
EXPORT SHARE SQUARED	-9.37E-10	-0.12	0.06
INTEREST RATE	3.26E-09	0	0.05
INTEREST RATE SQUARED	-1.79E-08	-0.02	0.05

Table 9. BMA Smaller Nations Only

Smaller Nations			
REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	8.11E-02	2.37	1
HUMAN CAPITAL INDEX	-2.06E-02	-1.77	1
POPULATION GROWTH RATE	-3.88E-01	-1.82	1
INVESTMENT SHARE OF GDP	2.31E-02	0.54	1
BASE YEAR GDPPC	-1.57E-07	-1.05	1
DEFICIT SQUARED	1.46E-05	0.79	0.45
INTEREST RATE SQUARED	-4.92E-06	-0.46	0.23
INFLATION SQUARED	-1.56E-03	-0.25	0.12
TIME DUMMY 1980-1984	-2.60E-03	-0.27	0.11
TIME DUMMY 1995-1999	1.06E-03	0.28	0.11
INTEREST RATE	-5.66E-05	-0.2	0.11
INFLATION RATE	-1.29E-03	-0.13	0.09
DEFICIT	-3.16E-05	-0.19	0.09
TIME DUMMY 2000-2004	5.77E-04	0.21	0.08
GOVERNMENT CONSUMPTION SHARE OF GDP	-2.83E-03	-0.14	0.07
BASE YEAR EXPORT SHARE	-1.31E-03	-0.18	0.07
TIME DUMMY 1990-1994	-4.13E-04	-0.14	0.06
EXPORT SHARE OF GDP	4.15E-04	0.12	0.06
DEBT SHARE OF GDP	-3.40E-06	-0.08	0.06
DEBT SHARE SQUARED	-3.30E-08	-0.07	0.06
TIME DUMMY 1985-1989	-1.23E-04	-0.03	0.05
STANDARD DEVIATION OF EXCHANGE RATE	-2.76E-06	-0.04	0.05
IMPORT SHARE OF GDP	3.31E-05	0.01	0.05
EXPORT SHARE GROWTH	7.49E-04	0.1	0.05
EXPORT SHARE SQUARED	8.67E-08	0.06	0.05

Table 10. Faster Growing Nations

Fastest growers			
REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	6.95E-02	2.59	1
HUMAN CAPITAL INDEX	-7.14E-03	-0.8	1
POPULATION GROWTH	-6.56E-01	-1.45	1
INVESTMENT SHARE	5.04E-03	0.15	1
BASE YEAR GDPPC	-6.49E-07	-0.76	1
DEFICIT	1.16E-03	1.38	0.74
INFLATION RATE	-1.41E-02	-0.75	0.43
TIME DUMMY 1980-1984	-7.38E-03	-0.61	0.33
INFLATION RATE SQUARED	-4.87E-03	-0.58	0.33
TIME DUMMY 1995-2000	1.47E-03	0.39	0.18
TIME DUMMY 1990-1994	-1.52E-03	-0.36	0.16
STANDARD DEVIATION EXCHANGE RATE	-4.14E-06	-0.29	0.13
EXPORT SHARE SQUARED	-4.16E-09	-0.22	0.11
DEFICITS SQUARED	-4.61E-06	-0.18	0.09
DEBT SHARE OF GDP	-4.62E-06	-0.15	0.07
DEBT SHARE SQUARED	-2.54E-08	-0.16	0.07
TIME DUMMY 1985-1989	1.72E-04	0.07	0.06
TIME DUMMY 2000-2004	1.83E-04	0.12	0.06
EXPORT SHARE	1.51E-04	0.07	0.06
INTEREST RATE	1.85E-05	0.1	0.06
BASE YEAR EXPORT SHARE	-4.23E-04	-0.08	0.06
GOVERNMENT CONSUMPTION SHARE	8.87E-04	0.07	0.05
IMPORT SHARE OF GDP	6.61E-05	0.03	0.05
EXPORT SHARE GROWTH RATE	2.81E-04	0.05	0.05
INTEREST RATE SQUARED	8.33E-07	0.06	0.05

