Energy Consumption, FDI, Government Effectiveness, and Economic Growth

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Abstract:

The availability of energy is essential in initiating and sustaining economic growth. FDI has also been positively linked to economic growth although some argue that economic growth promotes FDI. Studies examining the government effectiveness of nations have suggested FDI is more effective and energy resources are used more effectively when a country has solid governance. While studies have examined these aforementioned macroeconomic issues, there is no empirical study that examines all these variants within the same model. This paper investigates these factors and their effect on economic growth throughout 50 nations for the year of 2005. Economic growth is calculated in terms of GDP growth per capita as an annual percentage. The factors examined in this study include energy consumption, foreign direct investment, and government effectiveness. The OLS model used contains multiple proxies for energy consumption including fuel exports, fossil fuel energy consumption, electric power consumption in terms of kilo watt hours per capita, and electricity production in terms of kilo ton of oil equivalent. FDI is measured as percentage of GDP. To account for variances in governmental quality this paper uses government effectiveness as gauged by the Heritage Foundation and Wall Street Journal's annual index of economic freedom report. The results show a country's initial GDP per capita, FDI inflows as relative to GDP, electricity production in terms of an oil equivalent, and fossil fuel energy consumpion, significantly impact their percent growth of GDP per capita.

JEL Classification: O13, F21, O43, G18

Key Words: GDP, Energy, FDI, Corruption

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1.0 Introduction:

Energy consumption, FDI, and the effectiveness of government within a nation have all been studied and positively correlated to the rate of economic growth. While each of these respective factors of economic growth have been positively linked to the growth rate of GDP no studies have attempted to quantify which factor has the most significant effect on growth. FDI and energy consumption have been incorporated into many neoclassical and endogenous growth models that include factors such as capital and labor. This study incorporates FDI, government effectiveness, and energy consumption within a singular economic growth model which does not include labor or capital as variables but instead uses the GDP of the previous year, 2004 in this case, to account for the varying sizes of economies within the study.

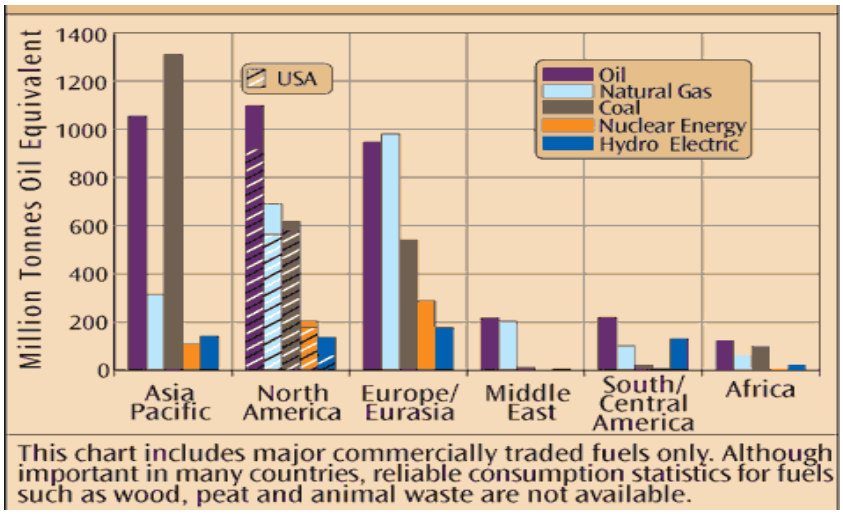
Energy use and its link to GDP has been an issue studied by energy economists intensely since the oil crisis of the 1970s. Current real world issues such as global warming and the subsequent climate change has placed the spotlight on energy consumption economics as well as energy policy. The availability of energy is a necessity to allow for economic growth. Therefore attempts to reduce emissions and decrease the consumption of energy have been an issue tended to by policy makers and studied by environmental economists heavily in recent times. Some economists however, support the 'neutrality hypothesis' which claims energy is neutral to economic growth because the "cost of energy is a very small portion of GDP and, thus, it is not likely to have a significant impact on output growth." (Ghali & El-Sakka, 2004)

Unlike this paper which incorporates factors of energy consumption into an OLS regression model, many studies have implemented Granger causality tests when studying the energy consumptions relationship to economic growth. The results of these causality tests have been various and contradictory. Some studies found causality from energy use to GDP, others found causality from GDP to energy use, and some found bidirectional causality between energy use and GDP. Fewer and farther between some studies have found no causality between the pair. Similarly to Stern and Cleveland (2004), Ghali and El Sakka (2004) attributes the contradictory findings of previous studies to failing to account for "time series properties of the variables involved and, thus, many of them have produced spurious results." (Ghali & El-Sakka, 2004) This paper does not test for causality but instead attempts to quantify the relationship between factors of energy consumption and economic growth.

