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TRADE-GROWTH NEXUS IN DEVELOPING AND DEVELOPED COUNTRIES: AN APPLICATION OF EXTREME BOUNDS ANALYSIS

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ABSTRACT

In this study, we investigated the relationship between foreign trade and economic growth in the developing and developed countries by using extreme bounds analysis approach. For this we used unbalanced panel data of 103 variables of 94 countries (74 developing countries and 20 developed countries) during 1990-2010. The estimation results of more than 1.6 million regressions show that more foreign trade indices are robust determinants of economic growth and have robustly positive effect on the economic growth of each country regardless of level of development. In the other words, results of this study support views of free trade advocates.

Keywords: Foreign trade, Economic growth, Robust, Extreme bounds analysis, Developing countries, Developed countries.

1. INTRODUCTION

There are different and even inconsistent views about the relation between economic growth and international trade in economic literature. Brilliant economists such as Hume, Smith, Ricardo, Mill, Singer, Prebisch, Myrdal have different ideas about the relation between free trade and economic growth. Theories about the impact of trade on economic growth could divide into two different groups. The first are consistent with free trade. The idea is that international trade is an engine of economic growth and accelerated it. The oldest view is Mercantilism's. Advocates of this doctrine believed that just positive trade balance cause economic growth. Smith (1776), Ricardo (1817) presented absolute advantage and comparative advantage theories and pointed out that

foreign trade increase production level and economic growth. John Stuart Mill believed that international trade causes more efficiency of production factors that he named it direct advantage of foreign trade. Heckscher, Ohlin and Samuelson likewise some other economists support free trade.

Endogenous theory of growth was considered trade policy and its rule on R & D activity. International product cycle also has some implications for economic growth of both developed and developing countries. As Shaw (1992) pointed out invention and new products take place in the developed countries where R & D activity is well developed. After some time, technology transfers to the less advanced country and they can produce these goods. Hence, trade in manufactured products occurred on the basis of exchange between the newest innovative goods produced only in the developed countries and the oldest goods that now produced predominantly by the developing countries. Indeed the developed countries import the goods that initially they exported them. According to this idea, international trade contributes in faster economic growth in both developed and developing countries. In developed countries, process of the migration of production of old and simple good to developing countries released resources for use R&D activity and produce of new goods. In the developing countries also growth occurs faster, because the resources needed for learning and adapting the techniques imported from the developing countries are less than those needed for autonomous new product development. In both countries, the subsidization of learning activities (innovation in developed countries, imitation in the developing) may be enhanced long run growth rates. But against these ideas, some believed that trade decrease economic growth of developing countries and increase international inequality. Among economist of this group, we can refer to Myrdal (1957) and Singer (1982). They believed that just developed countries benefits from international trade. In empirical aspect again, many studies have found a positive relation between trade and economic growth (Balassa, 1985; Chow, 1987)), Krueger (1990), and Sengupta and Espana (1994), Ekanayake (1999), Vamvakidis (1998)). Experiments of some countries, for example East Asian countries, show that presence in global market and gain from foreign trade is an important path for developing countries to improve their economies. In another hand, Krugman (1994), Rodriguez and Rodrik (1999), Vamvakidis (2002), Madsen (2009) and Singh (2010) argue that the effect of free trade on growth is questionable. Dowrick and Golley (2004) pointed out that the impact of trade on growth varies in both sign and significance with change the level of economic development.

As mentioned, there is consensus nor in theoretical views and not in empirical studies about the effect of foreign trade on economic growth, special about developing countries. The reason of difference in the results of empirical studies could be because of their specification of growth regressions. Researchers know well that results of regressions are sensitive to change in specification. For specification of empirical growth regressions, if we accept the variables that introduced by theories and confirmed by empirical researches as determinants of growth, multiplicity of theories and empirical studies cause to introduce large number of growth determinants. For example, Durlauf *et al.* (2005) in their outstanding review introduced about 150 variables, each of these variables at least have been statistically significant in one empirical study

and its sign has been compatible with a growth theory. It is worthy to mention that economic growth theories, as Brock and Durlauf (2001) mentioned, are open ended, in the sense that they are compatible with each others. Hence, if there is a set of K theories that all of them are logically compatible, there exist 2^k-1 possible specifications of growth regressions that each regression is based on a special combination of theories. Therefore selecting explanatory variables is often ad hoc and the results are likely to be sensitive to the selected variables.

