Financial Development and Energy Use (Consumption), Urbanization and Industrialization Role in South Africa.

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ABSTRACT

This paper looks at the relationship between energy consumption, financial development, economic growth, the role of industrialization and urbanization in South Africa from the year 1970 to 2014. The study employs the Johansen co-integration test and Vector Error Correction model (VECM) also, Granger causality test is used for the study. The result confirms that there is a long-run relationship between the variables (energy consumption, financial development, economic growth, industrialization and urbanization) in South Africa. More so, urbanization, financial development and industrialization are positively correlated to energy consumption in the long-run. The result obtained shows the long-run bidirectional causality between industrialization and energy utilization, financial development and energy consumption and also financial development and industrialization. Therefore the study recommends a well-developed financial system, an effective policy towards increasing the effectiveness of economic activities of the country. Likewise, promoting urbanization and industrialization helps in development processes. Hence increases energy consumption.

Keywords: Energy Consumption, Financial development, Economic growth, South Africa, Time series, Co-integration, Vector error correction model (VECM).

ÖZ

Bu bildiri aynı zamanda enerji tüketimi, finansal gelişme, ekonomik büyüme, 2014 çalışma Johansen eş-bütünleşme testi ve Vektör Hata Düzeltme modeli (VECM) istihdam için 1970 yılında Güney Afrika'da sanayileşme ve kentleşmenin rolü arasındaki ilişki bakar Granger nedensellik testi çalışması için kullanılır. Sonuç Güney Afrika değişkenlerin (enerji tüketimi, finansal gelişme, ekonomik büyüme, sanayileşme ve kentleşme) arasında uzun dönemli bir ilişki olduğunu doğrulamaktadır. Daha çok, kentleşme, finansal gelişme ve sanayileşme pozitif uzun vadede enerji tüketimi ile ilişkilidir. Elde edilen sonuç sanayileşme ve enerji kullanımında, finansal gelişme ve enerji tüketimi ve aynı zamanda mali gelişme ve sanayileşme arasındaki uzun dönemli çift yönlü nedenselliği göstermektedir. Bu nedenle çalışma iyi gelişmiş finans sistemini, ülkenin ekonomik faaliyetlerinin etkinliğini artırmaya yönelik etkili bir politika önermektedir. Aynı şekilde, kentleşme ve sanayileşme teşvik geliştirme süreçlerinde yardımcı olur. Bu nedenle, enerji tüketimini artırır.

Anahtar Kelimeler: Enerji Tüketimi, Finansal gelişme, ekonomik büyüme, Güney Afrika, Zaman serisi, Eş-bütünleşme, Vektör Hata Düzeltme Modeli (VECM).

I dedicate this work to God almighty and to my wonderful family.

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LIST OF ABBREVIATIONS

εi	Error Term
EC	Energy Consumption
VECM	Vector Error Correction Model
FD	Financial Development
$GDPC$	Economic Growth
IND	Industrialization
URB	Urbanisation
Ln	Natural Logarithm
ECT	Error Correction Term
WDI	World Development Indicator
ADF	Augment Dickey Fuller
PP	Phillip Perron
JJ	Johansen and Juselius

Chapter 1

INTRODUCTION

1.1 Research Background

Most of the Economic literature has discussed the role of financial development in an economy, and these are widely discussed both in cross-country and country-specific, and they mostly show the importance of financial development on the economic growth. Well-developed financial system raises the efficiency of financial sectors and in turn improves the innovations in the financial services delivery system. Also it helps in technology advancement, information cost reduction and investment profitability (Levine, 1996; Abu-Bader and Abu-Qarn, 2008; Bairer et al., 2004).

Financial market liberalization causes economic growth (Bekaert et al., 2001, 2002, 2005; Bekaert and Harvey, 2000). Investment, consumption and production are increased by an efficient financial system hence causes an increase in energy demand (Fung, 2009). Financial market liberalization improves monetary transmission mechanism and also boosts investments and savings. Hence, improve economic growth.

Literature also shows an opposite view which says that financial sector improvement is a result of economic growth (Stern, 1989; Lucas, 1988). Kraft and Kraft (1978) found that in the United States during the years 1947-1974 that economic growth causes energy demand to grow.

Shahbaz, M and Lean, H (2012) shows the nexus between energy use and nations' growth. Among other important factors which are population growth, industrialization and urbanization. These factors will boost effective utilization of energy. For example, the higher increase in the population size induces urbanization and in turn increases the use of energy. Also, industrialization directly or indirectly affects the use of energy. Industrialization refers to improvement in the industries, which means increase in production and this in turn raises energy consumption. Industrial growth means more labour is required or employed hence their earnings improve. Higher income means increase in the demand for energy consuming appliances which also increases the use of energy.

International Energy Agency (2007) states that between 2005 and 2030 the world primary demand for energy is expected to increase at the rate of 1.8%. 74% annually and this percentage will be contributed by the developing countries. Meanwhile India and China jointly accounts 45% of the increase in the demand for energy globally. The expectation was that energy demand for both India and China is to grow at the rate of 3.6% in 2030.

