The Effect of Energy Consumption on Economic Growth: Empirical Evidences from 13 Selected Emerging Economies 1997-2013

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ABSTRACT

Due to the essence of developing countries' economic structure, the role of energy consumption in their economies is crucial. Indeed, the aim of this study is to probe the association between economic growth, energy consumption, investment, inflation rate, trade openness, and government consumption.

In order to search the factors effecting economic growth, panel data approach methods have been employed; consequently, a sample data of thirteen developing countries, namely Argentina, Bolivia, Brazil, Chile, China, Hungary, Indonesia, Malaysia, Mexico, Poland, South Africa, South Korea, Taiwan, Thailand, and Turkey, is selected on an annual basis, from 1997 to 2013.

Fixed Effects Model and Random Effects Model are used as analytical methods to specify the models in which economic growth is a dependent variable while energy consumption, investment, inflation rate, trade openness, and government consumption are independent variables supposedly.

The results reveal that energy consumption and investment have significantly positive growth effect on the economy, while trade openness and government consumption have significantly negative effect on the economic growth of these thirteen emerging economies. Moreover, the nexus among inflation and economic growth is rejected.

Keywords: Economic growth, Energy consumption, Emerging economies

ÖZ

Gelişmekte olan ülkelerin ekonomik yapısının özü gereği, ekonomilerinde enerji tüketiminin rolü çok önemlidir. bu çalışmanın amacı, ekonomik büyüme, enerji tüketimi, yatırım, enflasyon oranı, ticaret açıklığı ve hükümet tüketimi arasındaki ilişkiyi araştırmaktır. Ekonomik büyümeyi etkileyen faktörleri araştırmak için panel veri yaklaşım yöntemleri kullanılmıştır; Dolayısıyla, Arjantin, Bolivya, Brezilya, Şili, Çin, Macaristan, Endonezya, Malezya, Meksika, Polonya, Güney Afrika, Güney Kore, Tayvan, Tayland ve Türkiye olmak üzere on üç gelişmekte olan ülkenin örnek verileri yıllık bazda seçilmektedir , 1997'den 2013'e kadar.

Enerji tüketimi, yatırım, enflasyon oranı, ticaret açıklığı ve hükümet tüketimi varsayımsal olarak bağımsız değişkenler iken, ekonomik büyümenin bağımlı değişken olduğu modelleri belirlemek için Sabit Efekt Modeli ve Rasgele Efekt Modeli analitik yöntemler olarak kullanılır.

gelişmekte olan bu 13 ekonominin ekonomik büyümesi. Ayrıca, enflasyon ve ekonomik büyüme arasındaki ilişki Sonuçlar, enerji tüketimi ve yatırımın ekonomi üzerinde belirgin bir büyüme etkisine sahip olduğunu ortaya koyarken, ticaret açıklığı ve hükümet tüketimi reddedildiğinde önemli ölçüde olumsuz etkiye sahiptir.

Anahtar Kelimeler: Ekonomik büyüme, Enerji tüketimi, Gelişmekte olan ekonomiler

DEDICATION

To my great family

Morteza Allahverdian, Ozra Shajari

Ali, Hamid, Sima

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First and always, I would thank my God to the infinite graces. Then, my mother to supported me with her self-devotion. Also, I want to declare my veridical respect to my best professor and my advisor Prof. Dr. Serhan Çiftçioğlu for the persistent patronage of my Master thesis, for fortitude, incentive, and infinite wisdom. His supervision and guidance aided me during my study and research for this thesis. I believe that without his advice and help, I could not finish my study. He has been a tremendous mentor for me.

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INTRODUCTION

1.1 What is an 'Emerging Market Economy'

Emerging markets, known as developing countries or emerging economies, are communities which concentrate their investments on more productive capacity. In fact, they are leaving their conventional economies which relied on exporting raw materials and agriculture. Leaders of these countries desire to create a better life style for their people. Accordingly, they industrialize rapidly and adopt a mixed economy or free market. Indeed, driving the growth in the economy throughout the world has made the emerging markets more important. Moreover, the financial system of these countries got more sophisticated in light of the 1997 currency crisis.

In general, there are five obvious characteristics in such economies. First, their per capita income is lower than the average. The World Bank definition of developing countries is those with income either low or lower than the middle level of $4,035 per person (See World Bank list). This low-level income fosters the second trait, a more rapid growth in these economies in comparison with advanced nations. Low income is the most important criteria since it provides an incentive to the second characteristic, rapid growth. The most developed countries, such as Germany, United States, Japan, and United Kingdom, experienced an economic growth rate of less than 3 percent in 2015 while the growth rate in Turkey, United Arab Emirates, and Egypt was about 4 percent in the same year. Moreover, India and China generated a

growth rate of around 7 percent in their economies. High volatility is the third characteristic which is caused by rapid social change. Emerging markets are more sensitive to volatile currencies like dollar, as well as commodities like food or oil. Moreover, less mature capital market compared to developed countries and higher return than average for investors are the other characteristics of these economies.

Energy, as one of the main factors of production, plays a crucial role for both emerging or developing countries and developed countries. The 1970s' oil crisis and the rise in oil price in the 1990s and 2000s ascertained the importance of an energy-dependent economy. Consequently, a bulk of researches have been conducted on the interrelation between energy and economic growth. Constantly increasing production has risen the demand for energy, but the paucity of natural gas and oil resources throughout the world impede the sustainable economic growth.

Electricity is a secondary energy resource which is obtained from the primary energy resources like fossil fuels (coal, natural gas, and oil) and wind energy. Unlike the role of oil in electricity production which has been declining due to the sharp rise of oil price since the late 1970s, the share of natural gas and nuclear power has been increasing in electricity generation in recent years. Also, coal has been turning to be the mostly used fuel in electricity production (IEA, 2013).

World sets a new record by generating about 20.2 trillion kilowatt-hours net electricity energy in 2010, and forecasted to increase the production by nearly 93% and reach a record of 39.0 trillion kilowatt-hours in 2040. Besides, this increasing rate in the OECD countries is slower than non-OECD countries (U.S. Energy Information Administration, 2013).

Developing countries have revealed significant growth in their economies, and it is extremely useful to find the relationship between economic growth and its determinants, especially energy consumption. There are several gauges for measuring the energy consumption. Scholars took various proxies to measure the energy consumption. Having said that, the electricity consumption as a proxy of energy consumption along with other variables, like investment, trade openness, and government expenditure, has been taken to see its effect on GDP growth of the selected emerging economies in this study.