Numerous empirical studies have concluded that energy used per unit of output has declined primarily due to shifts in energy sources being used. This shift has is exemplified by decreased use of low quality fossil fuels such as coal to contrary increased use of higher quality, more efficient forms of energy, primarily electricity. Within this study electricity production and electric power consumption are both used with the expectation that both should have a positive impact on GDP growth per capita. While the previously discussed empirical findings conclude energy internsity is decreasing, some argue that when accounting for the formerly noted shift in energy used, the decline in energy use per unit of economic output has not changed as drastically as some indications infer. Stern and Cleveland, (2004) in a review of previous literature on energy and its relationship to economic growth, contest "…time series analysis shows that energy and GDP cointegrate and energy use Granger causes GDP when additional variables such as energy prices or other production inputs are included. When theory and empirical results are taken into account the prospects for further reduction in the energy intensity if economic activity seem limited." (Stern & Cleveland, 2004)

More developed countries typically use more high quality energy while developing countries typically use lower quality, less efficient sources of energy such as coal which tends to emit higher levels of pollution. Also, some nations simply do not have the energy resources of other nations and must import energy products. Chontanawat *et al.* (2008), conducting causality tests, found that OECD member countries which are typically developed economies exhibit energy to GDP causality more so than non-OECD developing countries. Also, this suggests that conservation policies aimed at deterring climate change would be more disadvantageous to developed OECD countries than to developing non-OECD nations. The data set in this study contains 16 OECD member countries and 34 non-OECD countries.

Figure 1: World Energy Use by Fuel



Source: BP Statistical Review of World Energy 2004, www.bp.com

Due to the facts formerly presented, this paper uses variables that take into account varying levels of energy efficiency and endowment. To measure energy consumption this paper uses a variety of proxies that account for the varying energy sources and inputs used by respective nations. The proxies used to measure energy use in this OLS regression are as follows; fuel exports as a percentage of merchandise exports, fossil fuel energy consumption as a percentage of total energy use, electric power consumption in terms of kilo Watt hours per capita, and electricity production as an equivalent of kilo tons of oil.

Foreign direct investment (FDI) is also an issue that has been studied widely by economists as flows of FDI has increased substantially in recent decades. Nations have sought to liberalize policy in order to attract FDI in hopes of accelerating economic growth in a similar fashion to Ireland during the 1990s. As previously mentioned, the bases of most empirical studies pertaining to FDI's effect on growth are derived from neoclassical and endogenous growth models. (Neto, *et al.* 2008) According to the neoclassical growth theory the only root of sustained economic growth is technological change. Higher levels of FDI lead to faster technological diffusion from developed to developing nations. It also provides additional capital for countries with lower than ideal savings rate to invest in domestic needs such as education, infrastructure, and capital.

While, in theory, one would assume that higher levels of FDI would lead to higher economic growth, empirical evidence is not conclusive. Some studies such as Johnson (2006)

have found that FDI is better at spurring growth in developing nations than it is in developed countries where it usually has minimum implications towards growth. The empirical data finding the impact of FDI inflows as detrimental to GDP growth often point to internal issues of human capital, availability of skilled labor, and government ineffectiveness as the cause of lack luster results. (Wijeweera, Villano, and Dollery, 2008) Also, FDI inflows to the primary market as opposed to the secondary market often yield less than stellar results when referring to the impact on GDP. Simply put, while FDI should help spur economic growth, internal inefficiencies in recipient countries frequently produce to opposite effect. FDI is used as an independent variable in this study as a substitute for a typical input of neoclassical growth models such as labor and capital.

Of these aforementioned internal inefficiencies government effectiveness is perhaps the most useful internal condition of a country in predicting the level of success of FDI. As previously mentioned, FDI is more effective at increasing GDP in developing nations. However, in Africa where the majority of countries are developing economies, it is estimated that the continent as whole loses 25% of its GDP to corruption. This high level of corruption, a clear sign of ineffective governance, highlights why many African nations have had trouble growing and, in turn, how effective government is essential in prompting growth. However, majority of studies examining the effect of corruption on FDI have yielded results indicating an insignificant negative association. (Podobnik, *et al.* 2008) However, it is belived that this study will show a positive correlation between FDI inflows and economic growth.

Government effectiveness has been the center of many studies examining why nations with abundant natural resources and substantial FDI inflows often do not grow as quickly countries that are less endowed with resources and receive less FDI. As Sachs and Warner (1995, 1997, 2001) posit, nations with a greater abundance of resources typically have struggles with economic development. However Sachs and Warner do not account for the quality of institutions or effectiveness of government in these resource endowed nations. A slew of studies since that time such as Mehlum, *et al.* (2006) argue that resource rich nations can use their abundant supply to accelerate economic growth effectively if the institutions of the nation are formidable. Solid governance and strong institutions are a necessity in initiating and sustaining steady economic growth.