Financial development is referred to the decision of the country to allow and encourage activates e.g. promoting financial activities and increasing activities in the stock market. Improvement of these provides one possible way in which economic growth can be increased and thus affects energy demand. Financial development can impact the economy positively by increasing the efficiency of the country's economy and its financial system. Financial development can reduce the risk in financing and borrowing costs, improve transparency between creditors and debtors. Financial development affects energy demand by the most direct way which is by making borrowing access easier to debtors. This means easy access to credit and increase energy consumption through purchasing more electrical appliances which increases the overall energy usage of a country. It is easier and cheaper for businesses to get capital for financing and expansion of their standing businesses or create new ones which in turn may increase the demand for energy (Mankiw and Scarth, 2008). The stock market development indicates the level of economic growth which in turn busts the confidence of producers as well as consumers. Increase in energy demand is as a result of an increase in economic confidence.

1.2 Objective of This Study

To evaluate the nexus between financial development and energy use is the main objective of this study. Likewise, evaluating the role of economic growth, urbanization and industrialization in South Africa. The second objective is to check whether there exists any long run relationship between variables used in this study.

1.3 Research Methodology

We employ time series analysis to analyse the relationship between the estimated variables, the period covering from 1970 to 2014. A unit root test was done utilizing the Augmented Dicky Fuller (ADF) and Phillips-peron (PP) to test the stationarity of the variables used. Additionally, we utilize the co-integration test to check whether there exist a long run relationship amongst variables and after that Vector Error Correction Model (VECM) will be completed.

1.4 Organizational Structure

This examination comprises of seven chapters, where the first chapter contains the introduction, background of the study, the goal of the study, the methodology employed and it organisational structure. The second part shows the theoretical literature review; Chapter three shows the Empirical literature review.

Chapter four discuses energy use trend in the world; it shows the global trend and also the energy trend in South Africa. Chapter five shows the methodology used, the data used, data collection and the data analysis. Chapter six focuses on the findings and interpretation of the results. The last chapter concludes the study, summary of the research and also states the policy implication of this study.

Chapter 2

THEORITICAL LITERATURE REVIEW

2.1 Theory of Financial Development

Minsky (1982, 1986) extended the view through the ‘Wall Street Paradigm’ here, capitalism is perceived as essentially a financial system, an inclined to waves of financial instability and economic flaw. Minsky’s theories were extended by Kregal (2005) where he linked them to development as well as presenting exchange rate uncertainty, derivatives and ‘international dimension’ of how the financial construction of an economy is at all times a key component of its development track (Kregel 1998, 2001a, 2001b,2004, 2010, 2014; Kregel and Burlamaqui 2005). The uniqueness here is not ‘financing for development’, however it is macro-finance: Incorporation among the way the financial system works and by how it should be planned to successfully foster invention and expansion. The importance of this framework was understood by Schumpeter (1912), meanwhile he never developed it completely. These works were also used by Keynes (1936), as a bond and suggest that effective development procedures are essentially attached with proactive financial structures and strong economic and financial rule oriented in the direction of industrial financing. Suggestions were made that this particular rule and institutional set up allows countries to constantly upgrade their technological and invention competences and occupy in a strategy of succeeding as an approach for exceeding. This means that, development approaches should not be dreams and plans regarding how to meet up with local and/or worldwide benchmark countries; rather it should focus on how to exceed them. To catch-up may serve as a temporary approach at least.

Stern (2004) shows that energy resource takes different physical form which includes: the different forms of energy like thermal or mechanical energy can be transformed to natural gas, oil, electricity, biomass, wind energy, uranium, water fall, infrared radiation and more. The energy conversion plays an important role in production and to human experience.

Stern (2003) surveys the relation among energy use and the growth of a nation, he mainly specify the importance of energy in the country's production. Financial analysts and business people are more concerned about the influence of energy and oil prices on the nation's economy; well the main theory for economic expansion pays little or no attention toward energy role or toward the role of energy resources that is said to affect the economy. These extensive deliberations concerning the slowdown in subsequent to oil crises in 1970 are exception.

The primary idea in the financial matters of production is the reproducibility. Meanwhile some of the inputs are not reproducible, while others are made at the expense within the production framework. Input that exists at the very beginning of production, this inputs are not used directly in the production activities. During the production process, the intermediate inputs are created and are used up entirely in the production. Capital, land and labor are seen as the primary factor of production by the mainstream economists. Costs paid for the distinctive inputs to the inputs owners are seen as money paid for their provided services directly by the input owners or through intermediate inputs. In the production theory, the methodology concentrations are on the essential inputs particularly on land and capita. Natural business analysts faced off regarding that the amount of energy used in the production of intermediate inputs like fuel increase as the resources quality falls. The poses a negative productivity growth or change in technology. If the economy can be characterized as an input-output model which shows no substitution between factors of production then the embodied knowledge for factor of production can be overlooked. The use of energy to enhance the production of final goods is important, but in the actual word production cannot be proportional to its embodied energy (Stern, 2004).