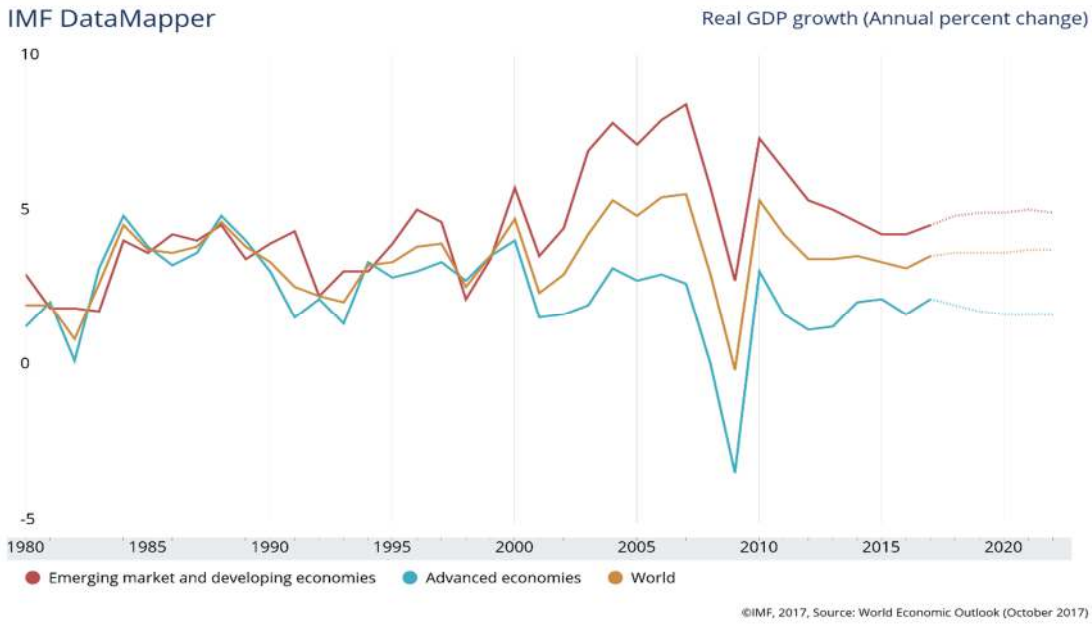

Figure 1: Real GDP Growth (Annual Percent Change)(IMF, 2017)

1.2 Research Gap

According to the 2017 annual report of International Monetary Fund (IMF), the GDP growth rate of 4.6% of the emerging economies, as the second biggest growth rate after ASEAN countries, has been recorded, which is more than advanced countries with the growth rate of nearly 2.2 %. However, the link between the economic growth and energy consumption of emerging market economies has been rarely

investigated in the literature. Hence, this study will be an important research for countries with emerging economies.

1.3 Research Question

In order to determine the elements which may impact the GDP growth rate, two essential questions will arise. These main questions which are pursued in this study are as follows:

i) What are the components which influence GDP in emerging market economies?

ii) How do these elements impact on GDP?

1.4 Research Objective

The aim of this thesis is to research empirically about the determinants of GDP growth in emerging market economies. In fact, it tries to explore any relationship between electricity consumption, as a target factor, and economic growth. Furthermore, the connection between other factors, like inflation, investment, trade openness and government expenditure, with GDP growth has been investigated.

1.5 Significance of the Study

This thesis is among the pioneers in the literature as it investigates the efficacy of energy consumption and other determinants of GDP in emerging economies. The provision of important implication is expected for future researches. Accordingly, the policy makers can employ the results of this study to make more accurate decision for their economic environment.

1.6 Scope of the Study

The annual data of 1997 to 2013 corresponding to thirteen developing countries have been extracted from DataStream, in which countries have been selected based on availability of their data. The countries under study are: Argentina, Bolivia, Brazil, Chile, China, Hungary, Indonesia, Malaysia, Mexico, Poland, South Africa, South

Korea, Taiwan, Thailand, and Turkey. Finally, there are 222 observations in the framework of panel data.

1.7 Limitation of the Study

The most important restriction of this study is the lack of a long-run solution for the relationship among the variables. This shortage is due to the use of differenced variables with respect to the stationarity problem at their level. Additionally, another limitation is that this study employed electricity consumption as the proxy of energy consumption. Probably, future studies should focus on different types of energy with regard to renewability or concentrate on the ability of countries in electricity production. Time horizon, as another limitation of this study, disabled the author to run a time series regression corresponding to each country in order to compare the relationships between the variables among cross-sections.

1.8 Structure of Study

This study includes five chapters. In the first chapter, the author gives an overview of the emerging economies and the trend of electricity consumption in recent years. The second chapter aims to investigate the essence of the relationship among the current variables in the literature, in which variables have been divided into five sub-divisions. In addition, his chapter presents the related literatures about the variables and economic growth. The third chapter discloses the methodology of the thesis including data collection, specifications, and all the statistical methods employed. The results and their interpretations are presented in the fourth chapter. Finally, the author concludes in the fifth chapter.

Chapter 2

LITERATURE REVIEW

2.1 Economic Growth and Energy Consumption

There is a great number of publications investigating the link between economic growth and energy consumption with different approaches and case studies. The results are different, which can be attributed to different structures and policies applied by countries and states. However, different methods lead to inconsistent results of papers. Granger's and Sim's tests, which have been mostly used worldwide, played a crucial role in investigating a part of articles' methodology and underwent major criticism, as both tests have been affected by time series. Furthermore, most studies till the early 1990s assumed that time series are stationary; In fact, that was a source for spurious result. A pioneering research about this topic has been done by Kraft and Kraft (1978) who found a unidirectional causality from Gross National Product (GNP), as a proxy of economic growth, to energy consumption in USA from 1947 to 1974. According to this research, the United States was able to implement energy conservation policies without affecting the economic growth. However, Akarca and Lang (1980) did not find any significant causal relationship between two variables via using a shorter horizon, showing the time horizon as another potential source of the results conflictions. Posteriorly, advances in multivariate co-integration approaches, like the Johansen-Juselius's maximum likelihood approach in 1990 and 1992, allowed testing to clarify the presence of all long-run nexuses that Engle-Granger might had failed to uncover. Johansen proposed another method for co-

integration to reshape the obstacles in Engel-Granger methods. There is a great number of publications on this topic. Yu and Hwang (1984) utilized the data from 1947 to 1979 and they failed to find any causal relationship between GNP and energy consumption. Investigations have become more extensive recently, where different types of countries and classes have yielded mixed and inconsistent results. Yu and Choi (1985) carried out causality test proposed by Granger (1969) for a number of different countries in a period of time between 1954 and 1976. They realized that the causality is running from GDP to energy consumption in Korea, while this direction is opposite in Philippines while they lost to find any causality between these variables in the USA, the UK, and Poland. Erol and Yu (1987) and Abdulkadir, Rafindadi, Ozturk (2015) found that energy consumption Granger causes the economic growth in Japan based on the data from 1950 to 1982, and 1970 to 2012 respectively. The former authors used electricity consumption as a proxy of economic growth. The same approach was applied by Hawng and Gum (1992), as well as Yang (2000) to the data of Taiwan from 1955 to 1993 and from 1954 to 1997 respectively. The results indicated a bi-directional Granger causality between the variables. In contrast to these authors, Cheng and Lai (1997) suggested that by employing Hsiao's (1981) Granger causality test, there is a unidirectional causality running from GDP to energy consumption in Taiwan. Meanwhile, they used the data from 1995 to 1993. Similarly, a causal relationship between energy consumption to GDP was found by Cheng (1997) and Wold-Rufael (2004) using data from 1963 to 1993 in Brazil as well as the data from 1952 to 1999 in Shanghai. Lee (2006) searched for the existence of the cause-effect linkage between economic growth and energy consumption of 11 developed countries between 1960 and 2001. He derived mixed consequences in his investigation. To examine the causal relation among the