While many have studied the effects of energy use, foreign direct investment, and government effectiveness on GDP growth, no empirical paper has incorporated all three factors within the same growth model. This paper, by using an OLS regression model, seeks to explain the impacts of energy consumption, FDI, and institutional quality on economic growth through a mix of 50 countries including 16 OECD member countries and 34 non-OECD member countries.

2.0 Literature Review:

Previous literature on energy consumption and its relation to GDP has produced varied arguments amongst economists. Some economists contend that there is strong causality between energy consumption and economic growth rates of individual nations. Energy is a necessity if economic growth is to be achieved. However one argument posited by economists suggests that this reliance on energy for continued economic growth could be interpreted as a "limiting factor of economic growth." Whether or not there is causality between energy consumption and GDP is important in deciding energy policies whereas, if there is causality, energy conservation could lead to losses in income and employment, while a lack of causality would ecourage policy promoting energy conservation.(Chontannwat, *et al.* 2008)

Stern and Cleveland (2004) examine, in depth, previous literature and empirical testing on pertinent biophysical theory, mainstream and resource growth models, critiques of mainstream models, and a variety of mechanisms that could potentially weaken the link between energy and growth. They argue throughout the report that energy consumption and output are positively correlated as energy availability is crucial in permitting growth. Also, they contend that significant decreases in energy intensity were the result of a shift toward higher quality, more efficient fuels. Stern and Cleveland also conceive further large scale reductions of energy intensity are limited due to their finding that technological change is subject to the same thermodynamic constraints as substitution. When exploring pollution emissions, Stern and Cleveland find that they tend to rise along with the income. While they believe we can harness the world's supply of solar power they do concede that environmental impacts resulting from growth will still occur.

Ghali and El-Sakka (2003) in a study of Canada, examined energy use and output growth using a VEC model after testing for multivariate cointegration between output, capital, labor, and energy use based on the neo-classical one sector aggregate production technology. Their results

show that the neo-classical assumption that energy is neutral to growth to be false. In summation, Ghali and El-Sakka conclude that energy is a limiting factor to output growth in Canada and, consequently, energy supply shocks will have a negative effect on GDP.

Zhang and Cheng (2009), in a multivariate model that incorporated gross fixed capital formation and urban population, applied the TY procedure and generalized impulse response to examine linkages between carbon emission, enerngy consumption, and GDP in China from 1960-2007. Viewing the results of their Granger causality test Zhang and Cheng argue that China, in the long run, can effectively maintain GDP growth while implementing energy conservation policies. While China's energy intensity has decreased it still remains much higher than the global average. Zhang and Cheng argue that China should further improve upon this issue by addopting technological solutions to reduce the high level of emissions caused by the 70% share of coal as the country's primary energy source.

Mallick (2007) delves into a case study specific to India where he examines the linkage between various forms of energy consumption growth and economic growth. He also studied the effects of energy growth components on private consumption and private investment growth rates. Using the Granger causality test Mallick found that the growth rate of GDP leads to higher demands for natural gas and electricity and increased levels of total energy consumption. Only coal energy consumption was directly related to GDP growth. He also found that energy growth components have no impact on private consumption and investment growth rates. However, when applying variance decomposition analysis, Mallick found a possible two-way causality between electricity energy consumption growth and economic growth. There was also the possibility of a similar unidirectional influence from economic growth to natural gas consumption growth as well as from coal consumption growth to economic growth coinciding with the Granger causality test. Mallick's study produces inconclusive results as to the causality between economic growth and energy consumption.

The link between FDI and economic growth has also been studied extensively by economists with empirical findings yielding inconclusive results. Wijeweera *et al.* (2008) studied the effect of FDI on economic growth throughout 45 countries from 1997 to 2004. They argue that FDI inflows do positively impact economic output when the recipient nation holds a substantial supply of highly skilled labor but FDI inflows alone do not constitute economic growth. Also, they find that a country cannot increase efficiency by means of technological

absorption associated with FDI without the supply of skilled labor. Essentially, a nation cannot absorb the advanced technology that coincides with FDI inflows unless there is enough human capital to operate it. Additionally, corruption was found to negatively impact economic growth while openness to trade positively impacted growth by way of efficiency gains. In summation Wijeweera *et al.* argue that poor nations can increase economic growth by limiting corruption, improving education, and strongly encouraging FDI.

