

**Seminar, Unified Growth Theory**  
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# **Factors to growth; a two-sided approach**

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*Contents*

**1. Introduction ..... 2-3**

**2. Economic income differences – Theoretical conclusions ..... 3-5**

**3. Empiric approach to economic growth; model and data ..... 5-8**

**4. Empirical results ..... 9-10**

**5. Discussion and perspective ..... 10-12**

**6. Conclusion..... 13**

**7. References ..... 14**

**8. Appendix ..... 15-18**

## 1. Introduction

Real GDP per capita in the United States almost tripled between 1960 and 2005. Dorms from 1960 normally only have two power sockets: one for a desk lamp and one for a bedside lamp. Today, most rooms bulge with a personal computer, television, DVD player, stereo system and the list go on. What has brought about this growth in production, incomes, and living standards? In modern Asia, even greater economic growth is realised. In China's bustling cities, people are participating in an economic miracle. They are creating businesses, investing in new technologies, developing local and global markets, and transforming their lives. Why have some countries like US and China grown rich, while others stay poor? Which forces have played a role in making the rich countries rich and why can the relatively poor countries not do them the trick after?

There exist numerous theories trying to explain economic growth. In general the types of theories have continuously evolved during the history. The development can be discovered in the four general theories: Classical Growth Theory, Neoclassical Growth Theory, New Growth Theory, and Unified Growth Theory.

The Classical Growth Theory<sup>1</sup> is the view that the growth of real GDP per person is temporary and that when it rises above the subsistence level, a population explosion eventually brings it back to the subsistence level.

The Neoclassical Growth Theory breaks with the view, as it proposes that real GDP per person grows because technological change induces a level of saving and investment that makes capital per hour of labour grow. Growth ends only, if technological change stops. Robert Solow suggested the most popular version of neoclassical growth theory in the 1950s. The problem with this theory is that all economies have access to the same technologies, and capital is free to roam the globe, seeking the highest available real interest rate. The theory therefore implies that income per capita around the globe should converge. While there is some sign of convergence among the rich countries, convergence is slow, and it is not imminent for all countries.

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<sup>1</sup> The Classical Growth Theory is also referred to as the Malthusian theory

The New Growth Theory (also referred to as the Endogenous Growth Theory) built on the theory of the new growth theory, but successfully incorporates microeconomic factors into the model such as the specific country's market structure and the preference of the individuals in the economy.

The New Growth Theory is, however, only able to explain growth rates of developed economies, not the developing countries. The Unified Growth Theory takes on that task, as it is an endogenous model, that is consistent with the entire process of development, and in particular the transition from the Malthusian state<sup>2</sup>, to the era of sustained economic growth.

This paper seeks a Unified Growth Theory approach to finding the answer: What creates growth and what are the main reasons for the international income differences? The work in this paper is two-sided as the first part of the paper (Section 2) presents the points and conclusions from a developed theoretical model explaining income differences, while the second part of the paper takes an empirical approach, by testing the significance of potential growth factors (Section 3 and Section 4). As it is not possible to test directly on the theoretical model in Section 2, the models in the two parts of the paper differ, but despite of this, both parts indicate similar results. These results are discussed and put into perspective in Section 5.

## 2. *Economic income differences – Theoretical conclusions*<sup>3</sup>

Stephen L. Parente (SLP) and Edward C. Prescott (ECP) raise questions concerning international Total Factor Productivity (TFP) differences in their article "Barriers To Riches". Simply put, they ask the question: "*Why do international incomes differ by so much?*"<sup>4</sup>. Their view is, that differences in international incomes, are the consequences of differences in the knowledge individual societies apply to the production of goods and services. They state that these differences are the primary result of country-specific policies that result in constraints on work practices and on the application of better production methods at the firm level. Many of these constraints, or barriers, are put in place to protect the interest of groups vested in current production processes. Such barriers at the individual production unit level imply differences in output per unit of the composite input at the aggregate level, that is, differences

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<sup>2</sup> Malthusian state is an economic state of a country that experience no or very limited growth in BNP per Capita as the benefits from slow technological progress are offset by population growth.

<sup>3</sup> The theory here builds on the article by Stephen L. Parente and Edward C. Prescott: "Barriers to Riches"

<sup>4</sup> "Barriers to Riches" pp. 1

in TFP. Most of the differences in international incomes, thus, are the result of differences in TFP.