These issues along with measurement considerations persuaded economists to examine variables between set of variables that are identified until now as determinants of growth, instead of following solely theories. Many empirical studies tried to determine variables that influence economic growth only using one or few regressions. Although the results of these studies might be logical and compatible with the theories, but the results could differ when changing the specification. Thus rely on these results might be diversionary. This weakness has been pointed out, among others, by Leamer (1983) where he emphasized that under uncertainty of model selection one must show how much the result depends on which variable are included in the regression. Therefore one should subject regressions to change in specification. This sensitivity analysis provides a convincing justification for removal or inclusion of individual variables in the probably true regression. One of the best approaches for selecting main determinant among vast potential determinants is extreme bounds analysis (EBA). This approach is attributed to Leamer and Leonard (1983). Levine and Renelt (1992) applied Leamer's extreme bounds test for the first time to identify robust empirical relations discussed in the economic growth literature. Levine and Zervos (1993) pointed out the EBA helps clarify the degree of confidence that can be placed to the partial correlations between growth and individual variables. If an indicator is roboustly correlated with long-run economic growth, then one should feel more confident about its association with growth than an indicator that has a fragile link. Merikas *et al.* (2000) used extreme bound analysis Levine and Renelt (1992) in the cross-countries framework (92 countries) to determine robustness of relationship between 3 proxies of trade openness (average of export share of GDP, average rate of export growth and the real exchange rate distortion) and economic growth. Their results show positive and robust link between export share expansion and economic growth, and negative and robust relation of the real exchange rate distortion and growth.

Hence, the purpose of this paper is to investigate the relationship between trade expansion and economic growth and its robustness in the developed and developing countries to test two different ideas about the effect of foreign trade on economic growth. Also this study for checking the sensitivity of results to change in specification use extreme bounds analysis approaches of Levine and Renelt (1992) and Sala-I-Martin (1997a). We implement these approaches with the unbalanced panel data of 21 years to determine robustness of correlation of trade proxies on economic growth in 74 developing countries and 20 developed countries. For checking the sensitivity of results to change in specification we use 103 variables as potential determinants of growth. The paper is organized as follows. The following section discusses the methodology and data set. Section three

presents the results from the extreme bounds analysis. Section four is allocated to concluding remarks.

2. METHODOLOGY AND DATA

Leamer (1978) and Leamer (1983) suggested a solution for the problem of uncertainty in model selection. They named it extreme bound analysis that essentially is an approach for reporting sensitivity of result to variation in model specification. The EBA version of Levine and Renelt (1992) employ a linear regression framework as follows:

$$Y = c + \beta_I I + \beta_M M + \beta_Z Z + u \quad (1)$$

where *Y* stands for growth rate of GDP per capita, I for a set of base variables always included in the regression, *M* for a variable of interest (trade proxies) that we want to examine its fragility or robustness and *Z* for a set of up to three variables that we choose from a set of variables that identified as a potential determinants of economic growth.

The approach of the Levine and Renelt (1992) is as follows. First, one should choose the variables were emphasized in previous empirical studies and then estimate a base regression that includes only the I-variables and the variables of interest. Second, regressions including all possible linear combinations of up to three Z-variables should be estimated to identify the highest and lowest coefficient of the M-variable (β_M). The extreme upper is defined as the maximum value of $\beta_{Mj} + 2\sigma_{Mj}$, the lower bound as the minimum value of β_{Mj}-$2\sigma_{Mj}$, where β_{Mj} is the estimated coefficient of M-variable and σ_{Mj} is its standard deviation in jth model. If the extreme upper bound and lower bound have same sign, then M-variable is referred to be *robust*, otherwise is *fragile*. As (Sala-I-Martin, 1997b) pointed out one should note that "this amounts to say that if one finds a single regression for which the sign of the coefficient β_{Mj} change or becomes insignificant, then the variables is not robust" (p. 178). In particular, if β_M is consistently significant and of the same sign in all regressions, then the M-variable is robust; otherwise it is *fragile*.