The study of Morasco (2008) sought to contribute to the study of FDI on growth by accounting for the addition of an "economic integration" variable. His results suggest that when economic integration is added as a variable the positive link between FDI and growth is exonerated. These findings lead Morasco to suggest that the recent attempts by countries of all income levels to entice FDI inflows in order to improve economic growth is ungrounded. He proposes that countries may be better off integrating their economy with the global market. The means by which countries integrate their economies, whether through FDI, free trade agreements, regional trade agreements, customs unions, or monetary unions, is irrelevant.

Neto *et al.* (2008) study the effects of FDI but, more specifically, concentrate on cross border mergers and acquisitions and Greenfield investments on economic growth in 53 countries from 1996-2006 using panel data. Their empirical findings show a positive and significant impact of FDI on economic growth. When a Granger causality test was applied bidirectional causality between mergers and acquisitions and growth were found. In conclusion, Neto *et al.* (2008) found Greenfield investments more beneficial to the host country's growth than mergers and acquisitions.

Johnson (2006) argues that FDI inflows should help spur economic growth through technological diffusion and physical capital gains. Using cross section and panel data for 90 countries, Johnson finds that FDI inflows have a positive effect on growth in developed nations however this is not the case for developed nations. Johnson attributes this to the fact that developed economies have comparable levels of domestic investment; domestic investment was shown to increase growth rates in developed and developing economies alike. This study however, assumes that FDI inflows to economic growth is the direction of causality. While economic growth and FDI inflows are potentially mutually supporting, Johnson points out that "for the case of most of the developing economies, even sustained economic growth is unlikely to result in market-seeking FDI due to the low income levels." (Johnson, 2006)

Many economists have also contributed empirical data and literary studies on the effects of government and economic institutions on economic growth. Boschini *et al.* (2007) contend that while certain natural resources are more likely to produce problems such as rent-seeking and conflict, solid institutional quality can counter these negative side effects of resource abundances. This study finds that formidable institutions can reverse the effects of the natural resource curse first presented by Sachs and Warner (1995) and turn resource abundance into an asset instead. "The negative effects of poor institutional quality are much more severe in countries rich in potentially more problematic types of resources, as compared to those rich in other natural resources." (Boschini, *et al.* 2007)

Podobnik *et al.* (2008) examine the effect changes in the Corruption Perception Index has on the economic growth rate of a country. Within their study Podobnik *et al.* found that a one unit increase in CPI leads to an increase in annual GDP per capita of 1.7% when accounting for all countries in the world from 1999 through 2004. When looking specifically at European transition economies a one unit increase in CPI corresponded with an average increase of 2.4% in GDP per capita. The study also examines the effect of changes in CPI on the level of foreign investments in a country. Their observations indicated that less corrupt countries have received higher U.S. investments per capita on average.

Mauro (2004) also examines the persistence of corruption within a country and its effect on economic growth. Mauro attempts to explain the close correlation between corruption and slow economic growth and between corruption and political instability notized by previous emperical studies using two models relying on strategic complimentarities in order to obtain multiple equilibria. This paper finds that striving, complete reforms are more effective in reducing corruption than gradual reformation. The paper also strengthens the argument for outside intervention and pressure on corrupt governments as it concludes governments may be unable to escape from the persisting corrupt nature of ruling as set standard in the country.

Sattar (1993) analyzes the effect government control on economic growth in Asia. Sattar examines Asian LDCs (least developed countries) and NICs (newly industrialized countries) as LDCs typically opt for planned development with large public sectors giving government much more control than in NICs which are more liberalized and market oriented. The study finds a signifcant relationship between government and growth in LDCs but not in NICs or other world

leading economies. While government control may have led to inefficiencies in LDCs it did not hinder growth.

Huynh and Jacho-Chávez (2009) also conducted an analysis on government and its relationship to growth using a nonparametric analysis. The study used six different measures of governance and found only three, voice and accountability, political stability, and rule of law to be significantly correlated to economic growth. Regulatory control, control of corruption, and government effectiveness were found to be insignificant. Growth profile curves are used to visually illustrate the results of the nonparametric analysis. The empirical results of the study are complementary to previous studies of growth factors in illustrating that specific, targeted reforms to enhance the quality of governance may be more effective than widespread reform in promoting economic growth.