One of the main equations in the article demonstrates, how policy-induced constraints or barriers at the plant level, give rise to differences in TFP at the aggregate level, and the articles chapter 6 closes with a calculation, which shows that even minor barriers, which only raises the cost of the production process by less than a factor of 2, leads to huge income differences: TFP of the poor country (with barriers), is in the example  $1/3$  of the rich country (without barriers), and the poor country's steady-state per capita NIPA<sup>5</sup> GDP, is  $1/27$  of the rich country. The calculations and equations are, of course, more thoroughly gone through in the article, but the above establishes the point, that barrier differences need not be large to account for the observed differences in international incomes. So the main answers to the above question, asked by SLP and ECP, are that most of the international income differences attributes to country-specific policy that directly, or indirectly, restricts the set of technologies that the individual production units can use. These differences in constraints translate into differences in TFP at the aggregate level.

Further they hypothesize that many of these constraints exist on account of monopoly rights that industry insiders with vested interests tied to current production processes have. With the governments' protection, these insiders impose restrictions on work practices and provide strong barriers to the adoption of better technologies. The policy prescriptions that follow from their theory are clear: To improve living standards, governments of poor countries must stop protecting monopoly rights of industry insiders with vested interest in the current production processes, as well as stop granting new monopoly rights in the future. If the constraints that prevent firms in the countries from using readily available technologies and efficient work practices are eliminated, growth miracles will ensue, and the cross-country differences in income levels will be of the order of magnitude of regional differences within countries. Governments can stop protecting these monopoly rights by promoting competition, they declare. If there is intense competition, industry insiders with the right to block efficient production will never exercise this right, because to do so, would spell the end of their industry. Moreover, if there is intense competition, a government is less likely to grant these rights in the future. This is because groups of factor suppliers are also less likely to make investments to try obtain these rights. If an industry is facing competition, there are no rents, and without these rents, there is little incentive for groups of factor suppliers to organize and

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<sup>5</sup> NIPA-data is the national accounting inventory of the earnings in the firm sector.

lobby the state. Having the industry monopolized instead of competitive, and public rather than private make it easier for states to protect the monopoly rights of factor suppliers. To promote competition, governments should foster free trade. The state needs to ensure that goods and services can move freely between regions inside its country's borders and between countries. International trade, thus, matters for development precisely because it is an important source of competition. Even if the number of domestic firms in an industry is small, the competition from foreign firms, in either domestic or international markets, can be enough of a force to eliminate the resistance to the adoption of better technologies and the efficient use of technologies.

The view of SLP and ECP are obvious: Countries are not poor because incentives to develop new technologies are lacking. The technologies have been developed in other countries, and it is just a matter of using the technology that is best, given factor prices, and using that technology efficiently. As they conclude, SLP and ECP think that inevitably insiders will gain the power to dictate work practices. Systems are needed in which it is not in the interest of the insiders to exercise this power to block efficient production. One such system is to have a federal government that prohibits states from interfering with interstate commerce and the free movement of goods and people between states. International trade agreements are another mechanism to achieve this objective. With such arrangements, it is not in the interest of groups with vested interests tied to current work practices to impose barriers to the use of the best available technology given factor prices.

This was the theory's proposition to factors that account for international income differences. Now let us look at the empirics.

### *3. Empiric approach to economic growth; model and data*

The World Bank economists Craig Burnside and David Dollar created in the year 2000 a lot of debate regarding aid allocation and economic growth with the publishing of their article "Aid, Policies, and Growth" in the American Economic Review vol. 90. This article is furthermore one of the most cited articles in economics<sup>6</sup>. Their empiric growth regressions found that aid had a positive effect on growth in developing countries with good fiscal, monetary and trade policies but has little effect in the presence of poor policies. However, interesting as it might be, this is not what this paper will focus on. I will, in contrast, focus on

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<sup>6</sup> Stated by RePEc (Research Papers in Economics); Repec.org. Detailed link: <http://ideas.repec.org/top/top.item.nbcites.html#repec:aea:aecrev:v:90:y:2000:i:4:p:847-868>

two policy-variables which the regression model also contains. I will elaborate on this later. The dataset<sup>7</sup> which is used in the analysis contains information about 62 low- and middle-income countries in the period 1966-1993, as mentioned earlier. The information is divided into seven 4-year periods: 1966-1969, 1970-73, 1974-77, 1978-81, 1982-85, 1986-89 and 1990-93 for each country. This is a panel dataset, which means that we follow the same countries during the given time-period. In all, there are 356 observations covering the countries and time-periods. The results from the article is based on the following linear regression model composed by Burnside and Dollar:

$$\begin{aligned} growth = & \beta_0 + \beta_1 y0 + \beta_2 ethnf + \beta_3 assassin + \beta_4 eth\_ass + \beta_5 icrge + \beta_6 m2gdp \\ & + \beta_7 ssa + \beta_8 easia + \beta_9 policy + \beta_{10} aid + \beta_{11} a\_policy \\ & + \delta_2 td2 + \delta_3 td3 + \delta_4 td4 + \delta_5 td5 + \delta_6 td6 + \delta_7 td7 + u \end{aligned}$$

*Growth*: Yearly average growth rate in GDP per capita, calculated in percent.