Sala-I-Martin (1997b) criticized on Levine and Renelt approach and argued that their criteria are very rigid and is really hard for any variable to pass it. He introduced the confidence level to quit giving the label of one or zero to the variables, and considered the whole distribution of coefficients of the M-variable, (β_M). He computed the fraction of cumulative distribution function lying on each side of zero and named the greatest area CDF(0). He also used the weighted approach to give more importance to the regression that is more likely to be true. He used the goodness of fit of model as a likelihood of being true. Sala-i-Martin pointed out even though each individual β_{Mj} follow a *t* student distribution, all estimates might be scattered in an unrecognized fashion. Hence, one can operate under two different assumptions.

If the distribution of the estimates of β_Ms is normal, one can calculate a cumulative distribution function (CDF) from the mean and the standard deviation of the distribution. The likelihood L for each possible model based on goodness of fit is necessary to calculate weighted mean of β_M and σ_M as follow:

$$\hat{\beta} = \sum_{j=1}^{n} w_j \beta_{Mj} \quad (2)$$

$$\hat{\sigma} = \sum_{j=1}^{n} w_j \sigma_{Mj} \quad (3)$$

$$w_j = L_j / \sum_{j=1}^{n} Lj \quad (4)$$

where Lj stands for likelihood of jth regression. If the distribution of the estimates of β_M across all models is not normal, one can compute individual CDF(0) for each regression, φ_{Mj}, then compute the aggregate CDF(0) of β_M as the weighted mean of all the individual CDF(0) that the weights are similar to normal case (equation(4)).Variables that their CDF are larger than 0.95 are labeled *robust*.

For more details suppose one wants to examine robustness of potential determinants of growth, for example growth of export, within a set of 103 variables. Four variables leaved as I-variables, one variable is the interested (growth of export) that is examined whether it significantly and robustly affects economic growth and rest of them, 98 variables counted as Z-variables that allow to combine in subset of up to three. Based on combination formula ($C(98, i) = 98!/(98\text{-}i)!\, i!$ that $i=1,2,3$) one have 98 single, 4753 binary, 152096 ternary combinations. So 156947 regressions, in addition to a base regression are estimated. In Levin and Renelt procedure if all 156948 coefficients of interest variable were statistically significant and of the same sign, it called *robust* determinant of growth, otherwise it is *fragile*.

The rule of decision in Sala-i-Martin approach is different. In his procedure, one must consider the distribution of estimated coefficients. Under normal assumption and by computing $\hat{\beta}$ and $\hat{\sigma}$ (equation 2 and 3), one can standardize the distribution of estimated coefficients then based on normal standard distribution table compute CDF(0). It should be noted that area under density function divided into two areas by zero, the greater area regardless of whether it is below or above zero, called CDF(0). But under non-normal assumption according to that we know each estimated variables have t-student distribution and this distribution tend to normal distribution if observation number is considerable, and under the assumption that $E(\hat{\beta}_M) = \beta_M$ one can standardize estimated coefficients then based on normal standard distribution table compute individual CDF(0) for each regression, then as we pointed above, compute the aggregate CDF(0) of β_M as the weighted mean of all the individual CDF(0). Therefore if aggregate CDF(0)>0.95, variable is significantly and robustly correlated with growth rate. As Sala-I-Martin (1997b) pointed out if for variable 1, CDF(0)=0.95 and for variable 2, CDF(0)=0.52, then variable 1 is more likely to be robustly correlated with economic growth.

It is important to know that Levine and Renelt (1992) and Sala-I-Martin (1997a) and other brilliant empirical researches (for example, Levine and Zervos (1993), (Hoover and Perez, 2004) estimated their models with cross-section data. There is few work that use panel data with EBA in economic growth literature, of which we can refer to Rao and Cooray (2010) who used panel data for only 13 variables and 7 countries of South Asia and to Chain and lee (1999) who used panel data with EBA on the American states for only 29 variables.

In this study, we apply EBA on 103 variables using random-effects model to estimate the following equation:

$$Y_{it} = \alpha_0 + v_i + \beta_I I_{it} + \beta_M M_{it} + \beta_z Z_{it} + u_{it} \quad (5)$$

Where v_i terms are the random effects for country *i*. The random-effects model was used because when some variables are constant for each individual, fixed-effects regression is not an effective tool due to that such variables cannot be included (Dougherty, 2007). The panel data of the study is composed of 74 developing countries and 20 developed countries over the period 1990-2010. The countries are listed in table (1) and (2), respectively.