energy consumption and economic growth, Chiou-Wei et al., (2008) engaged in both non-linear and linear Ganger causality of the USA, South Korea, and Thailand between 1954 and 2006. Unidirectional causality from economic growth to energy consumption was found on the data of Singapore and Philippines, whereas energy consumption Granger caused economic growth in Hong Kong, Taiwan, Indonesia, and Malaysia. Causality test between GDP and energy performed by Chontanawat et al., (2008) on 78 non-OECD countries and 30 OECD countries implies that it is more rampant to see the causality running from energy to GDP in developed OECD countries rather than in developing non-OECD countries. Mehrara (2006) ran the causality test on the data of 11 oil importing countries between 1971 and 2002, and found a unidirectional linkage from economic growth to energy consumption. Soytas and Sari (2007), and Chien-Lee and Chun-Chang (2007) could not find any causality between the variables in Turkey between 1960 and 2000 and in 16 Asian countries between 1971 and 2002 respectively. However, latter authors found a unidirectional causality from energy consumption to economic growth in the case of 16 Asian countries by applying the panel data analysis. Odhiambo (2008) found a unidirectional causality from total energy consumption and electricity consumption to GDP in Tanzania. A Granger causality test using Vector Error Correction Model (VECM) by Akinlo (2008) in 11 Sub-Sahara African countries revealed a bi-directional relation between energy consumption and GDP in Ghana, Gambia, and Senegal. However, this test shows that energy consumption is Granger caused by economic growth in Zimbabwe and Sudan. The neutrality is confirmed in Cote d'Ivoire, Cameroon, Nigeria, Kenya, and Togo. Apergis, Payne (2008) by applying the data from the period between 1980 and 2004 for six countries in Central America found a unidirectional linkage from Energy to Economic growth. Wolde-Rufael

(2008) came up with neutral hypothesis for 15 out of 17 African countries in this case. A bi-directional relationship among these variables was exposed by Ouédraogo and Tsani (2009) for Burkina Faso between 1968 and 2003, and they found a unidirectional causal relationship from total consumption of energy to real GDP by utilizing the data between 1960 and 2006. In addition, the empirical evidence denotes a causal relationship in the form of bi-directional nexus from residential and industrial energy consumption to real GDP at disaggregated levels, but no causality was identified between the energy consumption of transport part and real GDP in both directions. There are also many publications with different approaches conducted in China. Some of most recent investigations are as follows: Zhang, Cheng (2009) applied the data from 1960 to 2007 and found unidirectional relationship from energy to economic growth. Chang (2010) found unidirectional nexus from coal consumption to GDP by using data between 1980 and 2006, and they also found no causality between electricity and economic growth. Wang et al., (2011) elicited bi-directional linkage for variables in a study on 28 provinces of China from 1995 to 2007. On the other hand, Shahbaz, Khan, and Tahir (2013) found unidirectional nexus by using the data from 1971 to 2011 in China as a whole. Wang et al., (2015) also found bi-directional causality among the variables between 1990 and 2012. Bloch, Rafiq and Salim (2014) tested oil, coal, and renewable energy as three types of energy, and discovered a bi-directional nexus between all types of energy economic growth in China based on the data for the period between 1977 and 2013. Wang et al., (2016) also published an article about provinces of China, and disclosed bi-directional connection among the variables. Furthermore, it is also worthwhile to point out the research which has been done by Ozturk, Aslan and Kalyoncu (2010) who used the data of 51 countries between 1971 and 2005. They

came up with a fact that economic growth would cause the energy consumption in low income country group, while there is a bilateral relationship in lower middle-income country group and upper middle-income group. In addition, Pao and Tsai (2010) derived a bilateral causal nexus in BRIC countries during 1971 and 2005. Warr and Ayres (2010) exhibited a unilateral linkage between variables running from exergy to GDP both in short run and long run by redefining energy as exergy, which is the available amount of energy for useful work, in the case of the USA by applying the data between 1946 and 2000. Acaravci and Ozturk (2010) ran the test for the data from 1975 to 2005 in different countries and found mixed results. In fact, they found a unidirectional nexus from economic growth to energy in Denmark, Greece, and Italy as well as neutral link in Iceland and Portugal. Besides, they found a bi-directional relationship in Switzerland. The latter case is also true for Brazil, in which an investigation was carried out by Pao and Tsai (2011) on the data from 1980 to 2007. Belke, Dobnik, and Dreger (2011) found a bilateral linkage in 19 OECD countries by analyzing directional panel data from 1981 to 2007. Moreover, Haggar (2011) elicited unilateral nexus from economic growth to energy consumption between 1990 and 2007. Fuinhas and Marques (2011) did a test on the data from 1965 to 2009 of countries, like Portugal, Italy, Greece, Spain, and Turkey, in which they found a bi-directional long-run and short-run relationship. Surprisingly, Tugcu, Ozturk and Aslan (2012) came up with the same result for G7 countries for the data during 1980-2009. On the other hand, an investigation among Economic West African States (ACOWAS) showed mixed results in a research which has been done by Ouedraogo (2012) on the data during 1980-2008. The research revealed that the nexus is unidirectional from energy and electricity to economic growth both in short run and long run. Omri's result (2013) of the data from 1990 to 2011 revealed that

