LUND UNIVERSITY

Exchange rate regimes and economic growth

An empirical investigation of exchange rate regimes relationship with economic growth

Emil Hansson

Bachelor thesis – NEKH02

January 2022

Lund University – Department of Economies

Supervisor: Klas Fregert

Abstract

This study examines the relationship between exchange rater regimes and economic growth for a sample of sixty countries during the period 1970-2016. This pooled sample is divided into an industrialized sample and a non-industrialized for additional analysis. For the empirical investigation, the exchange rate regimes were represented by a dummy variable based on a de facto exchange rate classification and this dummy variable was then combined by various explanatory variables that are believed to have an impact on growth according to growth theory. With a panel data set, nine different regressions are run for the three different samples. The study concludes that the non-industrialized countries perform better under a fixed regime with significance for two out of three regressions while the industrialized countries perform worse under a fixed regime, implying that a floating regime is preferable.

Keywords: Exchange Rate Regime, Economic Growth, Panel Data, Exchange Rate Regime Classification

Table of Contents

1. Introduction

1.1 Background

Choosing an exchange rate regime has long been one of the more controversial subjects of macroeconomics and many studies have centered around finding the optimal regime given each country's circumstance. One of the more intriguing perspectives of exchange rate regimes are to connect the choice of the exchange rate regime and the long-term economic growth levels. Studying the relationship between exchange rate regimes and economic growth became more relevant after the collapse of the Bretton Woods system. The Bretton Woods system was a framework that took place after the second World War in which countries that were members of the International Monetary Fund agreed to peg their exchange rates at rates that could only be adjusted within IMF's agreement. This agreement was a consequence out of necessity to avoid a similar repetition of the economic policies that contributed to the great depression (IMF, n.d.). Since the fall of the Bretton Woods system, members of the International Monetary Fund were free to choose any form of exchange rate regime they wanted, allowing the currency the freely float, pegging the currency to another currency or forming part of a monetary union (IMF, n.d.). Today, there are a wide variety of regimes from the most freely floating to the most rigid pegs and all in between and the choice of the exchange rate regime brings consequences for the economic policy that a country can apply, making the choice of the exchange rate regime one of the more important macroeconomic decisions.

With all the different regimes that a country can choose to implement, it would be interesting to identify whether there are any specific regimes that are favorable when it comes to achieve and maintain economic growth. The gross domestic product is seen as the primary indicator when it comes to measuring macroeconomic performance. Studying this indicator with a long-term perspective combined with an important macroeconomic variable that are chosen by a country could therefore be interesting. Most of the empirical research that examines macroeconomic performances across countries has its focus on the exchange rate regimes impact on international trade and investments for example. The reason why this subject traditionally has less research than most other macroeconomic performances are that nominal variables are considered unrelated to long-term growth variables such as economic growth, therefore making it less likely to find significant results (Levy-Yeyati & Sturzenegger 2001). However, there are many ways of having an exchange rate regime and all ways contribute to

what countries can do on a macroeconomic level, therefore affecting the gross domestic product. The fact that many countries historically have switched exchange rate regimes frequently to affect the macroeconomic performance, makes this subject interesting to examine.

1.2 Purpose

The purpose of this study is to investigate if a country's choice of a fixed or floating exchange rate regime has any significant impact on the long-term economic growth on a sample of countries world-wide. This relationship will be investigated from both a pooled-sample perspective, and from an industrialized and non-industrialized country perspective. The goal of this study is to examine the results and find out if conclusions can be made regarding how a country should proceed when choosing an exchange rate regime.

With the subject at hand, this thesis tries to answer the following two researching questions:

1. Is there a relationship between the countries choice of exchange rate regime and the long-term economic growth?

2. Are there any different relationships between the exchange rate regime choice and long-term economic growth between industrialized countries and non-industrialized countries?

1.3 Structure

The thesis will be structured as following. Section 2 describes some previous research done on the subject at hand and what my contribution to the subject will be. Section 3 presents an overall frame of theory that helps to understand the purpose. Section 4 will present the data that are used in the study. Section 5 presents the method that will be used to analyze the data and some econometrical challenges that are common with this data. Section 6 presents the overall results. Section 7 discusses the results more in detail and what the results depicts. Lastly, section 8 presents conclusions from the study and some perspectives of what future research on the subject could present.

2. Previous studies

There has been some previous research that has attempted to find a relationship between long-term economic growth and a country's choice of exchange rate regime. There is no clear-cut answer from these studies whether there is a relationship between economic growth and exchange rate regime.

Table 1 show some of the recent research that has been done regarding this subject since all the research presented are done during this century. This table is presented from the perspective of a fixed exchange rate regime and economic growth, giving out a result what significance a fixed regime had according to these studies. As previously noted, the results from these studies in the table have no clear-cut conclusion whether the exchange rate regime of a country has any significance on economic growth and most of the studies in general of this subject lean towards the conclusion that other factors have more of an impact on growth than the exchange rate regime. Some studies however concludes that there is some significance to the exchange rate regime but mostly under some circumstances or for a specific group of countries.

The main factor that can contribute to the wide difference in results are the classification of exchange rate regimes. As will be pointed out in theory, there are two main classifications of the exchange rate regimes for a country, *de facto* and *de jure* classifications. Most of the early studies done centered around *de jure* classification published by the IMF on the Fund's "Annual Report on Exchange Arrangements and Exchange Restrictions based on what each country self-reported (Eichengreen & Razo-Garcia, 2012). The main problem with this classification though is that there was a contradiction in some instances between the reported regime and the actual prevailing regime, with some countries trying to maintain a fixed exchange rate and reporting this regime to the IMF but in practice being unable to maintain it fixed (Alesina & Wagner 2006). Another problem with the de jure classification according to research done by Calvo and Reinhart (2002) was that countries that was committed to a floating exchange rate regime might have experienced a fear of volatility of the exchange rate which could lead to intervention on the foreign exchange market to limit actual variability, leading to a non-floating actual regime.

Many of the more recent studies with the limitations of the *de jure* classification in mind have tried to solve this by creating a *de facto* classification as described in the theory. The *de facto* classifications are created in research attempts to find an exchange rate regime that match the

policy a country use in practice, leading to a more credible classification. However, even for the *de facto* classifications the conclusions are widely different. The most probable reason for the dissimilarities could be that many authors use different variables in their classification-algorithms since there is no clear way theoretically to classify a country's regime because many factors can have an impact. This creates a reliability problem with the studies that use the de facto exchange rate classification, (Eichengreen & Razo-Garcia 2012).

Table 1: Recent research on exchange rate regimes and economic growth. The result indicates what significance a fixed regime had on the economic growth for the number of countries in each study.

Authors	**Time-period and number of countries**	**Dependent variables**	**Method**	**Exchange rate classification**	**Results**
Levy-Yeyati and Sturzenegger (2003)	1974-2000. 183 countries	Investment/GDP, terms of trade, government spending, political instability, average initial GDP, population, trade openness, enrollment rate of secondary school, dummy variable for region and exchange rate regime	OLS; 2SLS	De facto	Positive for non-industrializers

Bailliu et al. (2003)	1973-1998. 60 countries	Initial GDP, investment/GDP ratio, number of secondary students, real government spending/GDP, trade openness, M2/GDP, private sector credit/GDP, domestic credit/GDP, net private capital/GDP, dummy variable for exchange rate regime	GMM	De facto and the jure	Insignificant
Husain et al. (2005)	1970-1995. 158 countries	Investment/GDP, trade openness, term of trade growth, average years of schooling, tax ratio, net government spending, initial average annual income/gross income, population growth, total population,	OLS	De jure	Negative on advanced economies. Positive on developing economies

		dummy for exchange rate			
Jakob (2015)	2012 74 countries	Exchange rate regime dummy, inflation, index of government spending, gross capital formation, index of human capital,	Enter method	De facto	Positive
Bleaney and Francisco (2007)	1984-2001. 91 developing countries	Dummy variables for growth rate, time, and exchange rate regime	Pooled OLS	De facto	Insignificant

2.1 This study in relationship to previous research

This study attempts to find a relationship between growth and exchange rate regime with an extended time-period compared to the studies mentioned in table 1, creating a larger sample and therefore more observations. This study will also use a different combination of variables in the regression that according to growth theory explain economic growth, making this study stand out in its setup of variables. For example, I will use some variables from the study done by Jakob (2015), like inflation and exchange rate regime dummy, and use some variables from Levy-Yeyati and Sturzenegger (2003), such as secondary school enrollment and openness.

I will also use the natural *de facto* classification by Reinhart and Rogoff (2004) which is different from most other studies and their classifications of the exchange rate regime. This study also attempts to find the relationship between economic growth and exchange rate

regime differ between industrialized and non-industrialized countries. This perspective is not unique but most studies to my knowledge focus on either the pooled sample as a whole or country specific groups, not both. This analysis will contain regressions on both pooled samples and country specific samples with industrializers and non-industrializers, creating another element that can be useful for analysis on this area. Lastly, I will make a more simplistic way of classifying exchange rate regimes, with countries either being floating or fixed regimes. This is more in line with literature that studies the exchange rate regimes effect on macroeconomic variables.

3. Theory

3.1 Exchange rate regime classifications

There are many more regimes than just strictly fixed, intermediate or floating that a country can apply. Classifying regimes can therefore be hard because intermediate exchange rate regimes can range widely from being so flexible that it in practice truly should be classified in the floating category or to so rigid that the regime should be classified as a fixed regime. Placing a country and its exchange rate regime into a correct category could therefore be quite difficult and the root of the complications originates from the difference between the *de jure* classification system and the *de facto* classification system, in other words, what countries report as a regime and what regimes countries use in practice based on their actions (Frankel, 2003).