Table 11. Slower Growing Nations

Slowest growers			
REAL GDPPC GROWTH RATE	Coef.	t	PIP
CONSTANT	1.76E-02	1.19	1
HUMAN CAPITAL INDEX	-2.36E-03	-0.46	1
POPULATION GROWTH RATE	-3.12E-01	-2.23	1
INVESTMENT SHARE OF GDP	2.16E-02	0.6	1
BASE YEAR GDPPC	-4.19E-08	-0.36	1
DEFICIT SHARE SQUARED	1.88E-05	1.31	0.7
TIME DUMMY 1995-2000	4.23E-03	0.85	0.49
TIME DUMMY 1980-1984	-3.45E-03	-0.52	0.27
DEFICIT	-1.22E-04	-0.45	0.22
INFLATION RATE	-2.71E-03	-0.35	0.19
INFLATION RATE SQUARED	-1.03E-03	-0.27	0.16
TIME DUMMY 1985-1989	1.24E-03	0.32	0.14
STANDARD DEVIATION OF EXCHANGE RATE	2.86E-05	0.25	0.13
EXPORT SHARE OF GDP SQUARED	7.46E-07	0.28	0.13
DEBT SHARE OF GDP	-8.07E-06	-0.24	0.11
DEBT SHARE SQUARED	-6.29E-08	-0.25	0.11
GOVERNMENT CONSUMPTION SHARE OF GDP	3.83E-03	0.24	0.1
TIME DUMMY 1990-1994	-2.19E-04	-0.15	0.07
TIME DUMMY 2000-2004	2.16E-04	0.16	0.07
INTEREST RATE	-1.14E-05	-0.14	0.07
INTEREST RATE SQUARED	-3.27E-07	-0.17	0.07
EXPORT SHARE OF GDP	-1.83E-04	-0.09	0.06
IMPORT SHARE OF GDP	8.99E-05	0.04	0.05
EXPORT SHARE GROWTH RATE	5.41E-04	0.07	0.05
BASE YEAR EXPORT SHARE	-7.29E-05	-0.03	0.05

Table 12. BMA Results of Interaction Between OECD Dummy and Independent Variables

Note: *Indicates Interaction Variables

BMA estimates	Obs = 170	k1=5	k2=29
REAL GDPPC	Coefficient	t	PIP
CONSTANT	3.95E-02	2.9	1
HUMAN CAPITAL INDEX	-6.00E-03	-1.25	1
POPULATION GROWTH	-5.37E-01	-3.63	1
INVESTMENT SHARE OF GDP	7.50E-02	3.09	1
BASE YEAR GDPPC	-8.24E-08	-0.87	1
OECD AND DEFICIT*	1.00E-03	1.8	0.84
TIME DUMMY 1980-1984	-1.30E-02	-1.52	0.77
INFLATION RATE SQUARED	-1.00E-02	-0.76	0.42
TIME DUMMY 1995-1999	3.00E-03	0.74	0.41
OECD AND STD. DEVIATION EXCHANGE RATE*	-1.09E-08	0	0.4
DEFICIT SQUARED	8.49E-06	0.69	0.38
INTEREST RATE SQUARED	-3.58E-06	-0.57	0.31
INFLATION SQUARED	-4.00E-03	-0.53	0.28
OECD AND INVESTMENT SHARE*	-1.30E-02	-0.47	0.26
OECD AND INFLATION SQUARED*	-3.00E-03	-0.48	0.24
OECD AND INFLATION*	-3.00E-03	-0.35	0.18
INTEREST RATE	-4.00E-05	-0.24	0.13
DEBT SHARE OF GDP	-1.30E-05	-0.29	0.13
OECD AND HUMAN CAPITAL INDEX*	4.00E-04	0.21	0.11
DEBT SHARE OF GDP SQUARED	-9.64E-08	-0.22	0.1
DEFICIT	-3.00E-05	-0.2	0.09
OECD AND DEFICIT SQUARED*	-4.54E-06	-0.23	0.08
OECD AND DEBT SHARE*	4.16E-06	0.09	0.07
TIME DUMMY 1990-1994	-3.00E-04	-0.19	0.06
OECD AND INTEREST RATE*	3.00E-05	0.15	0.06
OECD AND DEBT SQUARED*	4.66E-08	0.12	0.06
TIME DUMMY 1985-1989	1.50E-04	0.1	0.05
TIME DUMMY 2000-2004	7.00E-05	0.07	0.05
OECD AND BASE YEAR GDPPC*	-8.60E-09	-0.1	0.05

Table 13. Best Model Using Variables from Constant only Table 5 with PIP>0.5

		Adj. R2 0.2788	N=200
REAL GDP PER CAPITA GROWTH	Coef.	Std. Err.	t-value
HUMAN CAPITAL INDEX	-3.36E-03	4.04E-03	-0.83
POPULATION GROWTH***	-4.42E-01	1.13E-01	-3.91
INVESTMENT SHARE OF GDP***	6.33E-02	2.00E-02	3.17
BASE YEAR GDP PER CAPITA	-6.62E-08	5.80E-08	-1.14
INFLATION PERCENT***	-2.46E-02	5.27E-03	-4.68
DEBT SHARE OF GDP*	-7.68E-05	4.12E-05	-1.86
DEFICIT PERCENT OF GDP SQUARED**	1.58E-05	7.74E-06	2.03
TIME DUMMY 1980--84	-1.65E-02	5.45E-03	-3.02
TIME DUMMY 1990-94	8.19E-03	2.93E-03	2.8
CONSTANT	3.67E-02	1.13E-02	3.26

Note: Inflation, investment share, and population growth had 84%<PIP<88% and would, therefore demonstrate positive evidence of inclusion in the true model per Raftery's criteria (Raftery, 1995).

*Significant at 90% confidence level
**Significant at 95% confidence level
***Significant at 99% confidence level