3.0 Trends of International Energy Consumption, FDI, and Government Effectiveness:

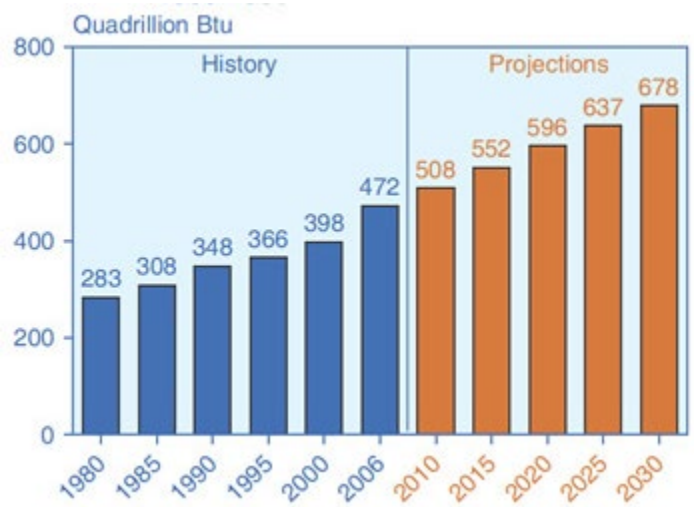
OECD nations are the largest consumers of energy in the world and also tend to have more sophisticated energy infrastructures. However as non-OECD nations increase their demand for energy at a much faster rate than OECD member countries; for emerging non-OECD countries, demand is expected to increase at 2.3% annually, while OECD members are predicted to see an increase in demand of 0.6% on an annual basis. This trend can be exemplified by China and India who, as the two most populated and rapidly growing non-OECD nations, will be significant world energy consumers in the future. In 1990 China and India together accounted for 10% of the world's energy consumption but by 2006 they combined to account for 19% of global energy consumption.

In 1971 the OECD countries accounted for 64% of world energy demand and the developing countries for 15%, the balance being attributable to the countries of the Communist bloc. By 1991, the latest year for which data are available, the balance of demand had shifted to 53% and 27% respectively.

Energy consumption will play a significant role economic growth in the coming decades. The International Energy Outlook 2009 study by the U.S. Energy Information Administration estimates that total world consumption of marketed energy will increase by 44% from 2006 to 2030. Despite predictions for increases in consumption, energy consumption has scaled backed slightly in light of the recent economic down turns. Depleted demand for goods and services by

consumers and the manufacturing sector have forced the EIA to revise the total world energy use down by 2% in the IEO2009 from the original IEO2008 estimate.

Figure 2: **World Marketed Energy Consumption 1980 - 2030**



Source: **History:** Energy Information Administration, *International Energy Annual 2006* (June- December 2008), web site www.eia.gov/iea

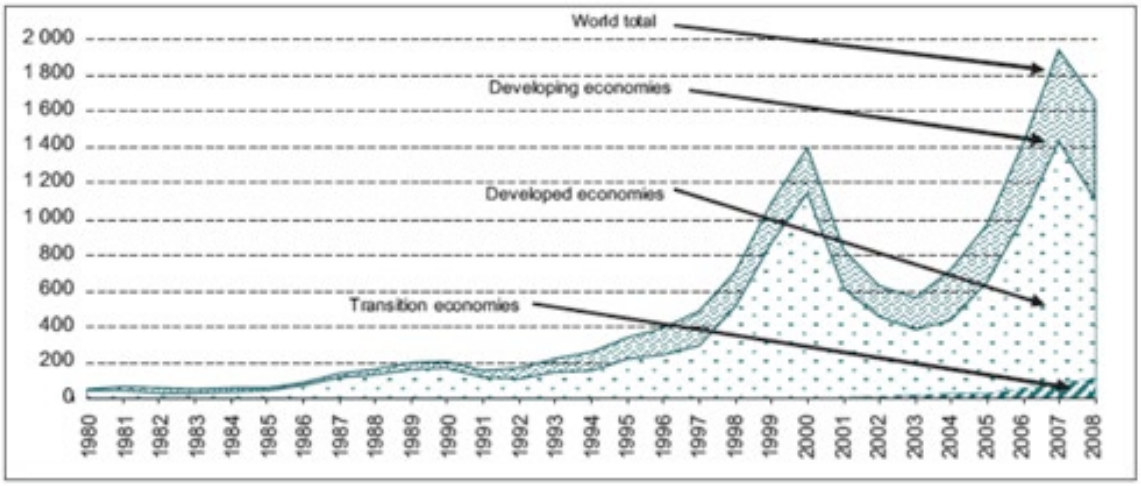
Projections: EIA, World Energy Projections Plus (2009)

Over the past few decades increased globalization and assimilation of international capital markets has lead to substantial increases in FDI flows. In the 1990s FDI flows grew vastly, increasing on average 13% annually from 1990 to 1997. From 1998 to 2000 recorded FDI inflows increased 50% per year reaching $1.5 trillion in 2000 thanks in large part to cross border mergers and acquisitions. However FDI inflows did decrease significantly in 2001 dropping to $729 billion.