Most of the early empirical studies and research on exchange rate regimes used the *de jure* classification compiled by the IMF. The regimes they report is based on what regime a particular country declares to run (Levy-Yeyati & Sturzenegger 2003). Inconsistencies of what regime a government declared to have, and the actual policy of a country created problems in the research. Many countries that declared themselves as a floating regime intervened in the exchange rate market to the extent that it in practice were hardly any difference at all between countries that have an explicit fixed exchange rate regime. Conversely, periodic devaluations of pegs in inflation-prone countries are the result of a monetary policy that are inconsistent with a fixed exchange rate regime and the policy effectively made the regime a flexible arrangement. There could also be a clear distinguishment in the policy a country implements under more severe times, with a country changing the course of action once the regime is under some sort of stress, leading to a misleading picture of the existing exchange rate regimes (Levy-Yeyati & Sturzenegger, 2003). Since 1999, the IMF itself also began to report countries actual regimes based on what was observed and concluded by the IMF staff (Andersson et al, 2008). One can therefore conclude that most research done before that year, basing the classifications on the *de jure* classification, could be misleading to some extent.

Rogoff et al. (2003) in their research compares the *de jure* classification and the *de facto* classification created by Reinhart and Rogoff (2004) between the time-period 1973-99. They illustrate that only about half the observations, where an observation corresponds to a

country's given exchange rate regime in a particular year in the time-period, where classified in the same broad category under both the *de jure* classification the *de facto* classification. The divergence is especially considerable among the floating regimes, where only 20 percent of the *de jure* classifications of floating exchange rate regimes were classified as floating in the *de facto* classification. Rogoff et al. (2003) mentions that potential reason for this significant divergence between the classifications are to a large extent a reflection of the prevalence of dual and parallel foreign exchange rate markets. During the 1970s and 1980s, about half of all economies had active dual and parallel markets, while nowadays foreign exchange rate markets are almost unified, (Rogoff et al. 2003).

With the limitations of the *de jure* classification in mind a lot of research and efforts have been made to create a classification system that is consistent with the policy and framework a country runs in practice, therefore creating a more accurate picture of the exchange rate regimes. The classification mostly used in today's research is the IMF *de facto* classification that attempts to classify countries based on their actions in practice (Eichengreen & Razo-Garcia 2012). The IMF classifies countries according to the *de facto* framework based on the degree of flexibility and countries commitments to exchange rate paths. The exchange rate regime is then combined with the monetary policy frameworks to provide greater transparency in the classification scheme and providing a greater understanding that different exchange rate regimes can be consistent with similar monetary frameworks (IMF, 2004). The IMF presents the following eight exchange rate regimes, shown in Table 2:

Table 2: The IMF exchange rate regime classifications:

IMF Regime	*Exchange Rate Regime classification*	*Definition*
Exchange Arrangement with No Separate Legal Tender	Fixed	The currency of another country circulates as the sole legal tender, or the country belongs to a monetary or currency union in which the same legal tender is common in the union.
Currency Board Arrangements	Fixed	Commitment to exchange domestic currency at a fixed exchange rate,

		combined with restrictions on the issuing authority to ensure fulfilment of its legal obligation.
Other Conventional Fixed Peg Arrangement	Fixed	A country pegs its currency at a fixed rate to another currency or a basket of currencies. The basket is formed from the currencies of a major trading partner or financial partner.
Pegged Exchange Rates within Horizontal Bands	Intermediate	The value of the currency is maintained within certain margins of fluctuation of at least $\pm 1\%$ *around a fixed central rate.*
Crawling Pegs	Intermediate	The currency is adjusted periodically in small amounts at a fixed rate or in response to changes in selective quantitative indicators, such as past inflation.
Exchange Rates within Crawling Bands	Intermediate	The currency is maintained a margin of fluctuation of at least $\pm 1\%$ around a fixed central rate.
Managed floating with No Predetermined Path for the Exchange Rate	Flexible	The monetary decisionmakers influences the exchange rate without any specific exchange rate path or target.
Independently Floating	Flexible	The exchange rate is market determined and there is no specific level that is being established.

All eight categories can be divided into the three more conventional categories, mostly used in the literature: fixed, intermediate, and floating exchange rate regimes, as done by Bailliu et al (2003). The IMF then combine these exchange rate regimes with different monetary frameworks to give out a more accurate way of describing each country's current regime.

Most of the *de facto* classifications that have been made in studies follow a somewhat similar approach with respective classification. Some of the more notable classifications that have been made in empirical studies are Bubula and Ötker-Robe (2002), Reinhart and Rogoff (2004) and Levy-Yeyati and Sturzenegger (2005).

Bubula and Ötker-Robe and Andersson base their classification mostly on the actual exchange rates supplemented by information from IMF country reports and sources related to those reports, for example press reports, news articles etc. (Eichengreen & Razo-Garcia, 2012). Reinhart and Rogoff divide their observations into two categories, those with a unified exchange rate versus dual or parallel rates. For those countries with a unified exchange rate, they use statistical methods to verify the trustworthiness of the *de jure* classification and then place the observation into alternative categories that are based on data observed related to inflation, exchange rate variability and announced bands. For countries with dual or parallel rates, they use the same methodology but based on the market-determined rate.
Levy-Yeyati and Sturzenegger classify exchange rate regimes based on the volatility of the nominal exchange rate, the variability of its rate of change and the volatility of international reserves (Eichengreen & Razo-Garcia, 2012).

3.2 Advantages of a fixed regime versus a floating regime

Since the object of this essay is to determine whether there is a difference for a country to implement a fixed regime versus a floating regime with regards to long-term economic growth, it is a good starting point to shine light on some of the academical factors that make a country chose a specific regime. I will now present advantages with both regimes.

3.2.1 Advantages with a fixed exchange rate regime

Frankel (2004) points out four different advantages to why a country would want to fix its currency. First, he mentions a nominal anchor for monetary policy. When a bank wants to fight inflation, it can fix the exchange rate to create more credibility. Managers that then set wages will therefore perceive that inflation will be stable in the future since the currency is pegged. Wages and prices directly follow the inflation and its expectations, and the result will be a more stable, lower level of inflation for any given level of output, with the presupposition that the country is pegging to a hard currency.
The second argument Frankel mentions is encouraging trade and investment. With a fixed

exchange rate, the volatility-factor of exchange rate variability that create uncertainty would be eliminated and therefore encourage international trade to a higher degree. Frankel however points out that this argument has lost some of its momentum mainly because the theory would suggest that the net effect of exchange rate uncertainty in the end will be insignificant because the negative effect will be taken out by a positive effect in another variable, price level for example, and the emergence of forward markets, used to hedge out risk.

The third argument that Frankel points out is the precluding comparative depreciation, meaning that a fixed exchange rate would prevent countries trying to gain trade advantages over another country by depreciating the currency, instead achieving a cooperative solution that benefits both countries.

Lastly, Frankel highlights the fact that a fixed exchange rate regime reduces the risk of creating speculating bubbles, such as the sort that pushed up the dollar in 1985. With no exchange rate fluctuations, there might not be spillover-effects into other variables creating macroeconomic uncertainty (Frankel, 2004).

3.2.2 Advantages with a floating exchange rate regime

Frankel (2004) points out four different advantages to why a floating exchange rate regime might be favorable, with the same structure as the fixed advantages. Frankel first mentions the fact that exchange rate flexibility allows a country to pursue an independent monetary policy framework. The arguments why independence of this magnitude is desirable is the ability for a government to respond in changes of demand for goods to prevent the country from going into a recession. By freeing the currency to float, a government can depreciate the currency, stimulating the demand for domestic products ant return to the desired levels of employment and output more rapidly than under the automatic mechanism that is in play with a fixed exchange rate regime.

The second advantage of a floating regime that Frankel bring up is the automatic adjustment to trade shocks, with the currency responding to developments in the country's trade market by depreciating, thus achieving a perhaps necessary real depreciation even in the presence of sticky prices and wages.

The third argument Frankel concludes as an advantage is the central bank's ability under a floating regime to act as a lender of last resort and seigniorage. With independence, the central bank can create as much money as possible to bail out banks in difficulty, preventing a potential breakdown in the financial system.

The fourth and final advantage of a floating regime that Frankel points out is corresponding to the fourth advantage of a fixed regime, decreasing speculative bubbles. The argument that arises from that in terms of an advantage for floating regimes are the decrease of potential borrowers effectively having unhedged exposure in foreign currency, possibly leading to speculative attacks (Frankel, 2004).

Frankel (2004) finishes his framework by stating which factors that tend to dominate depends largely on the characteristics of the countries at hand. Frankel states that an important factor whether a country would prefer the advantages for a fixed or floating regime is the origin of economic disturbances, if a country is subject to more external disturbances like fluctuations in a foreigner country's intentions to buy domestic goods and assets, the country is most likely leaning towards a floating regime, while on the other hand, if the country is subject to relatively more internal disturbances in macroeconomic variables, pegging its currency is most likely the best option.

To sum up the advantages of either a fixed or floating regime, whether a fixed or a floating regime is preferable for a country will in general depend on country-specific factors. A fixed regime might be preferable for an institutionally weak country that are sensitive to volatility on the exchange rate market and a floating regime might be preferable for a country that aspire more control in times of recession to react with monetary policy. A more detailed discussion of why countries choose a specific regime the way they do is needed to validate the advantages and disadvantages that comes with a fixed or floating regime. A deeper analysis of the determinants that come into play when choosing an exchange rate regime for countries will be presented in this next section.

3.3 Determinants of exchange rate regime choice

There is no clear consensus of what regime is best suited for a specific country, regarding macroeconomic stability and performance. The choice of exchange rate regime is therefore mostly concluded to depend on more country-specific features. There is a main difference between exchange rate regime choices for developed versus developing economies in the literature. A floating regime could be well suited in an advanced economy with stable institutions, while for a more undeveloped economy with underdeveloped institutions, a floating regime might not be as well suited since the country might not be ready for the

exchange rate volatility that are associated with a floating regime (Jakob, 2015).
I will present some factors that determine the choice of exchange rate regime and mostly focus on the difference between advanced and developed economies. First a short presentation of the Mundell-Fleming framework.