*y0*: The log of initial GDP per capita.

*ethnf*: Ethnolinguistic fractionalization<sup>8</sup>

*assassin*: Number of political assassinations, used to measure political instability

*eth\_ass*: Interactive term to measure civil unrest

*icrge*: Measure of institutional quality that captures security of property rights and efficiency of the government bureaucracy.

*m2gdp*: Level of broad money (M2) over GDP (lagged one period), which proxies for the development of the financial system. Lagged to avoid endogeneity problems.

*ssa*: Dummy variable , equals 1 for observations of countries in Africa south of Sahara, 0 otherwise.

*easia*: Dummyvariable , equals 1 for observations of countries in East Asia, 0 otherwise.

*policy*: Index, as computed by Easterly, Levine and Roodman for "good growth-promoting policy. Comprised of the budget surplus, inflation and trade openness.

*aid*: "Effective development assistance": Aid calculated in percent of GDP.

*a\_policy*: Interaction term between *aid* and *policy*.

*td1*: Dummy variable , equals 1 for observations in 1966-69, 0 otherwise.

*td2*: Dummy variable , equals 1 for observations in 1970-73, 0 otherwise.

*td3*: Dummy variable , equals 1 for observations in 1974-77, 0 otherwise.

*td4*: Dummy variable , equals 1 for observations in 1978-81, 0 otherwise.

<sup>7</sup> The dataset was originally used in W. Easterly, R. Levine and D. Roodman: "Aid Policies, and Growth: Comment", American Economic Review, Vol. 84, no. 3, June 2004

<sup>8</sup> "Easterly and Levine find that ethnolinguistic fractionalization is correlated with bad policies and with poor growth performance"; from "aid, policies and growth" pp. 4

*td5*: Dummy variable , equals 1 for observations in 1982-85, 0 otherwise.

*td6*: Dummy variable , equals 1 for observations in 1986-89, 0 otherwise.

*td7*: Dummy variable , equals 1 for observations in 1990-93, 0 otherwise.

Finally we have the error-term *u* containing the unobserved variables which also have an effect on the dependent variable.

I will test the significance of all the variables because it is interesting to see which are significant and which are not, but the two policy variables I will focus on are *icrge* and *policy*. *Icrge* is important, and relates to the theory from section 2, in that it describes institutional quality and in that way the efficiency of the government bureaucracy. Researchers have started to pay more attention to how institutions, that affect the governance of a nation, affect economic performance. Government officials respond, at least in part, to the incentives created by political and legal institutions. Therefore, the structure and quality of political institutions can affect whether the government facilitates or inhibits economic development. Stated most simply, the incentives institutions create for government decision-makers will determine whether the government uses its power to create a framework for productive economic activity or to redistribute wealth to itself or its supporters. Few would dispute that the security of property and contractual rights and the efficiency with which governments manage the provision of public goods and the creation of government policies are significant determinants of the speed with which countries grow. North<sup>9</sup> asserts, for example, that “...*the inability of societies to develop effective, low-cost enforcement of contracts is the most important source of both historical stagnation and contemporary underdevelopment in the Third World . . .*” because the absence of secure property and contractual rights discourages investment and specialization.

A definition of ICRGE is given here: “*ICRGE variables Expropriation Risk, measuring the risk of expropriation, and Rule of law, measuring whether there are established peaceful mechanisms for adjudicating disputes, are interpreted here as proxies for the security of property and contract right. If countries score low on these dimensions, they are likely to suffer a reduction in the quantity and efficiency of physical and perhaps even human capital*

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<sup>9</sup> North, D., 1990, Institutions, Institutional Change and Economic Performance. Taken from Stephen Knack and Phillip Keefer; "Institutions and economic performance: Cross country tests using alternative Institutional Measures", Economics and politics, november 1995, volume 7, issue 3, pp. 207-227

*investment*”<sup>10</sup> (Further definitions of the variable are given in the appendix, A2). The *icrge* variable is thus an index in which a poorly (low) score on these dimensions, is a strong indication that a bureaucracy lacks procedural clarity or technical competence and is likely to introduce criteria other than efficiency into the determination of government policies or the allocation of public goods. In particular, the bureaucracy is likely to award contracts, business and trade licenses, police protection and so forth on the basis of criteria other than those of allocative and technical efficiency.