The stretch of time from 2001-2004 saw decreases in the amount of FDI flows every year. FDI increased substantially in 2005 rising by 29% to $916 billion from its 2004 total. Much of this increase was due to international mergers and acquisitions. Developing countries saw their FDI inflows jump by 22% to a record $334 billion while developed nations saw their FDI flows rise 37% to $542 billion. Despite record inflows to developing countries their share of FDI slightly decreased to 36% of the world's share due to greater gains of inflows by developed

countries; essentially the gap in FDI inflows between developed and developing countries increased in 2005.

Figure 3: Global FDI inflows by region



Source: UNCTAD, *Assessing the Impact of the Current Financial and Economic Crisis on Global FDI Flows* (Geneva: UNCTAD, 2009), p. 6.

Higher prices of supplies and resources have influenced led to FDI inflows into developing countries rich in natural resources and energy supplies. Developing country TNCs have adjusted flows of FDI in order to obtain supplies of natural resources and gain substantial revenue from products. Western Asia and China saw the highest enlargement in FDI outflows amongst developing countries. Western Asia also saw the highest gains in inflows as FDI rose 85% from its 2004 total to $34 billion. Africa saw the second highest percentage gains in FDI inflows as the region received an increase of 78%.

When examining trends in government effectiveness one must look at actions taken by NGOs such as the IMF and World Bank. At the dawn of the 21st century the IMF and World Bank came under heavy scrutiny for allowing the rampant continuation of corruption. Specifically criticizers were curious as to how the IMF lost tens of millions of dollars to Russia, and why the World Bank continued extending loans to poorly governed nations. In response former Prime Minister Tony Blair with the help of others, organized the Millennium Campaign which has set forth to end poverty in developing countries. For nations to meet the standard of MDGs the presence of corruption must be insignificant. As Kara Alaimo (2008) states “it is now more urgent than ever for poor countries to mobilize domestic resources to fight poverty and

allocate it towards the MDGs and meeting the needs of their poorest citizens. This is the only sustainable long-term option for financing development. This can be achieved through a combination of widening tax bases, more effective tax collection, improving the efficiency of government systems of service provision, and fighting corruption."

4.0 Empirical Analysis

4.1Data

This study uses data collected from two different sources. GovtEff measures the effectiveness of governance within a country. GovtEff is measured by the Heritage Foundation and Wall Street Journal in their annual Index of Economic Freedom report. Data for the variables GDPPC, GDPPC4, FDI, FuelExp, FFEC, EPC (KWHPC), and EP(KTOE) are gathered from the World Development Indicators database published by the World Bank. While the WDI report covers more recent years only for 2005 was a substantial enough set of data available.

4.2 Empirical Model

The regression model used in this study is derived from a basic production function presented by Stern and Cleveland (2004) and the 100 nation study of Chontanawat *et al.* (2008). Stern and Cleveland present the following model:

$$(Q_I,\ldots,Q_M)' = f(A,X_I,\ldots,X_N, E_I,\ldots,E_P)$$

Where Q_i are the various outputs, X_i are the various inputs, and E_i are the different energy inputs. In this study the Q_i, or output is GDP growth per capita as a percentage increase for year 2005. The various inputs in this empirical analysis, instead of labor and capital as in most neoclassical growth models, are FDI inflows as well as government effectiveness and openness. E_i, or energy inputs, are the remaining independent variables shown in Equation 1 pertaining to energy use.

Equation 1:

$$\mathbf{GDPPC = \alpha + \beta_1 GDPPC4 + \beta_2 FDI + \beta_3 GovtEff + \beta_4 FuelExp + \beta_5 FFEC + \beta_6 EPC(KWHPC) + \beta_7 EP(KTOE)}$$

The dependant variable GDPPC is GDP growth per capita in terms of annual percentage. GDPPC4, the first independent variable is the GDP per capita of 2004. This variable is included in order to account for the different sized economies of the respective countries being studied. Secondly FDI represents foreign direct investment as a percentage of a country's GDP. GovtEff measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies (Huynh & Jacho-Chávez, 2009). FuelExp measures fuel exports as a percentage of total merchandise exports. FFEC gauges the fossil fuel energy consumption as a percentage of total energy consumed within a country. EPC(KWHPC) measures electric power consumption in terms of kilo Watt hours per capita, and EP(KTOE) measures electricity production in terms of kilo ton of oil equivalent.

5.0 Empirical Results

The motive for this study was to find the effects of FDI, government effectiveness, and energy consumption on economic growth. Of the eight independent variables presented in Equation 1, two were significant at the 1% confidence level; three variables, including the former two, were significant at a 5% confidence level; four variables, including the previously mention three, were significant at a 10% confidence level.