there is bilateral nexus among the variables in 14 MENA countries. Unlike the reviewed studies, Shahbaz et al., (2013) used seasonal data of Indonesia from 1975Q1 to 2011Q4, and failed to find any causal linkage in short run. A long run unidirectional relationship exists from energy to GDP in long run which has been discovered by Alshehry and Belloumi (2014) by running the test in the data of Saudi Arabia during 1970-2010. Karanfil and Li (2014) used data of 160 countries between 1980 and 2010 in their extensive study and found inconsistent results. In fact, they discovered a bi-directional relationship in OECD and high-level income countries and a unidirectional nexus in East Asia Pacific, Middle East, and North African countries. Moreover, the neutral hypothesis was not rejected in North America case. Kasman and Duman (2014) showed a unidirectional connection from GDP to energy in new EU members and candidates. They ran the analysis for the data during 1992-2010. Magazzino (2014) applied the data which has been extracted from Italy during 1970-2006 and found unilateral connection from GDP to energy consumption. Jebli, Youssef, and Ozturk (2015) used FMOLS and DOLS methodology in OECD countries, and elicited bi-directional dependency. Iyke (2015) engaged the data of Nigeria from 1971 to 2011 to the case of electricity consumption as a proxy of energy and found one-sided connection from electricity to GDP in both long-term and short term. Bhattacharya et al., (2015) revealed a One-way dependency from GDP to renewable energy by running the analysis for the data of 38 top countries consuming renewable energy from 1991 to 2012. However, the reverse relation is true in the Pakistan's data from 1972 to 2012, as it is investigated by Komal and Abbas (2015). Moreover, Azam et al., (2015) exposed a one-way nexus from energy to economic growth in long run for all 5-selected ASEAN countries by using the data during 1980-2012. Although conversely, Salahuddin, Gow, and Ozturk (2015) found

the reverse result by exploiting data during 1980-2012 and exerting the test on Gulf Cooperation Council (GCC) countries. Natural gas consumption, as another proxy of energy consumption, was used by Ozturk and Al-Mulali (2015) to show the relationship between the energy consumption and economic growth in GCC countries during 1980-2012; and, bi-directional linkage was found between natural gas consumption and GDP. Ozturk et al., (2015) found one-way connection from energy to economic growth in another research on this topic based on the data of Vietnam during 1971-2011. Saidi, Toumi, and Zaidi (2015) disclosed that economic growth has a statistically significant positive effect on electricity consumption in four global panels of 67 countries during 1990-2012. Simultaneously, Kais and Ben Mubarak (2015) employed the data of Algeria, Egypt and Tunisia, as three selected North African countries, during1980-2012, and revealed the short run unidirectional linkage from GDP to energy consumption. They also found a bilateral nexus between the variables in long run. Based on the data of India during 1971-2011, Nain, Ahmad, and Kamaiah (2015) elicited unilateral nexus from energy to GDP. Finally, Aslan (2016) recently utilized the data of the USA during 1961-2011, and found one-sided nexus from biomass energy to economic growth.

2.2 Investment

An investment is an item or asset which is bought due to the desire to appreciate or to generate profit in the future. From the economic view, investment is the action of purchasing some goods which are not consumed today, but they would be utilized in the future to generate wealth instead. Economic growth can be enhanced through the use of investments at any level of economy. When a company acquires or constructs a new piece of equipment to raise the total number of outputs within the facility, the increased production can be conducive to improving the nation's Gross National

Product (GDP). It also helps the economy flourish via increased production, on the basis of previous equipment investment.

Researchers have done many investigations to find empirical evidences about this relationship in various cases and time horizons, using different kinds of investments. A part of the related literature will be mentioned in this part. De Long & Summers (1991) found that investment on machinery and equipment has a strong correlation with growth, using the Penn World Table and the United Nations Comparison Project between 1960 and 1985. Blomstrom, Lipsey, and Zejan (1993) showed that a rise in the rate of fixed capital formation would cause a rapid growth in per capita GDP via using the simple causality by working on 100 countries. Nazmi and Ramirez (1997) used another type of investment. They took public investment expenditure as a proxy and showed a positive and significant effect on output growth. Equally, Gyimah-Brempong and Traynor (1999) found the same result. They denoted that capital as a factor of production has a positive effect on GDP. Banister and Berechman (2001) argued that investment conditions can address additional economic development in the presence of economic and institutional conditions. Colecchia (2002) denoted that investment in information and communication technology (ICT) contributes between 0.2 and 0.5 annual percentage points to economic growth by employing the data from the 1980s and 1990s in such countries, like the United States, the United Kingdom, Japan, Italy, Germany, France, Finland, Canada, and Australia. Choe (2003) discovered that FDI Granger-causes economic growth and vice versa by using FDI as a proxy of investment in 80 countries during 1971-1995. By looking deeper to results, we will see that the impact of growth on FDI is more apparent than the effect of FDI on growth. Additionally, Gross Domestic

Investment (GDI) as another type of investment does not have any causal effect on economic growth, while economic growth robustly Granger-causes GDI. The data from the Sub-Saharan African countries showed a positive and significant effect of DI (Domestic Investment) on economic growth. The similar results are also shown in the study by Adams (2009) on the data during 1990-2003. Podrecca & Carmeci (2010) found a bi-directional causality between economic growth and fixed investment for the period of 1960-1990 in 104 countries. Didier and Reed (2014) found a positive impact of Agriculture R&D investment on economic growth by using annual data of 57 developing countries during 1981-2010. Kolmakov, Polyakova, and Shalaev (2015) showed that there is a significant effect of Venture Capital Investment (VCI) on GDP in Russia and US at a 4-6 lag in a yearly basis during 1998-2011. Ibrahim and Okunade (2015) denoted that the data of the years between 1980 and 2013 of Nigeria conveys a significantly strong influence of domestic and foreign investment on economic growth both in short run and long run. Eren and Zhuang (2015) employed the data from 1999 to 2010 for 12 new EU members and analyzed them. They used different types of FDI and investment to show the relationship between the investment and economic growth. They also demonstrated that different types of FDI have differential effects on economic growth in these 12 new members of EU. The results imply that Greenfield investment mergers and acquisitions (M&As) do not have significant effects on their economic growth. Additionally, Greenfield investment has positive effect on economic growth. Domestic investment is disclosed to be a consistent contributor to GDP growth rate as well. Nasreen, Anwar, and Waqar (2015) showed that both human and physical capital investment have a positive effect on economic growth via using the data of 94 countries during 1985-2009. A sample data during 2001-

2013 of West Africa was used by Darma and Ali (2016), in which they demonstrated that a bi-directional granger-causality exists between GDP and telecommunication investment. They also showed that a unidirectional causality exists from investment to GDP, while there is no causal relationship among GDP and FDI. Hong (2016) extracted a bi-directional nexus among investment on ICT R&D and GDP during 1988-2013 in South Korea.