This exactly relates to the conclusion of the theory from section 2 which concludes that rent-seeking governments prevents adoption of known technology and thereby, in a way, prevents economic growth. So of course it’s relevant to check if an empiric analysis of the matter can back this theory up.

The second variable I will focus on, *policy*, is a index, for ”good”, growth-promoting policy. This is comprised of the budget surplus, inflation and trade openness where the latter, trade openness, is the most “important” factor in this papers perspective. The policy variable is measured in the following way<sup>11</sup>:

$$\text{Policy} = 1,28 + 6,85 \times \text{Budget surplus} - 1,40 \times \text{Inflation} + 2,16 \times \text{openness}$$

The openness index is a index computed by Sachs and Warner<sup>12</sup> and involves a series of trade-related indicators – tariffs, quotas coverage and the existing of export marketing boards. The link to the theory here, is a assumption that a country that is open and willing to participate actively in international trade, is also a country which are willing to adopt known technologies in order to further create economic growth – an immediate plausible assumption when considering the many positive externalities international trade may cause.

So, what will these variables tell us? Do they contribute positively to the economic growth in developing countries as the theory predicts? Are they even significant? Let’s find out.

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<sup>10</sup> Stephen Knack and Phillip Keefer; "Institutions and economic performance: Cross country tests using alternative Institutional Measures", Economics and politics, november 1995, volume 7, issue 3, pp. 210.

<sup>11</sup> "The American Economic Review, vol. 90" (sep.,2000), "Aid, Policies and Growth", pp. 855

<sup>12</sup> Sachs, Jeffrey D. and Andrew Warner (1995), Economic Reform and the Process of Global Integration, Brookings Papers on Economic Activity, no. 1, pp. 1-118.

#### 4. Empirical Results

The assumptions which needs to be fulfilled in order to get the best, linear, unbiased estimators (BLUE) are described in the appendix, A1. I will assume that these assumptions are fulfilled.

I have run the dataset in SAS in order to obtain the partial effect, if any, of the estimates.

Basically I've stated the null-hypothesis on a 5% significance level:

$$H_0: \beta_x = 0 \text{ (where } x = 1, 2, \dots, 11) \text{ against the alternative } H_1: H_0 \text{ not fulfilled,}$$

and got the following results:

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t	95% Confidence Limits	
Intercept	1	0.83065	2.58738	0.32	0.7484	-4.25884	5.92015
logGDPcap	1	-0.07465	0.32546	-0.23	0.8187	-0.71484	0.56554
Ethnf	1	0.16092	0.80964	0.20	0.8426	-1.43167	1.75352
Assassin	1	-0.37585	0.26264	-1.43	0.1534	-0.89248	0.14079
eth_ass	1	0.12695	0.55665	0.23	0.8197	-0.96801	1.22190
lcrge	1	0.33076	0.12199	2.71	0.0070	0.09080	0.57072
lly2_1	1	0.01922	0.01357	1.42	0.1577	-0.00748	0.04591
Ssa	1	-1.54126	0.57427	-2.68	0.0076	-2.67089	-0.41164
Easia	1	2.06337	0.63917	3.23	0.0014	0.80608	3.32066
Policy	1	0.14864	0.04044	3.68	0.0003	0.06910	0.22818
Aid	1	0.10552	0.15162	0.70	0.4869	-0.19273	0.40377
a_policy	1	-0.01570	0.01567	-1.00	0.3172	-0.04653	0.01513
td2	1	1.35970	0.70399	1.93	0.0543	-0.02508	2.74448
td3	1	1.71333	0.65960	2.60	0.0098	0.41586	3.01080
td4	1	0.00393	0.64001	0.01	0.9951	-1.25499	1.26286
td5	1	-1.48530	0.63739	-2.33	0.0204	-2.73907	-0.23152
td6	1	-0.80890	0.61630	-1.31	0.1902	-2.02120	0.40339
td7	1	-0.77290	0.59474	-1.30	0.1946	-1.94278	0.39698

As we see, both policy variables, *icrge* and *policy* have a positive parameter estimate and p-values below 0,05 which means that we can reject our  $H_0$ -hypotheses. Both parameter-estimates are thus positive and significant.

Assuming a index-value of 2.5 for both *icrge* and *policy* leads to the below, small calculation:

$$\Delta_{growth} = \beta_5 \times icrge = 0,33076 \times 2,5 = 0,8269\%$$

$$\Delta_{growth} = \beta_9 \times policy = 0,14864 \times 2,5 = 0,3716\%$$

This is just to show the potential gain from “good”, positive scores of the indexes considered.