The Mundell-Fleming framework studies small, open economies under which financial markets are integrated and capital is mobile internationally. The model the specifically focus on the exchange rate regime that a country applies, either a fixed or a floating regime. With a fixed regime, a country maintains a certain value of the nominal currency. With a floating regime, the central bank lets the currency float freely, making its value depend on the supply and demand of the exchange rate on the market. The model refers to a small country for which the world interest rate, noted with i* in the literature, foreign prices and incomes are given (Burda and Wyplosz, 2017).

Mundell argued that under a fixed regime and perfect capital mobility, the central bank of a small country cannot control the level of the interest rate, only the composition between domestic credit and foreign exchange rate reserves. An open market purchase of securities would lead to a decline in interest rates. Since both home and foreign securities are perfect substitutes, asset holders shift from home securities to foreign securities. The effect becomes that the central bank loses reserves by supporting the exchange rate, causing the money stock to fall. This process the continue until the money stock is back at its initial level and the interest rate is back at the international interest rate level. The net effect is zero because the reserve loss is offset by the increase security holdings by the central bank (Dornbusch and Giovannini, 1990).

Under a floating regime, the reverse occurs. Money is no longer endogenous, but interest rates will still be equal to the international interest rate, so output and exchange rate must adjust to accommodate monetary and fiscal disturbances. A monetary expansion will lead to an exchange rate depreciation and therefore lead to a competitive gain that will sustain an expansion in output (Dornbusch and Giovannini, 1990).

With a fixed exchange rate regime, a country refrains from an active use of a monetary policy and at the same time, leaves the economy vulnerable to demand disturbances, both at home and abroad. The fixed regime works if it is not challenged by external disturbances. With a floating exchange rate regime, monetary policy is preserved. The economy is shielded from real demand disturbances, yet the exchange rate could fluctuate strongly in response to

international financial disturbances. This would then lead to changes in the international competitiveness in one way or the other. The exchange rate could appreciate, leading to a decline in exports and therefore a decrease in output. Floating regimes are mostly associated with countries that have economic and political stability to entrust the central bank to ensure price stability (Burda and Wyplosz, 2017).

Most of the early literature on the long-run determinants of exchange rate regime choices centered around the theory of optimum currency areas starting in the 1960s (Juhn & Marro, 2001). The concept was first brought to life by Robert Mundell (1961) and have been studied since. The theory of optimum currency is related to trade and geographical aspects. This theory weighs the trade and welfare gains from a stable exchange rate versus a country's trade partners against the benefits of exchange rate flexibility as a shock adjuster in the presence of normal rigidities (Levy-Yeyati et al. 2010).

According to Rogoff et al. (2003), variables such as large size and low openness to trade, are most likely going to be associated with floating regimes. The background behind this may be that as trade openness rises, the transaction benefits from common currencies increase and therefore lead to a decline in independent currencies, and a rise in fixed regimes. In the 1970s however, more research centered around the size and nature of economic shocks as determinants of exchange rate regime choices. Higher volatility of terms of trade are believed to be associated with floating regimes, which help to reduce such external shocks, (Juhn & Marro, 2001).

Even though these variables have a long history in research, there are debates to whether these variables empirically back up the literature view. Some authors argue that a high level of openness provide incentives to maintain fixed regimes, while other authors argue that foreign shocks are more important for countries that are more open, increasing the incentives of floating regimes as better shock absorbers, alternatively that higher openness provide a greater scope for a more developed foreign exchange market and therefore making it easier to have a floating exchange rate regime, (Juhn & Marro, 2001).

Recently, more of the attention of determinations of regimes have been placed on capital mobility. Greater capital mobility is likely going to place countries in the extreme categories of exchange rate regimes, hard pegs such as currency unions or pure floats. Another potential determinant of exchange rate regimes is related to more of the historical and institutional characteristics view of a specific country. Though neither theory nor empirical findings seems

to provide an unambiguous view, a lack of institutional strength may make it more challenging to sustain a peg but may also on the other hand increase the attractiveness of a currency board, Juhn and Marro (2001).

To conclude this section, the findings of the most common determinants of the exchange rate regime does not give a clear-cut answer of why countries choose a specific way. There is no clear theory that are used by all countries to determine their best choice of the exchange rate regime. If all countries only chose the exchange rate regime based on what is economically best for a specific country, the research of this subject with exchange rate regime and economic growth would be unnecessary, since all countries maximize the economic output, all else being equal, with the right exchange rate regime. Economically, there would be nothing to compare and study.

There is no evidence though that all countries chose the exchange rate only based on economic reasons. Many countries could potentially choose a regime based on historical or institutional reasons. Historically, a country could have been part of a colonization, leading to a culture influence, and in turn potentially leading to a country implementing the exchange rate regime the settling country have as the current regime. Institutionally, a country might settle for a fixed exchange rate regime because of a lack of institutional strength, leading to a less volatile currency in the country. This might not be economically optimal since the country perhaps depend on international trade, therefore making it more suitable for a floating regime because the possibility of depreciation and appreciation of the currency as shock-absorber. One can therefore argue that certain countries could have an improper regime seen from an economic perspective. The assumption that will be in place for the countries chosen in this study are that there is no given determinant for why a country chose the way it chooses, making this study more relevant.

3.4 Economic growth theory

Economic growth is a measurement of a country's economic development in the long run. By studying long-run economic growth, short-term GDP fluctuations are removed from the analysis. The measurement mostly used is GDP per capita growth (Jones & Vollrath 2013). Most of the research surrounding exchange rate regime and economic growth do not center around one specific growth theory or model. Most of the research instead focus on factors that are said to be related to economic growth according to various theories. The two most

common growth theories are exogenous growth theory and endogenous growth theory. Exogenous growth theory is mainly based on the work of Robert Solow (see Solow, 1956), where the assumptions are that parameters such as capital, savings rate and population growth may vary over time but whose values are determined outside the model, meaning exogenously (Jones & Vollrath 2013).

These variables only provide levels effect, a temporarily effect on per capita GDP but do not provide long-rung growth effects. That can only take place with technological progress. This effect is explained outside of the models and therefore endogenous.

Endogenous growth theory unlike exogenous growth theory, attempts to understand the economic forces underlying technological progress. Examples of work contributed to endogenous models, that explains the technological development within the model are for example Romer (1986) and Lucas (1988). Within these models, the force behind technological progress are innovation and research (Jones & Vollrath, 2013).

3.5 Convergence

The phenomenon of convergence is an important concept in economic growth theory, especially when studying industrialized countries and non-industrialized as in this study. The concept is referred to the increased economic growth poor countries would experience in their catch-up phase to close the gap between rich and poor countries. Empirically, convergence hold according to the neoclassical model under the circumstance that countries have the same steady state. For the industrialized countries, with similar technology levels, investment rates and population growth, the same steady state assumption could work and therefore making the convergence theory hold. For countries that do not have the same steady state, the convergence theory does not seem to hold empirically. Countries that are below their steady state are due to a rapid growth and those above their steady state will grow slowly (Jones & Vollrath, 2012).

Barro and Sala-i-Maritn (1992) find in their research that unconditional convergence, meaning convergence for countries with the same steady state, is occurring in the US states, regions of France and prefectures in Japan. This would then match the empirical findings of convergence for countries with similar country-traits such as investment and population growth. This concept will mostly be reflected in the initial GDP per capita variable in the regressions and is of high relevance in this specific work since the analysis is partly based on industrialized countries and non-industrialized countries.

4. Data

The sample consists of sixty countries from across the world between the time-period 1970-2016. The data set is panel data with countries and variables over time. All the countries are presented in table 1 in the Appendix. The countries in the sample are based on the study by Bailliu et al. (2003). My background for choosing this country sample is because it covers countries from all parts of the world, and the countries that are included are different in all possible way, for example GDP per capita, land area and population. I also like this sample because the distribution between fixed and floating regimes are relatively even seen from the whole period.

All the data for the explanatory variables are gathered from The Global Economy (TGE) and the data for the dependent variable and the initial GDP level are gathered from the World Bank's World Development Indicators (WDI). Data across countries for different variables and time periods vary which means the regression that I will run is unbalanced, Dougherty (2016). The unbalanced dataset will cause my software to account for this, not making all observations over the period be included.

The variable in focus is the exchange rate regime and this variable will be a dummy variable with either a floating or a fixed exchange rate regime. This classification will be built upon the publications of Reinhart and Rogoff (2004) where they use a *de facto* classification with six different regimes. They re-classify actual reported exchange rate regimes according to the IMF into their own classifications that are more in line with countries policy in practice. I will use the same notion but with a more simplistic way to allow a dummy variable in the analysis by putting all classifications that can be seen as a fixed exchange rate regime or an intermediate exchange rate regime with a 1 and all classifications that can be seen as floating with a 0. A deeper presentation of the exchange rate classification and dummy variable will be presented in a forthcoming section. I will now present each variable in the analysis.

4.1 Dependent variable

The main object of the study is to find a relationship between GDP growth and exchange rate regime and therefore the dependent variable is therefore GDP per capita growth. This variable is defined as the annual percentage growth rate of real GDP divided by the total population at constant 2015 prices, expressed in US dollars (WDI). In all the regressions that I run this variable are defined as $\Delta GDPGPC$. This variable is gathered from the World Bank's WDI.

This variable is used as the dependent variable in most studies regarding this subject since it is seen as the best measurement of economic welfare in a country.

Worth pointing out however, is that this variable is not the only variable that are related to economic welfare and there are more ways to examine a country's economic welfare among the population. Offer (2000) points out that from the 1960s, more research has tried to emphasize alternative measurements for welfare. Offer mentions three approaches that have been followed. The first involved extending the national accounts to include non-market goods and services and eliminate harmful components. The second approach focused on social norms in the perspective of social indicators. The last approach had a direct target on mental states based on data surveys reporting well-being. The point being of these approaches that the pursuit of welfare is not always satisfied by economic growth, and that other measurements should be considered (Offer, 2000).