2.3 Inflation

For many years, the connection between inflation and economic growth has been one of the most broadly researched topics in economics. Inflation is explained as the rise of the level of prices. Based on the literature, this variable usually has a nonlinear impact on economic growth. For instance, Lopez-Villavicencio and Mignon (2011) showed this nonlinearity nexus. They also approved the existing of a threshold and its effect on economic growth in the data for 44 countries during 1961-2007. Besides, Kremer, Bick, and Nautz (2012) used the data of 124 countries during 1950-2004. They discovered the inflation rate targets around 2% for industrialized countries set by most of central banks. In addition, they estimated that the inflation rates of more than 17% dealt with lower rate of growth in economy in non-industrialized countries. However, lower than this threshold, the relationship remains insignificant. Barro (2013), reflected the causal relationship from inflation to economic growth by using the data of 100 countries during 1960-1990. Hasanov (2011) showed that estimated threshold model denotes a non-linear nexus between inflation and the rate of economic growth in Azerbaijan which presented a threshold about 13% below which growth rate of economy has a positive relationship with inflation rate. Malik and Dhankar (2017) denoted that there is a short-run causality among economic growth and inflation rate by using the data of India during 1996-2014. Dammak and Helali

(2017) found a non-linear nexus by a threshold of about 3.48% of inflation for the nexus between economic growth and inflation rate in Tunisia for a monthly frequency data from 1993-01 to 2012-11. In fact, they showed that the relationship is positive below this threshold, while the nexus is significantly negative above this index. In an investigation in the crisis after and before 2008 in six European countries (Austria, France, Germany, Greece, Hungary, and United Kingdom), Bibi Rouksar-Dussoyea et al., (2007) specifically revealed that in four out of six countries the relationship is notable, where growth in CPI is a significant predictor of GDP in the period of 1999Q1-2007Q4. While inflation rate has a negative effect on GDP growth between 2008Q1-2016Q4 and 1999Q1-2016Q4. Fu-ShengHung (2017) showed that the model finds a threshold level for inflation below which the inflation-growth relationship may be negative or positive for initial inflation, but it is definitely negative for inflation rate over that threshold.

2.4 Trade Openness

The nexus between economic growth and trade openness has received a great amount of attention both in the empirical and theoretical literature for the last three decades. In spite of everything, no consensus exists on whether the economic growth is stimulated by a greater openness to trade. A bulk of publications has been written to answer the important question of the impact of trade openness on economic growth. In fact, the linkage between these variables is blurred due to different factors (see Nannicini and Billmeier, 2011). Studies such as Ozturk and Acaravci (2013) showed no causality in Turkey between 1960 and 2007. Menyah, Nazlioglu, and Wolde-Rufael (2013) found no relationship, when they analyzed the data of 21 African countries between 1965 and 2008. By changing the frequency of the data from yearly to quarterly, 1975Q1-2011Q4, Arouri et al., (2013) denoted that economic growth

effects on both import and export in Bangladesh. Mounir and Belloumi (2014) used the data of Tunisia from 1970 to 2008, and their study did not show any causality between trade openness and economic growth in short run. Nasreen and Anwar (2014) employed the data from 1980 to 2011 of 15 Asian countries, and found a unidirectional nexus from trade openness to GDP growth in long run as well as a bi-directional connection in short run. Moreover, Solarin and Shahbaz (2015) investigated the data from 1971 to 2012 of Malaysia to find any connection between these variables, and they came up with the fact that trade openness has a positive impact on economic growth. Omri et al., (2015) utilized the data from 1990 to 2011 of 12 MENA countries and demonstrated a bi-directional connection among growth in economy and trade openness. Musila and Yiheyis (2015) discovered that the change in trade openness impacts on long-run rate of GDP growth in Kenya. In a research on the data of new EU member and candidate countries during 1992-2010, Kasman and Duman (2015) showed that a unidirectional nexus exists from economic growth to trade openness. Sakyi, Commodore, and Opoku (2015) utilized the data of the years 1970-2011 of Ghana. They have disclosed that the interaction of foreign exports and direct investment is critical in fostering the growth. Dritsakis and Stamatiou (2016) found a one-way nexus from trade openness to growth in economy in thirteen newest European Union members during 1995-2013, both in long run and short run. Likewise, Ali Polat et al., (2015) found the same result in South Africa on the data between 1970 and 2011. By using the data from 5 ASEAN countries during the years between 1980 and 2014, Vogiatzoglou, Nhung, and Nguyen (2016) found a long run relationship among economic openness and GDP. Additionally, Gimhani and Francis (2016) showed the same result in Sri Lanka. Iyke1 (2017) employed the data from Central and Eastern European countries, and they elicited that trade

openness plays an important role in the economic growth. Iyke et al., (2016) used a panel data set of eight West African Economic and Monetary Union (WAEMU) countries over the years from 1992 to 2009. They found a unilateral nexus from financial opening to GDP growth through trade openness. Another study on ASEAN countries during 1961-2012 by Pradhan et al., (2017) divulged a bi-directional nexus in short run and as well as a one-way connection from trade openness to GDP in long-term. In contrast, Sorge and Neumann (2017) failed to find any causality in the data of 70 WTO countries during 1971-2013. Iyke (2017) found that trade openness is important for growth in the CEE Countries by exerting the analysis on the data of 17 Central and Eastern European (CEE) countries from 1994 to 2014. Their results showed that the rise in trade openness is dealt with the growth in real GDP per capita.

2.5 Government Expenditure

Government expenditure means the purchase of goods and services which consists of public consumption, public investment, and transfer payments including income and capital transfers (pensions and social benefits). Government Expenditure and its connection with economic growth have attracted a vast interest in the literature where many authors utilized different methods to target numerous countries.

Devarajan, Swaroop, and Zou (1996) used the data of 43 developing countries during 1970-90, and found that a rise in the current expenditure has significantly positive effects on the growth, while the relationship between per-capita income and the capital component of public expenditure is negative. Sinha (1998) failed to find any causal relationship between government expenditure and growth of GDP in Malaysia for the data of 1950-1992. Fan, Hazell, and Thorat (2000) revealed that other

investments, like health, soil and water conservation, rural and community development, and irrigation, excluding the education, which has the third largest marginal effect on productivity growth, have a slight influence on the growth in India. Kolluri, Panik and Wahab (2000) utilized the data during 1960-1993 of G7 industrialized countries, and unveil the effects of national income growth on government expenditure both in the long-run and short-run. Loizides and Vamyouskas (2004) used government size to show this nexus in Greece, Ireland, and UK. As the first point, they denoted a unidirectional relationship from government size to economic growth in UK and Ireland. Secondly, they revealed a unilateral causal nexus from economic growth to relative size of the government in Greece. They also found the same result in the UK in the presence of inflation. Bose, Haque, and Osborn (2007) found that the portion of government capital expenditure in Gross Domestic Product (GDP) is positively correlated with growth in the economy by employing data of the 1970s and 1980s from 30 developing countries, while the current expenditure impact is insignificant. A massive set of data from 1950 to 2004 of 182 countries has been used by Wu, Tang, and Lin (2010) to show a bi-directional nexus between economic growth and government expenditure. Dogan and Tang (2011) exerted the causality test on 5 Asian countries, as Indonesia, Malaysia, Philippines, Singapore, and Thailand; and, they only found a One-way nexus from government expenditure to economic growth in Philippines. Hamdi and Sbia (2013) revealed that there is no causal relationship from government expenditure to GDP growth in Kingdom of Bahrain during 1960-2010. Chude and Patricia (2013) used data of Nigeria between 1977 and 2012, thereby indicated a statistically significant and positive impact of total expenditure education on economic growth. Tijani and Oluwasola (2015) showed a positive significant effect of the government expenditure