Levine and Renelt (1992) and Sala-I-Martin (1997b) used respectively 57 and 63 variables which found to be statistically significant in the previous studies. Durlauf *et al.* (2005) also collected 145 variables as the potential determinants of growth that at least were statistically significant in one study.

As regard to the variables, it should be noted that we could collect data on 103 variables considered as potential determinants of economic growth in the literature for the selected countries. Most of Levine and Renelt, and Sala-i-Martin variables are included in the present study. The dependent variable is growth rate of per capita GDP. The I-variables were chosen following the Levine and Renelt (1992). The I-variables are composed of investment share of GDP (IR), the initial level of real GDP per capita in 1990 (IN), the secondary school enrollment rate (ENSE) and annual rate of population growth (POPG). These variables, as Levine and Renelt (1992) also pointed out, have been selected on the base of large range of previous empirical studies and economic theories that rely on constant returns to reproducible factors and endogenous technological change. These I-variables are compatible with new economic growth (endogenous growth theories). As Mankiw *et al.* (1992) mentioned, the I-variables are entered on the basis of human capital-augmented neoclassical growth model. Barro (2003) for inclusion of investment ratio pointed out that the effect of the saving rate in the neoclassical growth model is measured empirically by investment ratio. The M variables are:

1. The export share of GDP (EXGDP)
2. The import share of GDP (IMGDP)
3. Fraction of primary products in total exports (PRIEX)
4. Growth of export share of GDP (GEXGDP)
5. Export growth (GEX)
6. Import growth (GIM)
7. Machinery and equipment imports (MACHIN)
8. Oil export (OILEX)
9. Trade share of GDP (OPEN)
10. Growth of trade share of GDP (OPENG)

The Z variables (89 rested variables) and their sources are described in detail in appendix A. Like Levine and Renelt (1992) and Levine and Zervos (1993), when evaluating the robustness of each M variable, we restrict this pool of Z-variables by excluding any variable which may measure the same phenomenon.

3. RESULTS

The results Levine and Renelt approach for developing and developed countries are presented respectively in table (3) and (5). The column (*I*) in these tables presents lowest and highest as well as coefficient of base regression for each variable. The column (*II*) reports the *t* statistics and column (*III)* reports *p* values. The column (*IV)* present the fraction of significant coefficients divided to negative and positive. The columns *(V)* and *(VI)* respectively report fractions of positive and negative coefficient from all coefficients (significant or insignificant). In the tables (4) and (6), Sala-i-Martin approach results for both groups of countries are reported. The columns (*I*) and (*II*) report the weighted mean of estimated coefficients of M-variables and weighted standard errors, respectively. The columns (*III*), (*IV*) and (*V*) present the significant level or CDF(0) in weighted normal, weighted non-normal and unweighted non-normal cases, respectively. The column (*VI)* present result of skewness and kurtosis test for normality of coefficients. At the end in both procedures, last column report status of robustness. As mentioned before, in Levine and Renelt approach if β_M is consistently significant and of the same sign in all regressions, then the M-variable is *robust*; otherwise it is *fragile*. Also in Sala-i-Martin approach, if CDF(0) is more than 0.95, the variable is robust.

Results of regressions in developing countries show that growth of export share of GDP (GEXGDP), export growth (GEX), import growth (GIM) and Growth of trade share of GDP (OPENG) passed too strong test of Levine and Renelt and coefficients of these variables are significant in all regressions, so introduced as robust determinants of growth. Although export share of GDP (EXGDP) and Oil export (OILEX) could not earn robust label, they were found significant respectively in 99.94 and 99.31 percent of specifications. The coefficients of machinery and equipment imports (MACHIN) and fraction of primary products in total exports (PRIEX) were positive and significant in more than half of regressions.