Table 1: Regression Results

Variable	Coefficient	t-Statistic	Prob.	Expected Sign
GDPPC4	-0.000171*	-3.406580	0.0017	-
FDI	0.113164***	1.780753	0.0842	+
GovtEff	0.005279	0.120376	0.9049	+
FuelExp	-0.022521	-1.585226	0.1225	+
FFEC	0.049009*	2.829154	0.0079	+
EPC(KWHPC)	8.34E-05	0.491779	0.6261	+
EP(KTOE)	1.95E-06**	2.289329	0.0286	+

Note: *, **, and *** denote confidence at the 1%, 5%, and 10% level respectively

GDPPC4, the GDP per capita of 2004, exhibits a statistically significant negative impact on economic growth for the year 2005. While one may think countries with higher income levels have more resources for investment and potential growth drivers, it is important to remember that developing countries grow at faster rates than developed countries. This intuition moves in lock step with the prediction of the EIA International Energy Outlook 2009 report that non-OECD Europe and Eurasia will average 3.6% annually while developed OECD Europe will grow at 2.0% annually over the time period from 2006 to 2030.

FDI is shown to have a statistically significant positive correlation at a 10% confidence level. Technological diffusion and physical capital gains undoubtedly help spur economic growth. Also, as formerly noted, FDI has a greater impact on growth in developing countries. As the majority of countries in this study are developing countries, it was expected that FDI should return a positive correlation to economic growth. The coefficient for FDI is also the largest coefficient returned by the regression indicating that FDI has the most significant impact on economic growth out of any singular variable in the model. Countries such as China and India, both included in this study, receive a the highest amount of FDI inflows in the world and accordingly have two of the highest growth rates measured in this study; Chinas annual GDP growth is 10.4% and India's is 9.35%. Two other nations that have also experienced rapid growth as of recent years are Singapore and Hong Kong. Singapore and Hong Kong also had two of the top five highest FDI inflows as a percentage of GDP. Singapore, which experience an increase in GDPPC of 4.8%, had FDI inflows accounting for just over 11% of GDP while Hong Kong, where GDPPC improved by 6.6%, had FDI inflows the comprised more than 18% of GDP. One major contradiction to the positive correlation exhibited by FDI on economic growth is exhibited in the case of Zimbabwe. Zimbabwe received FDI inflows accounting for 30% of GDP yet experience GDP retraction of more than 5%. However, it must be noted that while 30% of Zimbabwe's GDP comes from FDI inflows, the amount in dollar denominations received is far less than other African and Asian nations. The large percentage of GDP comprised by FDI has more to do with the fact that Zimbabwe has an extremely low GDP and is not a result of massive inflows of funds.

Government effectiveness exhibits a positive yet statistically insignificant correlation to GDPPC. The estimated beta coefficient points towards effective government as encouraging economic growth however its P-statistic, .9049, shows that the chances of this prediction being

incorrect are extremely high. One reason GovtEff may be statistically insignificant is that many of the countries with high percentile ranks are developed economies that grow at a slower rate relative to developing economies which tend to have less effective governments as policies and institutions are constantly adapting during the development phase. Hong Kong and Singapore aside, the top 10 ranked countries for government effectiveness in this study have an average growth in GDPPC of 2.2%. The lowest ranked 10 countries in this study had an average growth in GDPPC of nearly 5%. Also the lowest ranked countries on a global scale are not included in this study as the countries in the first through tenth percentile often have insufficient data available to study yet it is these countries that often have problems growing economically because of extremely ineffective governance. Additionally, GovtEff is measured as a percentile rank, severely limiting the accuracy of the variable. The insignificance of GovtEff in this study coincides with the findings of Huynh and Jacho-Chávez (2009) who find government effectiveness to be statistically insignificant in predicting economic growth.

FuelExp surprisingly had a negative relationship to economic growth although it was statistically insignificant with a probability statistic of .1225. When examining why a negative correlation is found we must further look into the countries within the study. As pointed out by Boschini *et al.* (2007) "Resources which are very valuable, can be stored, are easily transported (or smuggled) and are easily sold are, for obvious reasons, more attractive to anyone interested in short-term illegitimate gains. This suggests that resources such as diamonds or precious metals are potentially more problematic than, say, agricultural products." While Boschini *et al.* (2007) specifies diamonds and precious metals as problematic natural resources, it is safe to say that oil and natural gas fuels are problematic as they are valuable, can be stored, and easily sold. Despite having problematic resources a country can benefit from the resource if the problems presented are counter acted by good governance and solid institutions. "Given the right institutional framework, oil or diamonds have the potential of boosting a country's economic development, while the same resources are likely to lead to problems in a country with poor institutions." (Boschini *et al.* 2007) Of the countries included in this study, the top 20 ranked by FuelExp show realtively low levels of government effectiveness. Only Singapore, Australia, and Canada are ranked in the 75th percentile or higher for government effectiveness. Saudi Arabia, the worlds largest fuel exporter, and Mexico are the only two countries ranked in the 60s, while every other nation of the top 20 FuelExp has government effectiveness ratings in the 40s and 50s percentiles.