The above example shows that an *icrge*- and a *policy*-index of 2,5 will add 0,77% and 0,4423% , respectively, to the percentage yearly average growth rate in GDP per capita.

So, when all the other variables have been accounted for, the two policy variables have, *ceteris paribus*, a positive effect on the economic growth in the developing countries from the data-set. These results show that there is compliance between theory and statistics. One might say that the result is so intuitive that it's not surprising but then again, the *aid*-variable, for example, is insignificant. All in all, it is noticeable that there are only two other variables (not including the time-dummies) which are significant besides the two policy variables. Intuition is rarely sufficient in economics.

### 5. *Discussion and perspective*

The conclusion from the theory is stated and clear: Free markets and international trade are the keys to economic growth. This is a story which everyone who has dealt with economic growth in development countries (and in general) has heard before. And it is not like these "Washington Consensus"<sup>13</sup>-recommendations haven't been tried implemented in numerous development countries before, with limited success. The article by SLP and ECP states examples from 4 country cases which match their points and conclusions from their theory. I will shortly describe some of the examples before commenting on them: For example they state the question why modern economic growth started first in England in the late eighteenth century rather than in Continental Europe. Their answer they give is, that England at this time did not protect the monopoly rights of insiders<sup>14</sup>. This trend was due to a steady shift in power away from the crown and to Parliament. What emerged were to separate political bodies of similar power that competed for the rents associated with these monopoly rights. As a result of this competition, little regulations were in place in the middle eighteenth century in Britain, and no group could successfully block the adoption of better technologies that innovators developed. France, in contrast, had no political competition; the crown had all the power to grant monopoly rights and exercised this power to generate revenues. The economic structure of France, consequently, was dominated by government-sanctioned monopolies that were protected by elaborate regulations. In Spain, the situation at that time was similar to the situation in France. When France and Spain developed anyway it was because modern

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<sup>13</sup> The term Washington Consensus was initially coined in 1989 by John Williamson to describe a set of ten specific economic policy prescriptions that he considered should constitute the "standard" reform package promoted for crisis-wracked developing countries by Washington, D.C.-based institutions such as the International Monetary Fund (IMF), World Bank, and the US Treasury Department.

<sup>14</sup> Ekelund, R. B. and R. E. Tollison. "Mercantilism as a Rent seeking Society" (1991); document that the protection of monopoly rights declined in England in the three centuries leading up to the industrial revolution.

economic growth could not be stopped in the countries after it began in England on account of the competition between these sovereign states. Trying to protect monopolies and home markets would mean invasion and the risk of conquest by the richer states.

So, the theory states one thing, a couple of country cases backs it up and the empirics, documented in this paper, does not contradict it. But the most important result from the empirics, must be the result from the *icrge* variable. Because one thing is that theory and a couple of chosen examples suit each other, another (hi)story is, that the policy implications, that this seems to lead to, have been tried before. And if the solution is both discovered and implemented, then why do we still have developing economies instead of only modern growth regimes? I don't doubt that competition and international trade promotes economic growth. This is also backed up by the *policy* variable in the empiric section. But what is clear is, that good policy recommendations, as the ones the theory suggest (and as the ones the *policy* variable "contains") isn't sufficient. The *icrge* variable is important, in that it suggests that the institutions in the countries that receives these policy recommendations have to be sound and solid enough to carry out the suggestions. Make them work in the long run. Without knowing to much about the English, France or Spanish institutional systems in the 18<sup>th</sup> century, I am predicting, that these were relatively strong and well established. After all, it is nations with a long history of colonialism. The point is, that this stands in contrast to a lot of the developing countries we see today, maybe especially in Africa, where corruption and political instability are more than a part of everyday life. One can come up with a lot of policy recommendations to Uganda, for example, but if it is not made sure that the country has the proper institutions and that the incitements are right, and the competencies good enough for the leaders who have to implement the recommendations, then history shows us that the good initiatives will only have little, if any, effect. The idea of building a road to help the infrastructure of a country is great. But without making sure that that the road is maintained and that the country has the abilities to do this, makes the idea indifferent in the long run.