4.2 Explanatory variables

The explanatory variables that I will use in this study are inflation as percentage change in Consumer Price Index, trade openness, government spending, population growth, secondary school enrollment as percentage of all eligible children, capital investment as a percentage of GDP, domestic credit to the private sector as percentage of GDP, initial GDP, and a dummy variable for the exchange rate regime with a 0 for a floating regime and a 1 for a fixed regime. The choice of the explanatory variables is based on factors that according to different economic growth theories are believed to have an impact on growth. Here is a presentation for all explanatory variables.

4.2.1 Population growth

Defined as the exponential rate of growth of the population from year t-1 to t, with population being based on all residents regardless of citizenship or legal status (TGE, n.d). This variable is gathered from The Global Economy database. In the regressions this variable is defined as $\Delta POPG$. Population growth inhibits economic growth, when there is high population growth, the number of new workers force the total capital to increase to maintain the same level of capital per capita. This variable is then believed to influence my study in a negative way according to growth theory (Drury et al. 2006).

4.2.2 Inflation

Inflation in this instance is defined as the annual percentage change in the cost of a basket of goods and services for the average consumer, calculated by Laspeyres formula (TGE, n.d). This variable is noted as $CPI\%$. This variable is accessed from The Global Economy. According to growth theory, this variable is believed to have a negative impact on economic growth. According to research done by Robert Barro on 100 countries between 1960-1990, inflation affect economic growth and investments in a negative way (Barro, 1995). Inflation has a negative impact on economic performance because higher price levels create less purchasing power for people, leading to a decrease in the demand for goods because of less goods for the same amount of money. A decrease of demand will result in a lower GDP level and therefore influence growth negatively (Jakob, 2015).

4.2.3 Trade openness

Defined as exports plus imports as percentage of GDP (TGE, n.d). Defined as $OPEN$ in the regressions and this variable is also accessed from The Global Economy. The theoretical view on this variable in terms of the perspective with economic growth is highly debatable. Yanikkaya (2003) mentions that most of the research done surrounding trade openness has focused on the relationship between trade policies and growth, not trade volumes and growth. Although these two concepts are closely related, their relationship with growth could be considerably different. The reason is that there are other important factors that can affect a country's external sector such as geographical place, size of a country and overall income level. Most of the studies that have attempted to study openness and economic growth solely, have not concluded a clear answer on the relationship, pointing to other factors (Yanikkaya, 2003).

Another problem with openness is its wide range of definitions, with the definition of openness evolving considerably over time. Empirical studies have not been consistent with this, dealing with precise definitions of trade regimes. The literature has also not been successful to deal with the measuring type of trade orientation followed by a country (Edwards, 1993). Considering these problems with openness, the expected effect of this variable in the regressions are unknown.

4.2.4 Government spending

Defined as general government final consumption of all current expenditures for purchases of goods and services, as a percentage of GDP (TGE, n.d). In the regressions this variable is represented as GS and this variable is gathered from The Global Economy.
Government spending may inhibit growth since government expenditures entail a higher level of taxation, therefore reducing the private sectors actor's willingness to produce or work. Government consumption shift resources from the private sector to the public sector, this shift is believed to be more efficient, regarding the allocation of resources by the public sector, Drury et al. (2006).

4.2.5 Secondary school enrollment as percentage of all eligible children

Secondary education is defined as the complete provision of basic education that begins at the primary level. This variable is then the percentage of all eligible children in a specific country (TGE, n.d). This ratio is represented by $SSE\%$ and gathered from The Global Economy. In my analysis, this variable will be represented the human capital for a country.
Human capital is believed to be an important factor when it comes to endogenous economic growth theory. When education and health increases, productivity increases and therefore also economic growth. Studies show though that there are mixed results regarding human capital and economic growth, and Secondary School Enrollment have shown to have a negative impact on economic growth (Umut, 2015).

4.2.6 Capital investment as a percentage of GDP

Defined as gross capital formation and consists of investments in fixed assets in the economy, such as land improvement, and net changes in the level of inventories. Inventories are defined as stocks of goods held by firms with the intent to meet unexpected fluctuations in production or sales. This capital formation indicator is then divided with total GDP (TGE, n.d). This variable is defined as $CAPINV\%$ and accessed from The Global Economy database.
The more capital formation a country has, the more capital per worker. This leads to an increase in capital-labor ratio and therefore higher output produced by each worker, leading to higher GDP production and in long term higher GDP growth, (Jakob, 2015).

4.2.7 Domestic credit to private sector, percent of GDP

Domestic credit to private sector refers to financial resources provided to the private sector through loans, accounts receivable and purchases of nonequity (TGE, n.d). In the regression this is defined as $DCP\%$. This variable is gathered from The Global Economy database. This variable is associated with the financial institutions stability that are believed to have an impact on economic growth.

In a study by Gregorio and Guidotti (1995), they use domestic credit to the private sector as a ratio to GDP in their analysis of finding an empirical relationship between financial development and economic growth. Gregario and Guidotti points out that the main advantage of using this variable rather than other monetary aggregates is that it excludes credit to the private sector, and therefore representing the role of financial intermediaries in channeling funds to private participants on the market, in a more accurate way.

The potential disadvantage according to Gregario and Guidotti (1995) is that domestic credit to the private sector as a GDP ratio may be a weaker indicator of financial development broadly defined. This is a relevant phenomenon in industrialized countries, since these countries to a larger extent could have experienced significant nonbank financial innovation. In non-industrialized countries, most of the financial development has occurred within the banking system, making this variable better for these group of countries (Gregorio & Guidotti, 1995).

4.2.8 Initial GDP

This variable is defined as GDP in constant 2015 prices, expressed in US dollars (WDI, n.d), at the start of every period. This variable is defined as $GDPIN$ in the regressions and the variable are gathered from the World Bank's WDI.

This variable is a commonly occurring variable in studies of this subject since it reflects the theory of convergence, and it will provide the same purpose in this analysis. As the theory imply, convergence is of high relevance in this work because I am dealing with separate datasets of a pooled sample, industrialized countries, and non-industrialized countries. In the analysis this variable should be expected to have a positive impact in the GDP per capita growth, and specifically a more significant impact on the non-industrialized dataset, since these group of countries have a lower initial level of GDP. As pointed out in the Barro and

Salai-i-Martin (1992), the theory assumes the growth rate to be higher in initially poor countries.

4.2.9 Dummy variable for the exchange rate regime

This dummy variable is a simplification of the Reinhart and Rogoff (2004) *de facto* classification of exchange rate regimes used for countries, also known as the natural classification. In their work, they divide coarse exchange rate classifications into six different categories presented in table 3.

Rogoff et al. (2003) mentions that the natural classification is very similar with the IMF classifications previously mentioned in an earlier section, with about two thirds classified as the same in both classification systems. They also point out that the natural classification has less regimes classified as extremes, meaning full flexibility and rigid pegs. Since my data is spanning later than 2004, I will use the updated version of this same classification regime, given out in 2016 by Ethan Ilezetzki, Carmen Reinhart, and Kenneth S. Rogoff in their research (Ilezetzki et al. 2019). The natural classification regimes have data all the way to 2016 in this research which I will use. Otherwise, the classification process from the original report by Reinhart and Rogoff (2004) are the same.

I will use the natural classification in my analysis, presented in detail in table 3, but I will combine categories one and two as the fixed regime, categorized as a 1 in the dummy variable, and categories three, four and five as the floating regime, categorized as a 0 in the dummy variable. Category six is a missing variable but since none of my countries is classified into this category at any time during the period, this category is irrelevant for the analysis. This variable is defined as γERR in the regressions and is the variable my focus will be on for this analysis.

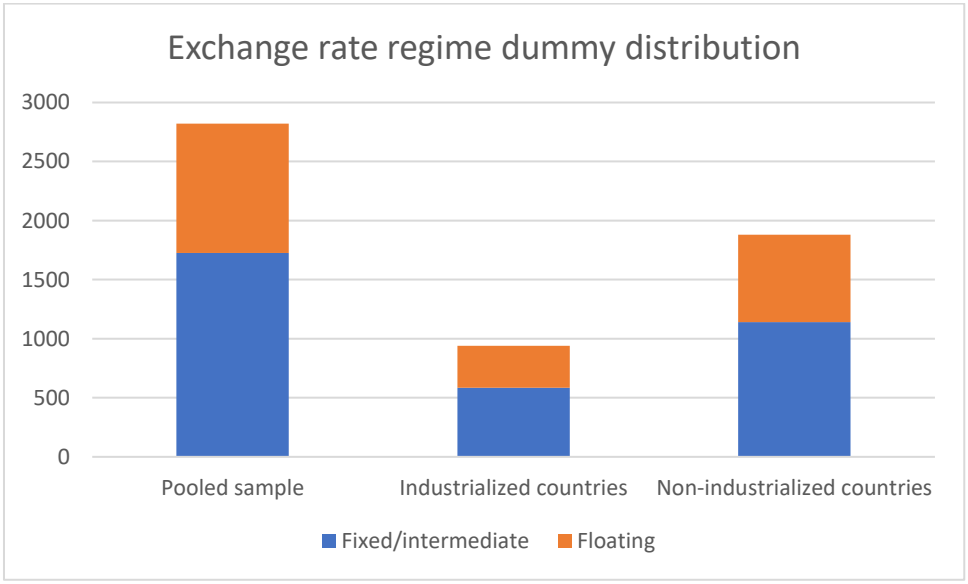
Table 3: De Facto Exchange Rate Arrangements by Reinhart and Rogoff (2004). Dummy variable used in this study.