Results of Sala-i-Martin approach for developing countries in table (4) show that in addition to 4 robust determinants in Levine and Renelt procedure, three variables of export share of GDP(EXGDP), fraction of primary products in total exports (PRIEX) and Oil export (OILEX) have labeled as robust. The CDF(0) value for all of these three variables in three cases of normality and weights, are more than 0.95. Judgment pertaining to machinery and equipment imports (MACHIN) needs more considerations. According to the result of skewness and kurtosis test for normality, coefficients distribution of MACHIN is non-normal. So the CDF(0) values in weighted an unweighted non- normal cases are the judging criteria. CDF(0) in unweighted non- normal case is less than 0.95 and in weighted non- normal case is more than 0.95, hence given at Sala-i-Martin decision rules, correlation of this variables with economic growth is not robust. The other variables

in this approach are fragile, too. The results indeed confirm positive effects of trade openness on economic growth in developing countries.

Results of Levine and Renelt approach in developed countries show that just import growth (GIM) and Growth of trade share of GDP (OPENG) passed too strong test of Levine and Renelt and coefficients of these variables are significant in all regressions, so introduced as robust determinants of growth, as observed in table (5). Although in developed countries growth of export share of GDP (GEXGDP), export growth (GEX), export share of GDP (EXGDP), import share of GDP (IMGDP) and fraction of primary products in total exports (PRIEX) could not receive robust label but their coefficients were significant and positive respectively in 99.3, 99.92, 93.71, 92 and 86.76 percent of regressions. Results of Sala-i-Martin approach for developed countries in table (6) show that for these countries 7 out of 10 indices are robust that in two cases are common with results of Levine and Renelt approach. With judging procedure of Sala-i-Martin, growth of export share of GDP (GEXGDP), export growth (GEX), export share of GDP (EXGDP), import share of GDP (IMGDP) and fraction of primary products in total exports (PRIEX) are added to robust determinants that identified in Levine and Renelt approach.

It is worth noting that export measurements in developing countries are more robust than developed countries. In the developing countries 4 variables could past very rigid and strict test of Levine and Renelt but in developed countries just two variables could pass this test. One of the 7 robust variables is different in two groups of countries. In the developing countries value of oil exports is robust but in developed countries is not, also import share of GDP in developed countries is robust but in developing countries is not. We totally estimate 1.6 million regressions that show most of trade measurement in all countries, developing and developed, are robust determinants of economic growth and enhance it.

4. CONCLUDING REMARK

Our empirical investigation between growth and trade measures has provided evidence that in a large sample of developing and developed countries, higher rates of economic growth are robustly correlated with higher rates of trade. So it seems that abroad-based *economic growth* is essential to sustainable, long-term growth. 7 out of 10 indices of free trade in these countries are robust determinants of economic growth. These variables, regardless of their level of development have positive effect on economic growth of both groups of countries. Hence, these findings confirm views that support free trade and are opposite with Myrdal idea, so policymakers of developing countries should pay attention more in this part of economics.

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Table-1. Developing countries names

Algeria	Albania	Kuwait	United Arab Emirates
Argentina	Latvia	Oman	Tanzania
Bangladesh	Madagascar	Gabon	Thailand
Armenia	Malawi	Gambia, The	Yemen, Rep
Bolivia	Malaysia	Guyana	Ukraine
Botswana	Mali	Guatemala	Tunisia
Brazil	Moldova	Honduras	Turkey
Ethiopia	Mongolia	Qatar	Uganda
Belarus	Mexico	India	Uruguay
Cameroon	Morocco	Indonesia	Venezuela
Bahrain	Mozambique	Iran	Vietnam
Bulgaria	Namibia	Jordan	Zimbabwe
Chile	Nicaragua	Kenya	Romania
China	Niger	Russia	Senegal
Colombia	Nigeria	Saudi Arabia	Lithuania
Lebanon	Pakistan	Sudan	Philippines
Ecuador	Panama	South Africa	
Egypt	Paraguay	Sri Lanka	
El Salvador	Peru	Syria	

Table- 2. Developed countries names

Australia	France	Japan	Spain
Austria	Germany	Netherlands	Sweden
Canada	Greece	New Zealand	Switzerland
Denmark	Ireland	Norway	United Kingdom
Finland	Italy	Portugal	United States