Africa is a continent often mentioned when examples of failed economic growth of nations, are on the table. But there is another reason that I cannot help mentioning and discuss Africa in this context: It is very straight forward to think about aid recommendations, when discussing the issues this paper contains. Especially has Denmark announced a new aid strategy at the beginning of this year, 2010. A strategy where the Danish government will, more than earlier, focus its developing aid resources on the African nations. The strategy is so new, that it has yet to be implemented in the allocations of the Danish aid, but it is a strategy which has been debated heavily in the media. The strategy is, in many ways, in line with the

theory described in this paper, in that it suggest a more intensive focus on private and open markets, private enterprises in the developing countries and especially securing of property rights. Thus, a focus on the private sector mainly. Whether or not the strategy proves successful, only time can tell. Basically it boils down to the question of whether economic growth, which is sustainable in the long run, is best created from a private initiative, as suggested by the new Danish strategy. Countries like China, South Korea and Vietnam for example have had economic growth successes with a strong central and governmental control and with a significant part of the growth coming from the state sector. At the same time, a bigger focus on the private market must, inevitably, reallocate resources from the public sector, thus taking funds from schooling, health and infrastructure. This must be considered problematic in a time where human capacities are decisive. As agreed before; economic competition is healthy and dynamic, but in a developing economic context one must ask the question about what kind of free competition is created when the difference in the possibilities for the humans/persons in the economy are abysmal. A child who does not receive the proper nutrition and care during the first years of life is highly likely to have learning difficulties. How can you talk about the initiative, skill and competition later in life if you are disabled from the start?

Likewise, it is hard to see how poor countries should be able to compete in a global economy if their children do not attend school. It cannot be too much to ask that international systems of economic competition and good governance are built around some basic rules designed to ensure that all people get a fair chance. Most importantly it takes a healthy and educated population to make sure that their political leaders “play by the rules”.

## 6. *Conclusion*

This paper sought to find the answer to what has made today's strong economies leave the Malthusian State and enter into a modern growth regime. The thought was, that the answer to this question, might help in finding out what the obstacles to growth are, for the development countries today. First I presented a theory - or the main points and conclusions from it - by SLP and ECP. Their conclusion was, that the main reason that developing countries today is not experiencing modern economic growth, are because of bad, restrictive and protectionist policies which prevent already discovered modern technology to be adopted, and thereby prevent work processes and competition to run efficiently. This conclusion was backed up by the empiric results, in section 4, where the two policy variables of the regression proved positive and significant. Finally, these results were discussed and sat in perspective. In particular it was considered, whether or not the results from theory and empirics seemed sufficient enough to create aid allocation strategies from. This discussion seemed relevant when considering how the Danish government just recently changed their aid strategy in a direction, that the theory and the empirical results presented would suggest. The important conclusion was reached, that even though a "correct" liberal policy is contributing to the economic growth in developing countries and even though a couple of historic country examples (among many others, of course) complies with this, it is also important to realize that institutions have a significant effect. This fact must be taking into consideration when dealing with aid strategies, or in general; when focusing on economic growth.

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## 8. Appendix

A1

The 5 assumptions MLR.1-MLR.5<sup>15</sup> demands the following:

MLR.1: Demands, that the model is linear in its parameters. In other words; the model should be written on the following form:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + u$$

MLR.2: Demands that you have a random sample of observations from the model and that there residuals average out to zero and the sample correlation between each independent variable and the residuals is zero. In other words there must not occur autocorrelation which is when the residuals depend on each other.

MLR.3: Demands that none of the explanatory variables are correlated with the error-term. The error-term,  $u$ , shall have an expected value of zero, given any values of the independent variables:

$$E(u|x_1, x_2, \dots, x_k) = 0$$

An example of what would violate MLR.3 is if one omits a important variable in the regression, which is correlated with one of the explanatory variables  $x_1, x_2, \dots, x_k$ . When Assumption MLR.3 holds, we often say the we have exogenous explanatory variables. If  $x_j$  is correlated with  $u$  for any reason, then  $x_j$  is said to be an endogenous explanatory variable.