Category by Reinhart and Rogoff (2004)	Definitions by Reinhart and Rogoff (2004)	Dummy variable estimation
1	• No separate legal tender • Preannounced ped or currency board arrangement • Preannounced horizontal band that is narrower than or equal to $\pm 2\%$ • De facto peg	1: fixed exchange rate regime
2	• Preannounced crawling peg • Preannounced crawling band narrower or equal to $\pm 2\%$ • De facto crawling peg • De facto crawling band that is wider or equal to $\pm 5\%$	1: fixed exchange rate regime
3	• Preannounced crawling band that is wider than or equal to $\pm 2\%$ • De facto crawling band narrower or equal to $\pm 5\%$	0: floating exchange rate regime

	• Managed floating	
4	• Freely floating	0: floating exchange rate regime
5	• Freely falling	0: floating exchange rate regime
6	• Dual market in which parallel market data is missing	Not included

The simplified binary classification of the exchange rate regime corresponds to the common practice in previous studies. Table 4 below presents a distribution of the exchange rate regime dummy. As seen, there are more fixed regimes for all samples.

Table 4: Distribution of the exchange rate regime dummy variable.



4.3 Descriptive statistics

The descriptive statistics of the variables are shown in table 5 to 7. All the datasets are unbalanced since data-availability for the variables vary across both time and country. The mean for all the explanatory variables is higher in the industrialized sample as expected. The industrialized sample has either a higher mean for categories like government spending or secondary school enrollment, where a high mean implies a positive impact on economic growth according to theory, or a lower mean in categories like inflation or population growth, where a high mean would imply a negative impact on economic growth according to theory. The most significant differences between industrialized countries and non-industrialized countries in this data are between inflation and domestic credit to the private sector. Both these categories in some forms are a reflection to the financial stability in a country and this could potentially explain why countries are either industrialized or non-industrialized. The dependent variable, GDP growth per capita is higher for the non-industrialized sample, the most probable reason for this is because of a lower initial GDP. This would confirm the theory of convergence in the theory, where countries with a lower initial GDP starts further away from their steady state and therefore experiences a higher GDP per capita growth.

As seen by the standard deviation for all samples, there is a large variation across the variables. Most of the standard deviation are from the non-industrialized country-sample. Especially inflation have a large standard deviation for non-industrializers. The large standard deviations from the variables might have a negative effect on my regressions.

Table 5. Descriptive statistics for the pooled 60-country sample

VARIABLE	OBSERVATIONS	MEAN	ST. DEV.	MAX	MIN
GDPG	2714	2,06%	3,99	23,99%	-36,56%
CPI	2629	15,70%	90,65	2947,7%	-11,40%
OPEN	2716	60,06	36,52	322,68%	4,92%
POPG	2819	1,53%	1,00	6,02%	-1,85%
SSE	2241	71,09%	32,70	157,17%	1,01%
CAPINV	2703	22,96%	6,47	52,69%	-5,74%
DCP	2765	53,22%	45,14	308,98%	0,06%
GDPIN	2678	13613,06	15712,47	75624,41	219,83%
GS	2682	15,15%	5,17	45,96%	2,93%

Table 6. Descriptive statistics for the industrialized 20-country sample

VARIABLE	OBSERVATIONS	MEAN	ST. DEV.	MAX	MIN
GDPG	876	1,96%	2,63	23,99%	-10,02%
CPI	933	5,71%	6,86	84,00%	-4,50%
OPEN	939	60,64%	29,44	227,40%	10,76%
POPG	939	0,64%	0,55	3,80%	-1,85%
SSE	776	100,16%	17,40	157,17%	37,59%
CAPINV	939	24,31%	4,59	48,28%	11,90%
DCP	927	84,39%	45,77	308,98%	0,06%
GDPIN	881	32239,03	12784,62	75624,41	7655,66
GS	939	19,32%	3,41	27,93%	9,87%

Table 7. Descriptive statistics for the non-industrialized 40-country sample

VARIABLE	OBSERVATIONS	MEAN	ST. DEV.	MAX	MIN
GDPG	1838	2,11%	4,49	21,24%	-36,56%
CPI	1696	21,20%	112,38	2947,70%	-11.40%
OPEN	1777	59,75%	39,76	51,25%	4,92%
POPG	1880	1,97%	0,87	6,02%	-0,77%
SSE	1465	55,69%	28,11	125,82%	1,01%
CAPINV	1764	22,23%	7,17	52,69%	-5,74%
DCP	1838	37,50%	35,68	253,26%	1,54%
GDPIN	1797	4481,463	5867,62	36462,31	219,83
GS	1743	12,90%	4,51	45,96%	2,91%

5. Method

5.1 Regression models

The regression[1] that I will use for my analysis is the following:

$$\Delta GDPGPC_{i,t} = \beta_0 + \beta_1 \cdot CPI\%_{i,t} + \beta_2 \cdot OPEN_{i,t} + \beta_3 \cdot GS_{i,t} + \beta_4 \cdot \Delta POPG_{i,t} + \beta_5 \cdot SSE\%_{i,t} + \beta_6 \cdot \gamma ERR_{i,t} + \beta_7 \cdot CAPINV\%_{i,t} + \beta_8 \cdot DCP_{i,t} + \beta_9 \cdot GDPIN_{i,t} + \alpha_i + \gamma_t + \mu_{i,t} \quad (1)$$

This regression consists of both cross-section and time variables with *i* representing the country observation and *t* the time-period for the observation. All definitions and explanations of the explanatory and dependent variables are presented in the data-section. I will then compute two more regressions with fewer variables. With fewer variables in the analysis, the different dynamic might present a different significance regarding exchange rate regime. $\beta_1 - \beta_9$ are the estimated coefficients of the explanatory variables and these will be presented in the results. The γ is indicating a dummy variable for the exchange rate regime, with a 0 for floating regimes and a 1 for fixed regimes. The error term $\varepsilon_{i,t}$, consist of extra elements because of fixed effects across both countries and time, the background and calculation for this choice of effects are presented in the next section.

The second regression will be run as the following:

$$\Delta GDPGPC_{i,t} = \beta_0 + \beta_1 \cdot CPI\%_{i,t} + \beta_2 \cdot SSE\%_{i,t} + \beta_3 \cdot \gamma ERR_{i,t} + \beta_4 \cdot DCP_{i,t} + \beta_5 \cdot GDPIN_{i,t} + \alpha_i + \gamma_t + \mu_{i,t} \quad (2)$$

The background for these variables is originated from the descriptive statistics analysis, in which these variables was differencing the most between the industrialized country sample and the non-industrialized country sample. Combining these variables with the exchange rate regime could then present another result when explaining exchange rate regime and economic growth for each sample. Most of these variables are included in Bailliu et al. (2003) analysis for the same framing of question. In their work they did not find a relationship between regime and growth, rather a monetary policy relationship with growth.

[1] The program I will use for my regressions are EViews 11 student edition

The third and last regression I will run for my three datasets are as follows:

$$\Delta GDPGPC_{i,t} = \beta_0 + \beta_1 \cdot GS_{i,t} + \beta_2 \cdot \Delta POPG_{i,t} + \beta_3 \cdot SSE\%_{i,t} + \beta_4 \cdot \gamma ERR_{i,t} + \beta_5 \cdot CAPINV\%_{i,t} + \beta_6 \cdot GDPIN_{i,t} + \alpha_i + \gamma_t + \mu_{i,t} \quad (3)$$

The choice of these variables reflects the most included variables used in the empirical growth literature. Most of these variables are in line with Jakob's (2015) research on the same area. In her research she found a positive relationship between fixed exchange rate and economic growth with a similar variable approach as this regression, but with a different method.

All regressions will be run with fixed effects both over country and period. Since the datasets are showing signs of heteroscedasticity, I will account for this in the regressions by adding Robust Standard Errors - White adjusted diagonal. All the econometric tests and challenges related to panel data in general and this dataset are presented in the appendix and the regressions I run will be built upon those analysis. Next sections present some of the econometric tests and challenges that have set the foundation of the regressions.

5.2 Panel Data

The regressions are built upon panel-data since I have observations cross-sectional sample data over two or more time-periods. This makes the application of regression analysis to fit into the econometric models more complicated. There are however several reasons for why panel data work has increased, and one important reason is the solution that it offers to the problem of omitted variable bias caused by unobserved heterogeneity (Dougherty, 2016).

5.2.1 Fixed/Random effects model.

The problem that can occur when working with panel data is that the error term in the cross-section sample is correlated with the explanatory variable, caused by country-specific attributes that are not observed in the initial model. This problem can be solved by including individual specific effects so that all observations get their own intercept, (Jochumzen, 2017a).

Individual specific effects can be either fixed or random (Dougherty, 2016). To find out whether individual effects should be fixed or random I perform a Hausman test and reject the null-hypothesis for all regressions and data-samples that the random effect is more effective. The results indicates that there are country-specific effects that are correlated with the variables in the model. I should therefore include fixed individual specific effects in my regressions for all my samples. All the results from the Hausman test will be presented in the Appendix in table 2.

I could also include time-specific effects in the model. Time-specific effects occur when the data is showing a trend related to the period, for example a common recession in most of the countries (Jochumzen, 2017a). There is reason to believe that time-specific effects should be included since external shocks could impact all my countries in the sample. To test for time-specific effects I perform a redundant fixed effects test- likelihood test. The null hypothesis is that only one intercept in the model should be added, and this hypothesis is rejected meaning I will have fixed effects both for cross-section and time. The result from this test is presented in the Appendix in table 3.

With the fixed effects added to the regression, the error term can now be re-written as: $\varepsilon_{i,t} = \alpha_i + \gamma_t + \mu_{i,t}$, where α_i is the individual specific effect, γ_t is the time specific effect and $\mu_{i,t}$ is the error term of the effects, typically assumed to be homoscedastic and not autocorrelated, Jochumzen (2017a).