Table- 3. Results of Levine and Renelt approach in developing countries

Variable		(I) β_M	(II) t	(III) p-value	(IV) Significant (%)			(V) Pos(%)	(VI) Neg.(%)	fragile / robust
EXGDP	low	2.096	1.42	0.15	99.94	Neg%	0	100	0	fragile
	base	7.22	3.86	0		Pos%	100			
	high	14.42	5.9	0						
IMGDP	low	-11.68	-4.99	0	3.65	Neg%	97.76	37.33	62.67	fragile
	base	-0.031	-0.02	0.99		Pos%	2.24			
	high	5.54	2.4	0.02						
PRIEX	low	-1.4	-1.18	0.24	52.96	Neg%	0	99.84	0.16	fragile
	base	2.22	1.94	0.052		Pos%	100			
	high	4.14	3.35	0.0008						
GEXGDP	low	0.019	2.4	0.017	100	Neg%	0	100	0	robust
	base	0.024	2.71	0.007		Pos%	100			
	high	0.036	4.15	0						
GEX	low	0.097	12.14	0	100	Neg%	0	100	0	robust
	base	0.144	18.49	0		Pos%	100			
	high	0.146	18.68	0						
GIM	low	0.026	2.58	0.01	100	Neg%	0	100	0	robust
	base	0.157	17.63	0		Pos%	100			
	high	0.163	18.26	0						
MACHIN	low	-0.314	-0.91	0.37	56.58	Neg%	0	99.6	0.4	fragile
	base	0.39	2.15	0.032		Pos%	100			
	high	2.61	5.4	0						
OILEX	low	0.012	1.36	0.18	99.31	Neg%	0	100	0	fragile
	base	0.034	3.16	0.002		Pos%	100			
	high	0.039	3.5	0.0006						
OPEN	low	-0.021	-2	0.046	0.02	Neg%	6.25	31.35	68.65	fragile
	base	-0.0005	-0.06	0.96		Pos%	93.75			
	high	0.022	2.12	0.035						
OPENG	low	0.097	4.6	0	100	Neg%	0	100	0	robust
	base	0.12	5.29	0		Pos%	100			
	high	0.127	5.9	0						

Table-4. Results of Sala-i-Martin approach in developing countries

Variable	(I) $\widehat{\beta}_M$	(II) $\widehat{\sigma}_M^2$	(III) CDF(0) Normal weighted	(IV) CDF(0) Non normal weighted	(V) CDF(0) Non normal unweighted	(VI) Normality	fragile/ robust
EXGDP	6.85	1.84	0.9999	0.9995	0.9997	Non normal	robust
IMGDP	-0.51	1.83	0.610	0.669	0.641	Non normal	fragile
PRIEX	2.08	1.07	0.974	0.951	0.960	Non normal	robust
GEXGD	0.025	0.009	1	1	1	Non normal	robust
GEX	0.14	0.008	1	1	1	Non normal	robust
GIM	0.15	0.009	1	1	1	Non normal	robust
MACHI	0.329	0.175	0.970	0.925	0.952	Non normal	fragile
OILEX	0.03	0.01	0.998	0.996	0.997	Non normal	robust
OPEN	0.0009	0.009	0.539	0.612	0.603	Non normal	fragile
OPENG	0.114	0.022	1	1	1	Non normal	robust

Table-5. Results of Levine and Renelt approach in the developed countries

Variable		(I) β_M	(II) t	(III) p-value	(IV) Significant (%)			(V) Pos(%)	(VI) Neg.(%)	fragile/ robust
EXGDP	low	-2.5	-1.06	0.29	93.71	Neg%	0	99.85	0.15	fragile
	base	4	3.72	0		Pos%	100			
	high	12.94	7.6	0						
IMGDP	low	-9.08	-1.9	0.06	92	Neg%	0.002	98.7	1.3	fragile
	base	4.98	3.32	0.001		Pos%	99.998			
	high	19.25	8	0						
PRIEX	low	-3.4	-2.4	0.02	86.76	Neg%	0.002	99.61	0.39	fragile
	base	2.7	3.03	0.002		Pos%	99.998			
	high	5.5	5.05	0						
GEXGDP	low	-0.0008	-0.06	0.95	99.3	Neg%	0	99.998	0.02	fragile
	base	0.11	6.3	0		Pos%	100			
	high	0.13	7.12	0						
GEX	low	0.03	1.3	0.19	99.92	Neg%	0	100	0	fragile
	base	0.17	16.32	0		Pos%	100			
	high	0.16	18.32	0						
GIM	low	0.04	2.19	0.03	100	Neg%	0	100	0	robust
	base	0.17	17.70	0		Pos%	100			
	high	0.16	15.92	0						
GIM	low	0.04	2.19	0.03	100	Neg%	0	100	0	robust
	base	0.17	17.70	0		Pos%	100			
	high	0.16	15.92	0						
MACHIN	low	-0.722	-4.68	0	5.5	Neg%	38.22	55.14	44.86	fragile
	base	-0.054	-0.36	0.72		Pos%	61.78			
	high	1.09	4.82	0						
OILEX	low	-0.03	-1.7	0.08	21.7	Neg%	0	97.76	2.24	fragile
	base	0.016	1.58	0.11		Pos%	100			
	high	0.05	5.3	0						
OPEN	low	-0.015	-2.29	0.023	19.43	Neg%	0.08	90.9	9.1	fragile
	base	0.006	1.18	0.24		Pos%	99.92			
	high	0.035	4.52	0						
OPENG	low	0.125	3.7	0.0002	100	Neg%	0	100	0	robust
	base	0.125	8.49	0		Pos%	100			
	high	0.311	9.36	0						