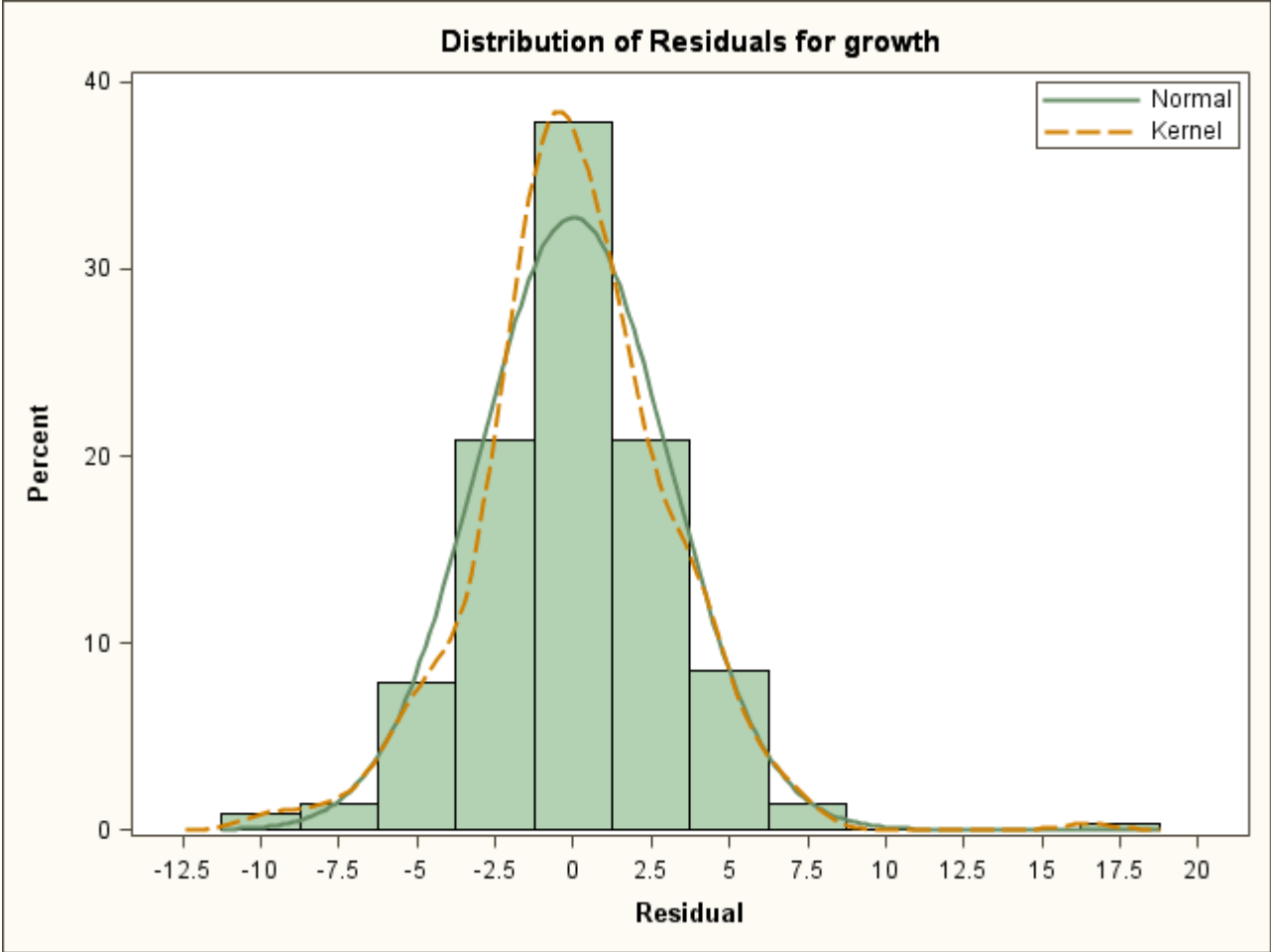
MLR.4: Demands that there is no perfect collinearity in the sample. So none of the independent variables must be constant, and there must be no exact linear relationship among the independent variables. This would be like having the same explanatory variable in the regression equation twice which, indeed, would make “ceteris paribus”-analysis problematic.