5.2.2 Heteroscedasticity

One of the more severe problems when it comes to OLS-estimation in econometrics is heteroscedasticity. An assumption of the OLS is homoscedasticity in the data meaning that the conditional variance of the error terms is constant. If this assumption is violated, we have a heteroscedasticity problem in our OLS estimation. The consequence is that the OLS estimator no longer is the most efficient estimator, and the standard errors are inconsistent (Dougherty, 2016). To test for this, I perform a heteroscedasticity test in EViews, where the null hypothesis is that the error terms are homoscedastic. I reject this hypothesis for all my samples and therefore I can conclude that my datasets show signs of heteroscedasticity. To account for this, I will use robust standard errors- White Diagonal, that corrects the heteroscedasticity and autocorrelation. The results from the heteroscedasticity tests are presented in table 4 in the Appendix.

5.2.3 Autocorrelation

Another assumption of the OLS estimator is that the value of an observation should be determined independently of its values in all the other observations from previous time-periods. If this assumption is violated, we are dealing with autocorrelation (Dougherty, 2016). This is commonly occurring in datasets dealing with some form of timeseries data and should therefore be looked at more closely. One way to test for autocorrelation is the Durbin-Watson test for AR(1) autocorrelation. The Durbin Watson d-statistics lies between 0 and 4 and is

calculated from the residuals using the expression;

$$d=\frac{\sum_{t=2}^{T}(\hat{u}_t-\hat{u}_{t-1})^2}{\sum_{t=1}^{T}\hat{u}_t^{\,2}}$$

If the d-statistic is between 0 and 2, there could be a suspicion for positive autocorrelation, and if the value lies somewhere between 2 and 4, there is suspicion of negative autocorrelation. The goal of the test is to have a d-statistic as close to two as possible, (Dougherty, 2016). In my regressions, I have a d-statistic almost always close to 1.5, meaning that there could be signs of autocorrelation depending on one's interpretation of the d statistic. To deal with this I will use robust standard errors, with the background being the same as the previous section with heteroscedasticity. The Durbin-Watson d-statistics are presented in table 5 in the Appendix.

5.2.4 Endogeneity

A very important assumption in our OLS-estimator is that the linear regression model is exogenous, meaning the expected value of the error term is not dependent on the explanatory variables, $E(\varepsilon_i|x_i) = 0$. If this assumption is violated, we have an endogeneity problem and all our estimations of the OLS becomes biased and inconsistent leading to misleading results, (Jochumzen, 2017b). I will focus on the problem that comes with multicollinearity, meaning that one or more of the explanatory variables correlates with each other. The other problem with multicollinearity is that the problem cannot be solve in my software using a specific function. Rather there is a question of how much degree of multicollinearity there is in my datasets (Jochumzen, 2017c).

The problem with multicollinearity creates high and misleading variances. To give an indication of whether I have high degree of multicollinearity or not in my data I will create a correlation-matrix for the pooled sample that will be presented in table 6 in the Appendix. The table indicates that some variables are correlated to the extent where they could exhibit a high degree of multicollinearity. Secondary School Enrollment are the most correlated variable with a high degree of correlation with domestic credit to private sector ratio, initial GDP, and population growth. Other than that, most variables do not correlate to the extent that a multicollinearity problem appear. The exchange rate regime dummy seems to have a very low degree of multicollinearity with all other variables. This will be important later in the regressions when evaluating the results. There could however be some multicollinearity in the other datasets, but I will assume that those other datasets for industrialized countries and non-industrialized countries reflect the pooled sample in this instance.

6. Results

In the following section I will present the results from all regressions and data-samples. Table 1 presents the pooled sample, table 2 presents the industrialized country sample and table 3 presents the non-industrialized country sample. Shown in the tables are the coefficient-value, the standard errors in parentheses, the R^2 values and total numbers of observations. The discussion of the results will then be presented deeper in the next section.

Table 8. Pooled sample

Regression	1	2	3
Observations	1911	1967	2037
CPI	-0,028***	-0,030***	
	(0,008)	(0,009)	
OPEN	0,004		
	(0,006)		
POPG	-0,869***		-0,993***
	(0,216)		(0,220)
GS	-0,135***		-0,150***
	(0,046)		(0,039)
SSE	-0,016*	-0,014*	-0,026***
	(0,009)	(0,009)	(0,009)
DCP	- 0,029***	-0,030***	
	(0,005)	(0,005)	
GDPIN	$6,5e^{-5}$**	$-8,2e^{-6}$	$7,29e^{-6}$
	$(3,2e^{-5})$	$(3e^{-5})$	$(2,29e^{-5})$
CAPINV	0,200***		0,219***
	(0,020)		(0,024)
ERR	0,309	0,464**	0,672***
	(0,216)	(0,235)	(0,240)
R^2	0,386	0,306	0,354
Adjusted R^2	0,349	0,266	0,319

Note: Standard errors in parenthesis.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 1 percent level

Table 9. Industrialized countries

Regression	1	2	3
Observations	705	706	718
CPI	-0,187***	-0,172***	
	(0,037)	(0,043)	
OPEN	0,012		
	(0,015)		
POPG	-1,106***		-1,419***
	(0,303)		(0,306)
GS	-0,388***		-0,422***
	(0,059)		(0,074)
SSE	-0,004	-0,010	0,003
	(0,009)	(0,010)	(0,010)
DCP	-0,011***	-0,014***	
	(0,004)	(0,004)	
GDPIN	$2,61e^{-5}$	0,001**	$4,83e^{-6}$
	$(3,89e^{-5})$	$(5,40e^{-5})$	$(4,32e^{-5})$
CAPINV	0,203***		0,185***
	(0,042)		(0,038)
ERR	-0,704**	-0,512	-0,151
	(0,307)	(0,401)	(0,341)
R^2	0,603	0,503	0,565
Adjusted R^2	0,557	0,449	0,518

Note: Standard errors in parenthesis.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 1 percent level

Table 10. Non-industrialized countries

Regression	1	2	3
Observations	1206	1261	1310
CPI	-0,029***	-0,030***	
	(0,008)	(0,008)	
OPEN	0,011*		
	(0,006)		
POPG	-0,820**		-0,628**
	(0,318)		(0,309)
GS	-0,089*		-0,104**
	(0,052)		(0,418)
SSE	-0,040***	-0,033**	-0,053***
	(0,013)	(0,013)	(0,013)
DCP	-0,035***	-0,028***	
	(0,007)	(0,007)	
GDPIN	$-6,42e^{-5}$	-0,0001	-0,0001
	$(6,39e^{-5})$	$(5,92e^{-5})$	$(5,54e^{-5})$
CAPINV	0,189***		0,218***
	(0,025)		(0,030)
ERR	0,384	0,487*	0,763***
	(0,264)	(0,270)	(0,293)
R^2	0,395	0,332	0,367
Adjusted R^2	0,349	0,281	0,322

Note: Standard errors in parenthesis.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 1 percent level

7. Discussion

First, I will give a presentation of the overall result of the explanatory variables from the study, followed by a more detailed comparison of all different datasets and the different results that follow by the three standalone samples. Then an analysis on the focus-variable, the exchange rate regime dummy, will be presented in a separate part with a deeper analysis. Lastly, I will put this study's result in contrast to other studies done on this subject, to show similarities and differences in results, and give conceivable areas to continue research on this subject.

The pooled regressions in table 8 present a low R^2, the R^2 is a good indicator of the model's strength since it explains how much of the regression is determined by the explanatory variables in the model(Dougherty, 2016). A low R^2 might occur when many variables that would contribute to explaining GDP per capita growth is missing. Since R^2 is a measurement of fit, 35% percent of the GDP per capita growth for model one can be explained by the model. However, the adjusted R^2 is more relevant in this instance. The adjustedR^2, called the ´corrected´ R^2, only considers variables that affect the dependent variable. R^2 generally, increases when one adds new variables into the regression. The adjusted R^2 compensate for this automatic increase by imposing a penalty for increasing the number of explanatory variables (Dougherty, 2016). This makes the determinant of coefficient decrease to a level between 25% to 35% for all three regressions. This would imply that many more variables in the analysis need to be considered to explain GDP growth per capita. This is a reasonable assumption since GDP growth per capita can be determined by a lot of factors not included in the model and be determined differently between countries depending on their structure, institutional development, and level of technological level.

As seen in table 8, factors such as inflation, population growth, secondary school enrollment and government spending have a significant negative impact on economic growth, which the theory mostly would support. Capital investment have a positive significant impact on economic growth, also expected since theory would indicate that more capital formation has a positive effect on long term growth. The two variables that do not match theory are domestic credit to private sector ratio and initial GDP per capita. Domestic credit to private sector has a negative significant impact on long term growth, the reverse of what the theory imply. A high domestic credit to private sector was seen as an indicator of a well-developed financial system, which in turn would be accommodating for economic growth. Initial GDP according

to the convergence theory would have an impact on economic growth, but in this table, there is only significance on the first regression, where more variables are included.

Table 9 presents the industrialized country sample, this dataset presents a similar overall result compared to the pooled sample, which could be an indicator that the industrialized countries contribute more to the results in the pooled sample. Most of the variables such as inflation, population growth, government spending, domestic credit to private sector and capital investment ratio, are all significant in the same way as with the pooled sample. The noteworthy difference between the pooled and industrialized sample are one hand the secondary school enrollment, where there is no significance reported in either of the regressions. This could occur because these more advanced countries have an already established level of technology. A higher share of the population that educate themselves at this level might show diminishing return in technological progress, decreasing the impact on economic growth. For these countries that are already developed, this result indicates that other factors than education are significant to maintain economic growth over the long run.

On the other hand, a big difference for this sample is in the measurement of fit. The industrialized sample presents a higher degree of R^2 and adjusted R^2. The potential reason for this could be a significant amount of less observations, around 1200 observations less. This decreases the chance of outlying observations that causes a big variety in the data, making the regressions harder to explain. This could be reasonable, since well developed countries usually have a more stable economy over time, where factors such as inflation and investments are similar on an annual basis, unlike developing countries where inflation usually are harder to maintain because of government or institutional weakness. With less outlying observations, this in turn makes it easier to explain the regressions. This would be confirmed by the descriptive statistics, where the non-industrialized country sample are a lot more volatile than the industrialized country sample.