Due to the fact that the top nations ranked by FuelExp have, in general, relatively poor governance and according to the argument presented by Boschini *et al.* (2007) one can see why this study yields a negative correlation between FuelExp and GDPPC.

As discussed earlier in this paper developed OECD countries typically use more high quality, efficient energy sources such as fossil fuels and electricty than developing non-OECD countries which use less refined energy sources such as coal. FFEC, fossil fuel energy consumption, exhibits a statistically significant positive correlation to GDPPC. Of all the countries in this study where FFEC accounts for at least 80% of total energy use only one, Italk, where FFEC accounted for 91.103% of total energy use, expirienced a loss in GDPPC for the year 2005 contracting by -0.186%. Other developed OECD European countries who used at least 80% fossil fuels included Germany, Greece, Hungary, Portugal, Spain, and the UK, whom expirienced growth in GDPPC of 0.840876%, 3.439017%, 4.106996%, 0.455548%, 1.930455%, and 1.252593% respectively. In summation a one percent increase in FFEC should add a 0.049009% increase to GDPPC.

EP(KTOE), electricity production (kilo tons oil equivalent), and EPC(KWHPC), electricity production (kilo Watt hours per capita), both exhibit extremely small positive correlations to GDPPC. EP(KTOE) is shown to be statistically significant holding a probability statistic of 0.0286 while EPC(KWHPC) holds a probability statistic of 0.6261 indicating a high chance of error in predicting the variable's coefficient. Measuring electricity production in terms of oil equivalent may be what renders the variable EP(KTOE) significant. Instead of measuring on a per capita basis we can see the overall level of electricity produced by a country. An example as to why EP(KTOE) is more significant than EPC(KWHPC) in predicting growth can be seen when looking at data from China; the country's electic power consumption was relatively small due to its large population totaling only 1,783.165 kilo Watt hours per capita, but as a whole China produced more electricity measured as an equivalent to oil than any nation in the world, 1,643,873, and coinsidingly expirienced growth in GDPPC of 10.4%.

The possible reasons why EPC(KWHPC) is statistically insiginifcant are infinite. Just because a country has high levels of electric power consumption does not mean that this energy is being used productively. Developed nations had much higher levels of electric power consumtion, however, citizens within these countries typically have much more leisure time in which to use an increasingly large supply of electronics and entertainment devices that do not

constitute productivity and therefore do not promote growth. In essence the range of activites electricity is consumed for could arguably be the reason there is a high expectation of error in the variable's estimation.

5.0 Conclusion

In summation, a country's initial GDP per capita, FDI inflows as relative to GDP, electricity production in terms of an oil equivalent, and fossil fuel energy consumpion, significantly impact their percent growth of GDP per capita. Government effectiveness, electric power consumption, and fuel exports were insignificant in determining GDPPC. This study could be adjusted in many ways as the number of proxies available for energy consumption are abundant. Also measuring FDI inflows in dollar amounts rather than as a percentage of GDP could drastically change the results of this model. Additionally, instead of using government effectivenes as a measurement, one could use another proxy for the effectiveness of government proven statistically significant in previous studies such as voice and accountability, political stability, and rule of law. (Huynh & Jacho-Chávez, 2009) The hypothesis presented, that energy consumption, good governance, and FDI promote economic growth can be debated. The regression model returns a .526777 R^2 value indicating that 47% of variations explaining percent growth in GDP per capita are not recognized within the independent variables presented.

Appendix A: Variable Description and Data Source

Acronym	Description	Data Source
GDPPC	Percentage change in GDP per capita	World Bank: World Development Indicators
GDPPC4	GDP per capita for year 2004 in dollar amount	World Bank: World Development Indicators
FDI	Foreign direct investment inflows as a percentage of GDP	World Bank: World Development Indicators
GovtEff	Measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies	Heritage Foundation and Wall Street Journal's annual Index of Economic Freedom Report
FFEC	Fossil fuel energy consumption as a percentage of total energy use	World Bank: World Development Indicators
FuelExp	Fuel exports as a percentage of total merchandise exports	World Bank: World Development Indicators
EP(KTOE)	Electricity production in terms of kilo tons of oil equivalent	World Bank: World Development Indicators
EPC(KWHPC)	Electric power consumption in terms of kilo Watt hours per capita	World Bank: World Development Indicators

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