Table- 6. Results of Sala-i-Martin approach in developed countries

Variable	(I) $\widehat{\beta}_M$	(II) $\widehat{\sigma}^2_M$	(III) CDF(0) Normal weighted	(IV) CDF(0) Non normal weighted	(V) CDF(0) Non normal unweighted	(VI) Normality	fragile / robust
EXGDP	4.34	1.21	0.9998	0.991	0.993	Non normal	robust
IMGDP	5.23	1.64	0.999	0.983	0.984	Non normal	robust
PRIEX	2.5	0.879	0.998	0.980	0.981	Non normal	robust
GEXGD	0.10	0.017	1	0.997	0.999	Non normal	robust
GEX	0.163	0.011	1	0.99996	0.99996	Non normal	robust
GIM	0.154	0.010	1	1	1	Non normal	robust
MACHI	0.013	0.156	0.532	0.775	0.745	Non normal	fragile
OILEX	0.014	0.009	0.928	0.865	0.887	Non normal	fragile
OPEN	0.00699	0.0056	0.846	0.888	0.890	Non normal	fragile
OPENG	0.276	0.034	1	1	1	Non normal	robust

Appendix A

variable	description	variable	description
EXGDPG	growth of Fraction of export in GDP(WTO)	CREDVA	variability of credit growth
EXG	export growth(WTO)	INVSTF	investment freedom(The Heritage Foundation)
IMG	import growth (WTO)	ENSF	School enrollment, secondary, female (% gross)
BM	Broad money (% of GDP)(WB)	RELF	religion fractionalization
INF	inflation growth(WB)	FERT	Fertility rate(births per woman)(WB)
CREDVO	volatility of domestic credit to private sector as a % gdp(WB)	BUD	fraction of population that are buddhist
DEF	deficit % of GDP (WEO database of IMF)	BRIT	british colony dummy
HE	Health expenditure, public (% of GDP)(WB)	SUR	survival rate of adult to age 60(per 1000)
PRIEX	Fraction of primary products in total exports(WTO)	BUSSF	business freedom(The Heritage Foundation)
OPENG	Trade (% of GDP) growth as openness growth (Penn World Table 7.1)	CHRIS	fraction of population that are chiristian(fact book of CIA)
IMG	Fraction of import in GDP(WTO)	LDI	Linguistic diversity index(www.ethnologue.com)
MSH	money shock, volatility component of m1(money supply)(WB)	MUS	fraction of population that are muslim(fact book of CIA)
ENPM	School enrollment, primary, male (% gross)(WB)	PRIGHT	property rights(The Heritage Foundation)
CORR	corruption index(International Country Risk Guide by PRS group)	FINF	financial freedom(The Heritage Foundation)
MFREE	monetary freedom(The	SPAN	spanish colony dummy