Table 10 presents the non-industrialized countries in the sample, a higher number of countries compared to the industrializers. This sample is different from the other two samples in more than one way. Factors such as inflation, capital investment and population growth have the same significant impact on GDP per capita growth. With non-industrializers, openness has a significant positive impact at the 10-percent level, indicating that maybe an increased

involvement in international trade could be impactful for boosting economic growth. A potential explanation for why it could have an impact for this group of countries, when the theory was indistinctive on the impact openness had, is that an increased openness for less developed countries have a spillover effect in the sense of technological exchange between countries. An increase in international trade could increase the technological level of less developed countries by just adopting existing technology in richer countries, therefore have a significant positive impact on economic growth.

The other variable that stands out compared to previous two samples are secondary school enrollment. This variable has a negative significant impact across all regressions. This is contradictory towards what I believe would be the case in practice, where an increase in education at any level for a country that is less developed would lead to a higher level of human capital for the population in a country, leading to increased abilities of technological progress and research, which in turn are leads to economic growth.
The non-industrialized country sample, like the pooled sample, have a low degree of $R^2$and adjusted R^2, making it harder to deliver precise analyses.

For the pooled sample in table 8, the exchange rate regime has a significant impact on the 5-percent level for the sample that are built on variables that vary the most between industrializers and non-industrializers, and significant on the 10-percent level for the regression with variables mostly associated as important factors in various theories if economic growth theory. An overall finding is therefore the regressions with less variables in the model have a greater significance on exchange rate regime regarding economic growth. The positive coefficient in all regressions would imply that it is the fixed regime that have a positive impact on economic growth, since this regime was represented by a 1 in the dummy variable. Therefore, a fixed regime seems to have a positive impact on economic growth when considering the pooled sample, and significant in two of the regression-models.

In table 9, with the industrialized sample, a different result is being noted for the exchange rate regime dummy. The significance is now on regression one, which included all variables in the study. The coefficient is now a negative value, indicating that a fixed regime represented by a 1 in the dummy variable preform worse among industrialized countries. Implying that a floating regime might be preferable for an industrialized country. A negative

coefficient is highly unexpected, and it is hard to find any explanations for why a fixed or regime are having a negative impact on the long-term economic growth. This unexpected result could be due to a smaller sample size compared to the other datasets. This could mean that many countries are missing in the analysis, making the results misleading. However, this sample seems to be the best sample in terms of explaining the regressions, with a much higher degree of R^2 and adjusted R^2 compared to the other two sample. It could also be the case of a different distribution of fixed and floating regimes in the sample. In the other samples, there are a higher share of fixed regimes over the whole time-period while this sample of industrializers are almost distributed with half of all regime observations as floating regimes. This is seen in table 4. This combination along with high preforming countries could be the case of an unexpected result.

The most likely reason though, since many of the countries are a member of the Economic Monetary Union, are that this cooperation has a negative effect on economic growth. Hafner and Jager (2013) writes in their work about EMU as an optimal currency union that EMU clearly does not represent an optimum currency area. Many of the member countries differ in terms of economic performance and structure and the common currency brought greater industrial specialization with it, leading to increased vulnerability of the eurozone to asymmetric shocks. The EMU is also restricted, as national preferences with crisis-management differ across the member-countries. This is a contradiction for what the optimal currency area criteria addresses. The euro turned out to be a heavy burden for some countries when the EMU was hit by an asymmetric shock during the financial crisis 2007-08 (Hafner and Jager, 2013).

Since the period for the regression spans over a long time, mainly over the time since EMU was implemented, the negative coefficient in my regressions could be an indication that the EMU cooperation has not been a success, and that countries are better off with implementing their own currency, based on Hafner and Jager's (2013) work. This unexpected result could also be the consequence of the countries in my sample specifically, where the floating regimes simply has outperformed the fixed regimes economically, and the interpretation for the sample is that all fixed regimes have a negative effect on growth. This could be the case since high-income countries such as Norway, United States and United Kingdom for the most part of the sample-period has been a floating regime. These countries according to the data have been high performing for a long time and therefore could have more impact on the results than some of the other countries with a fixed regime.

In table 10 with the non-industrializers for the exchange rate regime dummy, the results from the regressions reflect the pooled sample regressions to a higher degree than the industrialized country sample. There is significance for the two regressions that include less variables than the original regression. There is significance at the 10-percent level for the second regression consisting of the variables that differ the most from the industrialized sample, and there is significance at the 1-percent level for the regressions consisting of variables that are most related to factors according to various growth theories explain long-term economic growth in GDP per capita. The positive coefficient then indicates that there is an advantage of a fixed regime for non-industrialized countries in relationship to economic growth. This may reflect the theory that a fixed exchange rate regime is related more closely to a less volatile exchange rate, making it easier for developing countries to maintain a peg.

Less developed countries are also more related to weaker institutions and political stability, a fixed regime might be preferable in this instance since a floating regime could lead to more fluctuations, in turn leading to higher inflation for example. Inflation is believed according to theory to have a negative impact on the long-term economic growth and the results of this study back up the theory with a negative coefficient. Many countries in this dataset demonstrate very high levels of inflation according to the descriptive statistics. According to Ghosh et al. (1996) in their research about macroeconomic performances and exchange rate regime choices, they conclude that a pegged currency, meaning a fixed regime, is associated with better inflation performances for members of the International Monetary Fund since 1960. This would imply that fixed regime is better for this sample of countries who according to the descriptive statistics have shown high levels of inflation.

My study confirms what some of the studies have shown in terms of economic growth and economic growth. The results of this study are mostly in line with what Levy-Yeti and Sturzenegger (2003) find in their research. They find that a fixed exchange rate regime is associated with higher growth performance for non-industrialized countries. However, their method, variables included in the regressions analysis, and classification of exchange rate regimes differ from my study, although their purpose is mostly in line with my work, dividing the sample into industrialized and non-industrialized samples. My results for the industrialized country sample, that a fixed regime should have a negative impact on economic growth is theoretically a bit confusing and not in line with previous research. My pooled sample show that fixed regimes perform better, and this is also in line with some of the

studies but as previously noted, this study differs from many of this studies that are trying to study the same questions, since the build-up of countries, time-period and regime and method differ widely.

8. Conclusion

The purpose of this study has been to examine whether the exchange rate regime has any significant impact on economic growth for a sample of sixty countries between 1970-2016. More specifically, the study has attempted to find out if a fixed or a floating regime is more associated with economic growth for datasets consisting of a pooled country sample, an industrialized country sample and a non-industrialized country sample. A dummy variable based on the classification by Rogoff and Reinhard (2004) was created as the focus variable and this variable was complemented by various other variables that are believed to be associated to economic growth according to theory. The regressions were made using a panel data set, and after some relevant econometrical testing, it was concluded that the regressions should include fixed effects both over individual-specific effects and time-specific effects, along with White adjusted standard errors to account for the autocorrelation and heteroscedasticity.

To conclude the results from the regressions that were performed in this study, we find that industrialized countries perform worse under a fixed regime and that it was statistically significant for the regression consisting of all the variables. This was an unexpected result, but a potential reason could be due to an underperforming European Monetary Union. For the non-industrialized sample, a fixed regime had a significance impact for two of the regressions with fewer variables. This regime might be preferable when inflation is high, and institutions are weak as is common in this sample. The pooled sample was mostly a reflection of the non-industrialized sample, also with statistical significance for two of the regressions consisting of fewer variables, the close reflection could be due to an unbalanced share of industrializers and non-industrializers, with the non-industrializers being a significantly higher share.

Potential future research on this subject has many potential entries. First, the sample of countries could be expanded, as done in many other studies. Higher sample-size might present a different result. On the flip side, it could be interesting to specify the sample to more geographically centered areas, for example European countries. This would make it easier to perhaps make conclusions and policy-suggestions of the results since the countries share more common country-characteristics. The variables that are included in the analysis could always be changed. One specifically that can be useful is a dummy variable that accounts for various

crises that has occurred during the time-period. This would make the regressions more country-specific since global crises like the one 2007-08 affects most countries.

The classifications of exchange rate regimes are also something that can be varied and affect the results. One interesting way of examining this subject is with regime classifications that are more in line with the IMF definitions, consisting of eight different regimes. Another interesting area is to compare different de facto classifications that are common in research and see the differences between the classifications.

Instead of a dummy variable of a fixed and floating regimes that are more in line with the literature, a more specified analysis with more dummy variables consisting of more distinct categorizations. The problem this brings is that data-availability could be hard to access for all these regimes and classification complications might be a problem.
Lastly, future works may focus on the volatility of the exchange rate and its relationship to economic growth, rather than the regime itself (see Barguellil et al. 2018). This perspective could produce different results and complement this type of analysis to provide a greater understanding of this macroeconomic area.

9. References

Alesina, A & Wagner A.F. (2006). Choosing (and reneging on) Exchange Rate Regimes. *Journal of the European Economic Association*. 4(4): 770–799.

Andersson, H. Stone, M. & Veyrune, R. (2008). Exchange Rate Regimes. International Monetary Fund. *Finance and Development*. Volume 45. No (2).

Bailliu, Jeannine, Lafrance, R. & Perrault, J. (2003). Does exchange rate policy matter for growth? *International Finance.* 6: 381–414.

Barguellil, A., Ben-Salha, O., & Zmami, M. (2018). Exchange rate volatility and economic growth. *Journal of Economic Integration*. 33(2), 1302–1336

Barro, R.J, & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy*. vol. 100, no. 2, pp.223–251.

Bleaney, M & Manuela F. (2007). Exchange rate regimes, inflation, and growth in developing countries—An assessment. *The B.E Journal of Macroeconomics*. No (7).