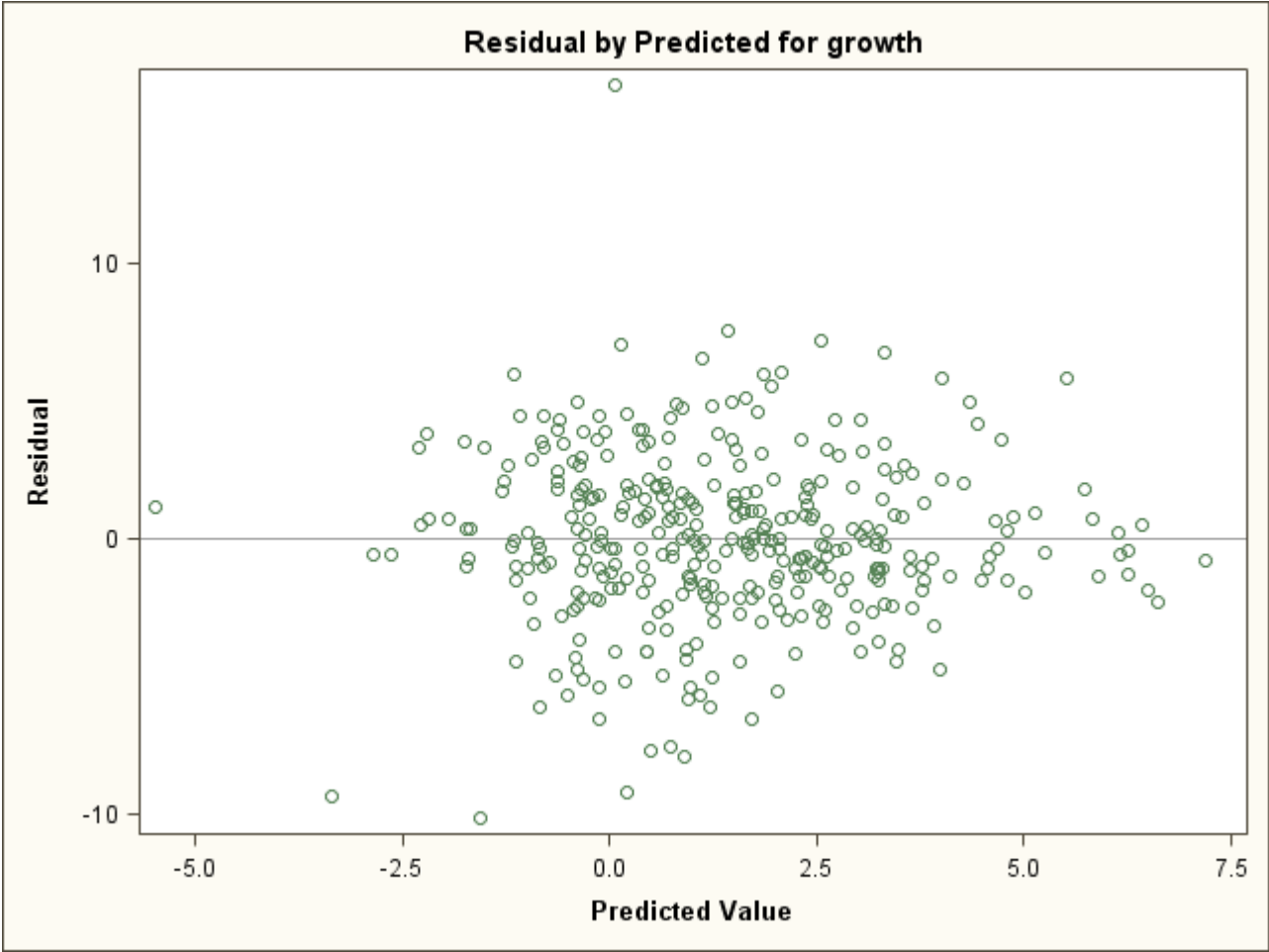
MLR.5: Demands that the variance in the error term,  $u$ , conditional on the explanatory variables, is the same for all combinations of outcomes of the explanatory variables. If this assumptions fails, then the model exhibits heteroskedasticity. This means, that the variance in the value of the residuals is rising with the estimated value of the dependent variable.

The diagrams below show that the residuals are normally distributed and that there are constant variance; so no heteroskedasticity:

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<sup>15</sup> MLR stands for Multipel Linear Regression. The assumptions are described in Jeffrey M. Wooldridge “Introductory Econometrics”, chapter 3.





*International Country Risk Guide (ICRG)*

*Quality of the Bureaucracy:*

High scores indicate “autonomy from political pressure” and “strength and expertise to govern without drastic changes in policy or interruptions in government services”; also existence of an “established mechanism for recruiting and training.” Scored 0-6.

*Corruption in Government:*

Lower scores indicate “high government officials are likely to demand special payments” and “illegal payments are generally expected throughout lower levels of government” in the form of “bribes connected with import and export licenses, exchange controls, tax assessment, policy protection, or loans.” Scored 0-6.

*Rule of Law:*

This variable “reflects the degree to which the citizens of a country are willing to accept the established institutions to make and implement laws and adjudicate disputes.” Higher scores indicate “sound political institutions, a strong court system, and provisions for an orderly succession of power.” Lower scores indicate “a tradition of depending on physical force or illegal means to settle claims.” Upon changes in government in countries scoring low on this measure, new leaders “may be less likely to accept the obligations of the previous regime.” Original variable name in ICRG is “law and order tradition.” Scored 0-6.

*Expropriation Risk:*

*Repudiation of Contracts by Government:*

Indicates the “risk of a modification in a contract taking the form of a repudiation, postponement, or scaling down” due to “budget cutbacks, indigenization pressure, a change in government, or a change in government economic and social priorities.” Scored 0- 10, with lower scores for higher risks.