in agriculture on economic growth in Nigeria from 1970 to 2006. Okur and Soylu (2015) found a two-way nexus between government expenditure and economic growth in Turkey via analyzing the data from 1980 to 2013. Alejandro and Rivero (2016) analyzed the data of Bolivia during 1993-2012, and found a simultaneous effect of government expenditure on the growth of economy in an opposite direction. Chau, Khin, and Meng (2016) elicited data from 1970 to 2014 of Malaysia, and denoted that the development expenditure is unlikely to have any significant effect on GDP. Lingxiao, Peculea, and Xu (2016) found a unidirectional nexus from government expenditure to GDP growth by using the data from 1991 to 2014 of Romania. Tatahi, Cetin, and Cetin (2016) used the data of 60 countries from 1976 to 2010, thereby showing the acceptance of a short-term dynamic and long-term elasticity relationship between government expenditures and GDP growth rates for high group countries. However, this relation is valid only in long-run for middle group countries, as opposed to the short-term. In addition, they failed to find any causal relationship in low middle countries both in long run and short run. Gemmellt, Kneller, and Sanz (2016) used the data of OECD countries in the 1970s, in which they disclosed the evidences of the positive impression of reallocating total spending towards education and infrastructure on long-term output levels. Moreover, reallocating spending in social welfare may be related to the slight negative impacts on output in the long term. The same case study was used by Wahab (2017) on the data of 1950-2000, in which they discovered that the government expenditure rises less proportional to the hastening economic growth and shrinks more corresponding to the decelerating economic growth. Alexiou and Nellis (2017) showed a positive effect of government expenditure on economic growth with the data of 1960-2014 in Greece. Hussain, Khan, and Rafiq (2017) study denoted the growth effect of public

development expenditure on economy, whereas current expenditure decreases economic growth in Pakistan using data from 19973-2014. Another simultaneous research by Saez, Alvarez-Garcia, and Rodriguez (2017) showed that there is no nexus among these variables in EU countries where they employed the data from 1994 to 2012. Paul and Furahisha (2017) used the data during 1978-2014 of Tanzania, and thereby found promotion in economic growth by development expenditure and recurrent expenditure from foreign sources in the outputs.

Chapter 3

METHODOLOGY

3.1 Data Collection

The data of this sample is collected from Thomson Reuters Data stream which provides over 10 million economic time series of 162 markets with comparable data. 13 countries which are classified as emerging economies or developing countries during 1997-2013 have been selected in this case. Moreover, the period is chosen based on the availability of the data corresponding to the selected countries. Finally, the sample includes 221 country-year observations.

3.2 Variables

The first difference level of natural logarithm of variables have been used in in this study, which shows the growth percentage in every unit of them. Furthermore, Gross Domestic Products (GDP) has been taken as the proxy of economy size which plays the role of response variable in its aforementioned modified form. Additionally, electricity power consumption (kwh per capita), as a proxy of energy consumption, gross capital formation (% of GDP) as a proxy of investment, consumer prices (annual %) as a proxy of inflation, export plus import as a proxy of trade openness, and the final consumption expenditure (% of GDP) are the regressors.

Table1 denotes an abbreviation of the variables and their final forms which are used in the model specification. The letter L shows the natural logarithm and D implies the first derivative of the variable.

Table 1: Summary of the Variables

Variable Name	Proxy	Abbreviation	Final Variable
economic growth	Gross Domestic Products (GDP)	GDP	DLGDP
energy consumption	electricity power consumption (kwh per capita)	ENG	DLENG
investment	gross capital formation (% of GDP)	INV	DLINV
inflation	consumer prices (annual %)	INF	DLINF
trade openness	export plus import	TO	DLTO
government consumption	final consumption expenditure (% of GDP)	GCON	DLGCON

3.3 Model Specification

This study discloses the effects of five different variables on economic growth in the 13 selected emerging economies. In fact, the DLGDP is the explained variables and other five explanatory variables are DLENG, DLINV, DLINF, DLTO, and DLGCON. Accordingly, the model specification will be as follow:

$$\text{DLGDP}_{it} = \beta_0 + \beta_1 \text{DLENG}_{it} + \beta_2 \text{DLINV}_{it} + \beta_3 \text{DLINF}_{it} + \beta_4 \text{DLTO}_{it} + \beta_5 \text{DLGCON}_{it} + \varepsilon_{it}$$

In which i changes from 1 to 13 is the number of each cross-section, and t is the years from the period 1997-2013.

3.4 Data Analysis

3.4.1Poolability Test

This test is used to test if the data are poolable or not. Subsequently, if the data are poolable, the OLS analysis can be exerted.

3.4.2 Fixed Effects Mode

Fixed effects model is used as a methodology in this study. After testing the stationarity of data and finding those which are stationary at their level and those which are stationary at their first difference level, the growth rate of the variables is determined by using the first difference of logarithm of the data for all of variables. To do so, Fixed Effects Model is used to fit to the data at the first step; then, the Random Effect is utilized by using the Housman test. In fact, fixed effects model is based on a specific impact of every cross section on the dependent variable separately. Assume that this equation is a panel data model as:

$$y_{it} = \alpha + \beta x_{it} + u_{it} \quad (*)$$

Where y_{it} is the dependent variable, α is the intercept term, β is a k×1 vector of parameters to be estimated on the explanatory variables, and x_{it} is a 1× k vector of observations on the explanatory variables such that $t = 1. \cdots . T; i = 1. \cdots . N$. In order to show how the fixed effects model is exerted, the error term of above equation, u_{it}, is relaxed as a specific effect of each entity (i.e. μ_i) and the reminder error term, v_{it} that changes both over time and individually. In fact, it captures all the features unexplained about y_{it}. Hence, by substituting $u_{it} = \mu_i + v_{it}$ in the equation $(*)$, the equation $y_{it} = \alpha + \beta x_{it} + \mu_i + v_{it}$ will be derived. Now, for every country there is a fixed effect, μ_i, in the equation which dose not change over time. The Least Squares

Dummy Variable (LSDV) is a general equation for this model which can be shown as follow:

$$y_{it} = \beta x_{it} + \mu_1 D1_i + \mu_2 D2_i + \cdots + \mu_N DN_i + v_{it}$$

Where $D1$ takes 1 for all observations pertinent to the first cross section as a dummy variable and D_2 for those germane to the second cross-section. Subsequently, other Ds have the same manner as discussed. Now, the coefficients and their significance level would be estimated via using OLS.