Bubula, A & Ötker-Robe I. (2002). The Evolution of Exchange Rate Regimes since 1990: Evidence from De Facto Policies. *International Monetary Fund Working paper*. (02/155).

Burda, M & Wyplosz, C. (2017). *Macroeconomies: A European text,* 7th edition, Oxford University Press.

Calvo, G & Reinhart C. (2002). Fear of Floating. *Quarterly Journal of Economics*. 47(2): 379–408.

Dornbusch, R & Giovannini A. (1990) Monetary policy in the open economy. *Handbook of monetary economics*. Vol (2). Princeton University Press, Princeton, NJ.

Dougherty, C. (2016). *Introduction to econometrics*, Oxford ; New York, NY: Oxford University Press

Drury, A. C., Krieckhaus, J., & Lusztig, M. (2006). Corruption, Democracy, and Economic Growth, *International Political Science Review*, vol. 27, no. 2, pp. 121–136.

Edwards, S. (1993). Openness, trade liberalization, and growth in developing countries. *Journal of Economic Literature.* 31, 1358 – 1393.

Eichengreen, B & Razo-Garcia, R. (2012). HOW RELIABLE ARE DE FACTO EXCHANGE RATE REGIME CLASSIFICATIONS? *International Journal of Finance and Economics*. 18:216–239.

Frankel, J. A. (2003). Experience of and Lessons from Exchange Rate Regime in Emerging Economies. *National Bureau of Economic Research Working Paper Series*. No. 10032.

Gosh, R. A., Gulde, A, Ostry, D. J, Wolf, H. (1996). Does the Exchange Rate Regime Matter for Inflation and Growth? *Economic Issues*. No. 2, Washington, D.C., International Monetary Fund.

Husain, A. M., Ashoka M, and Kenneth S. R. (2005). Exchange rate regime durability and performance in developing versus advanced economies. *Journal of Monetary Economics.* 52: 35–64.

Ilzetzki, E., Reinhart C.M. & Rogoff K.S., (2009). Exchange Rate Arrangements Entering the 21st Century: Which Anchor Will Hold? *Mimeo*. University of Maryland and Harvard

University

International Monetary Fund. (n.d.). *The end of the Bretton Woods System (1972-81*). Retrieved January 9, 2022, from: About the IMF: History: The end of the Bretton Woods System (1972–81).

International Monetary Fund. (n.d.). *Cooperation and Reconstruction (1944-71)*. Retrieved January 9, 2022, from: About the IMF: History: Cooperation and reconstruction (1944–71).

International Monetary Fund. (2004). Classification of Exchange Rate Arrangements and Monetary Policy Frameworks. *IMF staff reports; Recent Economic Developments; and International Financial Statistics*. Retrieved January 4, 2022, from:: Classification of Exchange Rate Arrangements and Monetary Policy Frameworks -- as of June 30, 2004 (imf.org)

Jager, J & Hafner, A.K. (2013). The Optimum Currency Area Theory and the EMU. An Assessment in the Context of the Eurozone Crisis. *Intereconomics*. Volume 48: No 5.

Jakob, B. (2015). Impact of Exchange Rate Regimes on Economic Growth, *Undergraduate Economic Review*: Vol. 12: Iss. 1, Article 11.

Jochumzen, P. (2017a). Estimating a LRM with panel data: fixed effects model, NEKG31, YouTube - digital lecture, LUSEM Lund, May 11th, 2017.

Jochumzen, P. (2017b). When are the OLS estimators unbiased and consistent?, NEKG31, YouTube – digital lecture, LUSEM Lund, April 23rd, 2017.

Jochumzen, P. (2017c). Multicollinearity, NEKG31. YouTube – digital lecture, LUSEM Lund, April 9th, 2017.

Jones, C. I., & Vollrath, D. (2013). *Introduction to economic growth*, New York London: W. W. Norton & Company.

Juhn, G. Mauro, P. (2002). Long-Run Determinants of Exchange Rate Regimes: A Simple sensitivity Analysis. *IMF Working Paper*. 02/104.

Levy-Yeyati, E, & Sturzenegger, F. (2001). Exchange Rate Regimes and Economic Performance. *IMF Staff Papers*. No (47).

Levy-Yeyati, E & Federico, S. (2005). Classifying Exchange Rate Regimes: Deeds vs. Words, *European Economic Review*. 49 (2005), 1603–1635.

Levy-Yeyati, E, Sturzenegger, F. & Reggio, I. (2010). On the endogeneity of exchange rate regimes. *European Economic Review*. 54(5), 659–677.

Levy-Yeyati, E, & Federico S. (2003). To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth. *American Economic Review*. 93 (4): 1173–1193.

Lucas, R. E. (1988). On the mechanics of economic development, *Journal of Monetary Economics*. vol. 22, no.1, pp. 3–42.

Mundell, R. (1961). A theory of optimum currency areas. *American Economic Review*. vol. 51, November, pp. 509±17.

Offer, A. (2000). 'Economic Welfare Measurements and Human Well-Being'. *University of Oxford Discussion Papers in Economic and Social History*, no. 34

Reinhart C & Rogoff K. (2004). The Modern History of Exchange Rate Arrangements: A Reinterpretation. *Quarterly Journal of Economics.* 119(1): 1–48.

Rogoff, K. S., Husain, A.M., Mody, A, Brooks, R, & Oomes, N. (2003). Evolution and Performance of Exchange Rate Regimes. *IMF Working Paper*. Washington, DC: Raghuram Rajan.

Romer, P. M. (1986). Increasing Returns and Long-Run Growth. *Journal of Political Economy*. vol. 94, no. 5, pp. 1002–1037.

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

The Global Economy. (n.d). Download Economic Data. Retrieved December 30, 2021, from: Download data: GDP growth, inflation, and other indicators | TheGlobalEconomy.com

Umut, G. (2015). Impact of Human Capital on Economic Growth: A Panel Data Analysis. Retrieved January 18, 2022, from:: (PDF) IMPACT OF HUMAN CAPITAL ON ECONOMIC GROWTH: A PANEL DATA ANALYSIS | Gökhan Umut - Academia.edu

World Bank. (n.d). World Development Indicators. Retrieved December 30, 2021, from: World Development Indicators | DataBank (worldbank.org)

Yanikkaya, H. (2003). Trade openness and economic growth: a cross-country empirical investigation. *Journal of Development Economies*. 72 (1), 57-89.

10. Appendix

Table 1: List of all countries in the sample.

60-country sample		
Argentina	Gambia	**New Zealand**
Australia	**Germany**	Nicaragua
Austria	Ghana	Niger
Bangladesh	**Greece**	**Norway**
Brazil	Haiti	Philippines
Central African Republic	**Iceland**	**Portugal**
Cameroon	India	Senegal
Canada	Indonesia	**South Africa**
Chile	**Ireland**	South Korea
China	Israel	**Spain**
Colombia	**Italy**	Sri Lanka
Costa Rica	**Japan**	Sudan
Cyprus	Kenya	**Sweden**
Denmark	Malawi	Thailand
Dominican Republic	Malaysia	Togo
Ecuador	Malta	Turkey
Egypt	Mauritius	**United Kingdom**
El Salvador	Mexico	**United States**
Finland	Nepal	Uruguay
France	**Netherlands**	Venezuela

Note: Industrialized countries in bold. The notation for industrialized or non-industrialized countries are based on Levy-Yeyati and Sturzenegger's (2003) same notations in their research between non-industrialized and industrialized countries. The countries are based on the study by Bailliu et al. (2003), with the only exception being Germany included instead of Guatemala.

Table 2. Results from the Hausman test

Hausman test for fixed or random effects estimator	
Test with pooled sample H_0: Random effects are efficient and effective P-value: 0,000	Test with industrialized country sample H_0: Random effects are efficient and effective P-value: 0,000
Test with non-industrialized country sample H_0: Random effects are efficient and effective P-value: 0,000	

Table 3. Results from Heteroscedasticity-test

Heteroscedasticity test	
Test with pooled sample H_0: Residuals are homoscedastic P-value: 0,000	Test with industrialized country sample H_0: Residuals are homoscedastic P-value: 0,000
Test with non-industrialized country sample H_0: Residuals are homoscedastic P-value: 0,000	

Table 4. Results from the Redundant fixed effects test – likelihood ration

Redundant fixed effects test – likelihood ratio	
Test with pooled sample	Test with industrialized country sample
H_0: Only add one intercept in the model	H_0: Only add one intercept in the model
Cross section F: 0,000	Cross section F: 0,000
Period F: 0,000	Period F: 0,000
Cross section/Period F: 0,000	Cross section/Period F: 0,000
Test with non-industrialized country sample	
H_0: Only add one intercept in the model	
Cross section F: 0,000	
Period F: 0,000	
Cross section/Period F: 0,000	

Table 5. Durbin Watson test statistics

Durbin Watson test	
Test with pooled sample	Test with industrialized country sample
Durbin Watson d-statistic: 1,36	Durbin Watson d-statistic: 1,37
Test with industrialized country sample	
Durbin Watson d-statistic: 1,41	

Table 6. Multicollinearity matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CAPINV(1)	1,00									
CPI (2)	-0,10	1,00								
DCP (3)	0,11	-0,24	1,00							
GDPIN (4)	0,01	-0,20	0,63	1,00						
ERR (5)	0,04	-0,19	-0,13	-0,13	1,00					
GDPPCR (6)	0,41	-0,12	-0,04	-0,07	0,01	1,00				
GS (7)	-0,10	-0,18	0,41	0,64	0,01	-0,18	1,00			
OPEN (8)	0,11	-0,17	0,32	0,17	0,08	0,11	0,23	1,00		
POPG (9)	-0,14	0,11	-0,45	-0,57	0,08	-0,10	-0,37	-0,11	1,00	
SSE (10)	0,11	-0,17	0,62	0,76	-0,18	0,02	0,51	0,25	-0,74	1,00