MING	Heritage Foundation) fraction of mining in GDP(UN)
GSTAB	Government Stability(International Country Risk Guide by PRS group)
TRF	trade freedom(The Heritage Foundation)
IR	Investment Share of GDP(Penn World Table 7.1)
VOICE	Voice and Democratic Accountability (International Country Risk Guide by PRS group)
GIN	standard deviation of GDP growth as growth innovation (WB)
URB	Urban population (% of total)(WB)
POPG	Population growth
WAR	dummy for war and duration(www.war-memorial.net)
LPRATE	Labor participation rate, total (% of total population ages 15+)(WB)
STDMSH	standard deviation of money shock
ENP	School enrollment, primary (gross)(WB)
SAFRIC	Sub-Saharan Africa dummy
EXG	Fraction of export in GDP
IN	GDP per capita in 1990 as initial income GDP (Penn World Table 7.1)
LIFE	Life expectancy at birth,(years) (WB)
FDI	Foreign direct investment, net inflows (% of GDP) (WB)
GC	Government Consumption Share of GDP (Penn World Table 7.1)
BMI	black market exchange rate primum index(FEW)
CREDG	growth of domestic credit to private sector as a % GDP(WB)
OIL	Value of oil exports U.S. dollars(billion)(WEO database of IMF)
LATIN	Latin America dummy
RULE	rule of law (International Country Risk Guide by PRS group)
ARLAND	Arable land (% of land area)(WB)
ENSM	School enrollment, secondary, male (% gross)(WB)
GENDER	gender equality as a social development index(http://www.indsocdev.org)
HINDU	fraction of population that are hindu
ENSE	School enrollment, secondary (% gross)(WB)
PC	Price Level of Consumption(Penn World Table 7.1)
GGC	growth of Government Consumption Share of GDP (Penn World Table 7.1)
AREA	Surface area (sq. km)(WB)
LTOTAL	total Labor force,(WB)
MILIT	military expenditure %GDP(WB)
DENS	Population density (WB)
CIVIC	civic activism as a social development index(http://www.indsocdev.org)
DEM	democratic countries dummy(Torsten Persson and Guido Tabellini :2009)
INF	Inflation, GDP deflator (annual %)(WB)
65AB	Population ages 65 and above (% of total) (WB)
COAST	Coastline (fact book of CIA)
REVCO	revolution and coup detat(CNTS)
POP14	Population ages 0-14 (% of total)(WB)
P1564	Population ages 15-64 (% of total) (WB)

ASSASIN	number of political assassination(CNTS)
PI	Price Level of Investment(Penn World Table 7.1)
STDINF	standard deviation of inflation
EXCONS	Constraints on executive *(Polity IV)*
DEBT	External debt dummy
ENPF	School enrollment, primary, female (% gross) (WB)
ELF	Ethno-linguistic fractionalization index(http//:weber.ucsd.edu\~proeder\elf.htm)
MORT	Mortality rate, infant (per 1,000 live births) (WB)
BUQ	Bureaucracy Quality (International Country Risk Guide by PRS group)
TLINE	Telephone lines (per 100 people) (WB)
G1565	growth of Population share of ages 15-64(WB)
FFCORR	freedom from corruption as a corruption index (The Heritage Foundation)
LIT	Literacy rate, adult total (% of people ages 15 and above) (WB)
POP	Population(WB)
FISF	fiscal freedom(The Heritage Foundation)
EASTA	Dummy for East Asian countries
ENT	School enrollment, tertiary (% gross) (WB)
MEDAGE	median age of countries people(fact book of CIA)
DOLLAR	dollarization dummy
OPEN	Trade (% of GDP) as openness(Penn World Table 7.1)
ETHNIC	ethnic tension(International Country Risk Guide by PRS group)
OTHER	fraction of population that have other religion(fact book of CIA)
NONREL	fraction of population that have no religion belief(fact book of CIA)
MYSC	mean years of schooling of adult (+15)(UN)
LATIT	absolute value of latitude, calculated from dataset for La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R.W., 1999
ECONF	economic freedom(The Heritage Foundation)
G	government spending index(The Heritage Foundation)
OPEC	dummy for years of being OPEC members
M2G	Money and quasi money growth (annual %)(WB)
RAIN	annual average of rainfall(UN)
LAND	dummy for land locked countries

*Data source are in parenthesis. WB: World Bank database, WTO: World Trade Organization time series, UN: United Nation data, CNTS: Banks, Arthur S. Cross-National Time Series, *Polity IV:* The *Polity IV* project, *EFW*: *Economic Freedom* of the *World*. For complete definition of variables refer to the sources.