3.4.3 Random Effects Model

Alternatively, there is another model which resembles the fixed effects model, and it proposes different intercepts for different entities which are constant over time. However, the intercept for each cross section is assumed to be elicited from a common intercept α which is the mean of all the individual intercepts through all entities in random effects. Plus, there is a variable ϵ_i which is constant over time but changes over entities and measures the random deviation from the common intercept α for every cross-section. Accordingly, the random effect panel model is:

$$y_{it} = \alpha + \beta x_{it} + \omega_{it}. \quad \omega_{it} = \epsilon_i + v_{it}$$

Where xi is the vector with the size k×1, and the heterogeneous effect of countries is shown in ϵ_i. Besides, v_{it} are the error terms. In this method, Generalized Least Squares (GLS) is used, since the estimators from OLS are inefficient. Afterward, via using the modified variables and using

$$y_{it}^* = y_{it} - \theta \bar{y}_i$$

$$x_{it}^* = x_{it} - \theta \bar{x}_i$$

$$\theta = 1 - \frac{\sigma_v}{\sqrt{T\sigma_\epsilon^2 + \sigma_v^2}}$$

the cross-correlation in the error terms is solved. This method discloses the coefficients and the significance level of them.

3.4.4 Hausman Test

Hausman test, as another method used in this thesis, shows Random Effects Model's quality of being suitable. The null hypothesis in this test is such that there is no difference between fixed and random effects estimators. In fact, the statistic has a $\chi 2$ distribution asymptotically. Rejecting the null hypothesis denotes that the random effects are correlated with some regressors and in this situation fixed effects model outperforms the random effect model. Otherwise, the Random Effects model is more suitable than the Fixed Effects model.

Chapter 4

EMPIRICAL RESALTS

4.1 Descriptive Analysis

Descriptive statistics expose a general view of the data, as it is depicted in following table via E-views platform.

Table 2: Descriptive Statistics

	DLGDP	DLENG	DLINV
J Mean	0.068450	0.032138	-0.003928
Median	0.089051	0.031158	0.008026
Maximum	0.404326	0.191225	0.671364
Minimum	-0.829752	-0.083220	-0.638301
Std. Dev.	0.141830	0.040416	0.133430
Skewness	-1.791372	0.499716	-0.701866
Kurtosis	11.20316	4.973736	10.02628
Sum	13.34783	6.266823	-0.765881
Observations	195	195	195

Table 3: Descriptive Statistics Table 2 (continued)

	DLINF	DLTO	DLGCON
Mean	-0.041708	0.016676	0.007580
Median	0.021787	0.020318	0.007878
Maximum	3.002850	0.550046	0.168792
Minimum	-4.824879	-0.408540	-0.184077
Std. Dev.	0.801102	0.095262	0.047647
Skewness	-1.178052	0.176712	0.306762
Kurtosis	11.04842	9.525158	5.043764
Sum	-8.133048	3.251846	1.478171
Observations	195	195	195

According to the table, the investment and inflation rate is negative in their mean of all of the countries' observations, while other variables' mean are positive.

4.2 Poolability Test

In order to see if there is any possibility to use pooled data and run the OLS analysis, we used poolability test.

Table 4: Poolability Result

F-statistic	Df_1	Df_2	p-value
2.9862	48	143	2.773e-07

The results, Table 3, showed that the null hypothesis of poolability of data is rejected at 1% confidence level since, p-value (=0.0000002) < 0.05. In fact, this result shows that we are not allowed to pool the data and run OLS on them. This test has been run on R-package software.

4.3 Fixed Effects Model

The table 4 shows the results of fix effect models from the dependent variable, DLGDP and independent variables, like DLENG, DLINV, DLINF, DLTO, and DLGCON. Furthermore, all variables except DLINF are significantly notable. In fact, DLINF doesn't reject the null hypothesis of $\beta = 0$.

Table 5: Fixed Effects Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0. 059930	0. 010703	5. 599518	0.0000***
DLENG	0. 887640	0. 228160	3. 890421	0.0001***
DLINV	0. 501000	0. 057459	8. 719303	0.0000***
DLINF	0. 005552	0. 010040	0. 552992	0. 5810
DLTO	-0. 773462	0. 093715	--8. 253308	0.0000***
DLGCON	-0. 647515	0. 184641	-3. 506889	0.0006***
Adjusted R^2	0.4999	Durbin-Watson	1.910770	
Prob(F-Statistic)	0.0000	Sum squared resid	1.780545	

Note: ***Significant at 1%, **Significant at 5%, *Significant at 10%.

Based on the output in the preceding table, the effects of energy consumption (DLENG) and investment (DLINV) are positive, while the impact of other significant variables, like trade openness (DLTO) and government consumption (DLGCON), are negative. Based on this analysis, the change in the rate of economic growth is about 0.89% by energy consumption in terms of every 1 percent rise in the independent variables. Equally, this rate is 0.5% by investment, -0.77% by trade openness, and -0.65% by government consumption. Meanwhile, the p-value of 0.0000 for overall test in the total model denotes that it is generally significant. In this test the White diagonal approach has been used as justification approach for the standard deviations.

4.4 Random Effects Model

The first panel of Table 5 shows the relationship between the variables, in which the DLGDP is dependent variable. The same is true for the essence of the nexus among the variables in the Random effect view. Except the inflation (DLINF) all other variables have significant impacts on economic growth.

Table 6: Random Effects Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0. 061972	0. 010544	5. 877449	0.0000***
DLENG	0. 827900	0. 189604	4. 366481	0.0000***
DLINV	0. 503094	0. 056684	8. 875427	0.0000***
DLINF	0. 004275	0. 009871	0. 433068	0. 6655
DLTO	-0. 764880	0. 091923	--8. 320908	0.0000***
DLGCON	-0. 660596	0. 180050	-3. 668959	0.0003***

Note: ***Significant at 1%, **Significant at 5%, *Significant at 10%.

Indeed, this method demonstrates a 0.82% increase for every 1% increase in the rate of energy consumption, while the rate increase rate is about 0.50% in terms of every 1% increase in the investment (DLINV). Unlikely, trade openness and government consumption have negative influence on the rate of economic growth which are about -0.76% and -0.66% respectively in terms of 1% rise in these variables.

4.5 Redundant Test

Redundant test, as presented in Table 6, targets the hypothesis to clarify whether the fixed effects of cross sections are equal to zero or not. In fact, the p-value of 0.6621 and 0.6026 for both F-statistic and chi-square statistics don't reject the null hypothesis of equality of the country-fixed-effects to zero respectively. So, based on this test, countries contributing in this study do not have their own specific effect on the relationship among these variables.

Table 7: Redundant Test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	0.788283	(12,177)	0.6621
Cross-section Chi-square	10.152432	12	0.6026

4.6 Hausman Test

To choose the best model between the Fixed Effects model and the Random Effects model, the Hausman test has been employed. The result is presented in table 7. Indeed, the null hypothesis in this test is such that the Random Effects model is the best one, due to the fact that it is not rejected at the 5% confidence level based on the p-value of nearly 0.9906 > 0.05. Therefore, the Hausman test denotes the validity of random effects model, because the country-specific effects (μ_i) are insignificantly correlated with the regressors in most cases.

Table 8: Hausman Test

Test Summary	Chi-Sq. Statistic	d.f.	Prob.
Cross-section random	0.540183	5	0.9906

4.7 Final Result

At the final step, The Hausman test revealed that the Random effects model has more propriety in this data. According to Table 8, the final specification based on random effect model and with regards to removing the insignificant variable, DLINF, is as below:

$$DLGDP_{it} = 1.02DLENG_{it} + 0.47DLINV_{it} - 0.88DLTO_{it} - 0.61DLGCON_{it} + \varepsilon_{it}$$

Table 9: Random Effects Model

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0. 052043	0. 010568	4. 924623	0.0000***
DLENG	1. 021381	0. 191692	5. 328228	0.0000***
DLINV	0. 468311	0. 060430	7. 749601	0.0000***
DLINF	0.005552	0.010040	0.552992	0.5810
DLTO	-0. 881199	0. 086355	--10. 20433	0.0000***
DLGCON	-0. 614336	0. 189566	-3. 240753	0.0014***

Note: ***Significant at 1%, **Significant at 5%, *Significant at 10%.

Therefore, in terms of every 1% rise in the independent variables, DLENG, DLINV, DLTO, and DLGCON, the increasing rate of economic growth is nearly 1.02%, 0.47%, –0.88, and –0.61% respectively.

In this specification, the energy consumption has a significant positive influence on the economic growth which validates some publications, like Zhang & Cheng (2009) and Shahbaz et al., (2013) on China, Apergis and Payne (2008) in Central America, Iyke (2015) in Nigeria, Odhiambo (2008) in Tanzania, Bhattacharya et al., (2015) in 38 top renewable energy consuming countries, Lee and Chang (2007) in 16 Asian countries in long run, Alshehry and Belloumi (2014) in Saudi Arabia in long run, Tang et al., (2015) in Vietnam, Aslan (2016) in the US, Nain, et al., (2015) in India, Ouédraogo (2009) in Burkina Faso, Belke et al., (2011) in 19 OECD countries, Tugcu et al., (2012) in G7 countries, Omri (2013) in 14 MENA countries, Pao and Tsai (2010) in BRIC countries, Wang et al., (2011) in 28 provinces of China, Pao and Tsai (2011) in Brazil within a bi-directional form of relationship. It is worthwhile to note that, Iyke (2015) in Nigeria found a nexus from electricity to economic growth both in long and in short run. Nain, et al., (2015) also found a unidirectional relationship from the proxies of energy consumptions to the economic growth in India. Economic speaking, the energy growth will affect the economic growth through the productivity channel. In fact, with the assumption of constant capital and labor, increasing the energy consumption will increase the productivity thereby increasing the production. The results also show a positive significant effect of investment on the economic growth which goes hand in hand with all the literatures in this study, apart from their proxies, case studies and the essence of their relationship.

Moreover, the effect of trade openness is significantly negative on the economic growth. This can be due to increasing the inefficiency of economy through the misallocation the resources such that the governments devote them to subsidize the exports. It means that the governments are devoting the tax revenues which is gathering from all people to exporters and provide a protect just for them, so, the economy faces inefficiency and as a result, more trade openness has negative effect on the economic growth. This finding is consistent with researches in different time periods, like Iyke (2017) in 17 Central and Eastern European (CEE) countries, Vogiatzoglou and Nguyen (2016) in 5 ASEAN countries, Omri et al., (2015) in 12 MENA countries, Musila et al., (2015) in Kenya, Nasreen and Anwar (2014) in 15 Asian countries, Solarin and Shahbaz (2014) in Malaysia, Pradhan et al., (2017) in ASEAN countries, Dritsakis and Stamatiou (2016) in thirteen newest European Union members, Polat et al., (2014) in South Africa, Gimhani and Francis (2016) in Sri Lanka, and Sakyi et al., (2015) in Ghana. The types of relationship whether they have negative or positive impact on the economic growth is also notable.

The government spending denotes a significant effect on economic growth. It is also consistent with the results in publications, like Wu et al., (2010) in 180 countries (bi-directional), Rivero (2016) in Bolivia, Tatahi et al., (2016) in 60 countries, Alejandro & Rivero (2016) in Bolivia that demonstrated a significant but negative impact of the government expenditure on economic growth.

Chapter 5

CONCLUSION

The aim of this thesis is to probe the factors which influence economic growth in 13 selected emerging economies throughout the world. Based on the annual report, the IMF disclosed that the economic growth of emerging economies has been the second largest after ASEAN countries (IMF, 2017). This topic has not been considered in the second largest growth economy group so far. However, managing the economic growth and its determinants, specifically the energy consumption, is fundamentally important in every country. Therefore, this thesis is an interesting area for research.

13 countries of emerging economies have been chosen to specify the factors which affect the economic growth during 1997 - 2013. Furthermore, Gross Domestic Product (GDP) has been taken as the dependent variable, and ENG, INV, INF, TO, and GCON are the independent variables. Thus, different regression models, such as random effects model, and fixed effects model, are exerted to achieve the goal of the thesis. Additionally, redundant test and Hausman tests have been employed to determine the most proper model among the Fixed Effects model and the Random Effects model, and the corresponding results specified that the random effects model outperforms fixed effects model. The growth impact of the INF is not significant based on this study, and its efficacy is ambiguous. In contrast, other explanatory variables have significant effects on economic growth.

According to the empirical results, the relationship between energy consumption and economic growth is significantly positive. It is applicable for policymakers, such that the energy conservation attributes to a downside trend in economic growth, due to the fact that this nexus is almost one to one; that is, in terms of every 1 percentage rise in the rate of energy consumption, the increased amount of rate of economic growth is about 1%. On the other hand, they will be able to raise the rate of economic growth by increasing the energy consumption in these countries. Likewise, investment as shown by gross capital formation, shows a significantly positive impact on economic growth which is a dependent variable. Accordingly, policymakers can augment the rate of economic growth by increasing the gross capital formation by less than 1% in terms of every 1% increase in this variable.

Moreover, the other two explanatory variables, government consumption and trade openness, denotes a significantly negative growth effect on economy. It shows that more restrictive policies in the amount of import and export will help the countries to enhance the rate of economic growth. In addition to trade openness, the government consumption should decrease in order for economic growth to accelerate. In other words, the policymakers may engage in contractionary fiscal policy by constricting the government expenditure to hasten the rate of economy.

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