2.2 The Basic Growth Model

The advancement of a speculative economy with time as it quality and amount of the different inputs used in production changes is examined by the economic growth model. The simple basic model here is based on Solow (1956). The model says that capital employed increases as the output increases at a decreasing rate. On the off chance that the work power increments at a steady rate after some time, the aggregate amount of yield and capital stock will increment as well while the capital and output per worker remains the same as soon as the economy reaches the development equilibrium.

2.3 Environmental Implication

The debate on the relationship between utilization of energy and its level of the growth of an economy is debated on, it was seen that energy use has an assortment of effects on the economy. Energy extraction and treatment reliably include a few structures of natural break, including both geomorphological also, natural disturbance and additionally contamination. As every human activity requires energy use, energy use shows every human effect on nature (Stern, 2004).

Chapter 3

EMPIRICAL LITERATURE REVIEW

It is important to know energy demand factors for a clear knowledge about the changes in demand for energy in developing countries. The race for economic success by major developing economy hot up, the significance of the relationship between energy utilization and the growth of a nation is estimated to be unhindered. Understanding the components of energy use is extremely crucial for developing economies for a few reasons. Firstly, energy as an uncommon product is utilized as contribution as a part of production of all products and including services. Numerous emerging nations are creating at a pace much speedier than were evaluated already. This may have made an expansion in the interest for energy. Despite the fact that 2009 saw worldwide economic downturn, the significant energy overpowering countries in Asia – China and India – have scarcely been influenced (Sadorsky, 2010).South Africa, for example, is considered to have the most elevated energy production in Africa likewise consumes more of energy. Eskom, a parasternal responsible for the supply of power in South Africa, remains evaluated to create around 66% of the whole sub-Saharan African power production and 80% of the aggregate southern African generation (Estache et al., 2008).

By a producing limit of around 40 000MW, Eskom is evaluated as one of the main five energy utilization on the planet. For the most part, the energy sector accounts around 15% of the South African GDP, other than it employs around 250 000 individuals. The key energy asset in South Africa is coal; this contributes around 88% of the nation's aggregate power. All things considered, the nation as of late encountered a fall in its reserve, which constrained it to get on various interferences in mid-2008 (South Africa Energy report 2005).

The study on energy use has dependably characterized the real possible factors that are gathered estimatedly within the improvement variables, costs, demographic variables, outside variables and money related variables. Development variables incorporated real GDP also the offer of mechanical range in the economy. Population and urbanization are the components of demographic variable. Improvement in finance is seen as external and budgetary determinants, exchange and remote direct theory. Monetary development is seen as the guideline fundamental motivation of energy utilization. At the point when economy develops, it uses more energy. In this way, nations with dynamic salary per capita levels will have dynamic energy utilization per capita. All things considered, after the natural Kuznets curve theory, the consumption of energy fundamentally increments with wage and afterward diminishes after income gets to a point on a specific level. The effect of income on energy use is an alternate perspective; this is divided into three properties which incorporate scale impact, and procedure impact and creation impact (Copeland and Taylor (2004). The general effect of financial development on vitality utilization lays on which impact is more grounded and rules the others.

Developing financial system tends to increase the utilization of energy through development improving impact. By making it all the more economically and simpler for purchasers to acquire money, monetary improvement raises the interest for more energy expending strong products (Sadorsky, 2011; Islam etal.2013). Access to improve finance, technologies and foreign trade, stork is permitted by global market possibly corresponding in decreasing energy utilization. An extensive study on the relationship between energy utilization and its determinants, the use of energy and GDP long-run relationship is examined by Narayan et al (2010).

To examine the nexus between financial development and energy utilization in 22 developing countries by using a generalized method of moment’s estimation technique and data from the period 1990–2006. Evidence of a positive impact of financial development on energy consumption was found Sadorsky (2010). Poumanyvoung and Kaneko (2010) examined the impact of urbanization on CO2 emissions in a panel of 99 countries from the period 1975–2005. By using different models, they found that urbanization decreases energy consumption in low-income countries, while it increases energy consumption in the middle-and high-income countries. The relationship between economic growth and financial development is unpredictable in both exact and hypothetical literary works (McKinnon, 1973; Claessens and Laeven, 2003; Kaminsky and Schmukler, 2003; Dow, 1996). Without filtering the predominant financial development, steps taken for financial development improvement furthermore, financial market liberalization might be hurtful to the economy (Stiglitz, 2000; Rogoff, 2004; Arestis and Stein, 2005).Resistance amongst nearby and remote banks makes the budgetary market more versatile and makes logically and new open entryways for hypothesis. This versatility enhances the relationship between financıal advancement and development of an economy (Mankiw and Scarth, 2008; Karanfil, 2008; Sadorsky, 2010). Sadorsky (2010) used various financial development indicators of in twenty-two rising economies within the time of 1990-2006. He found that the impact of financial growth on energy use demand is sure and basic however little. Shahbaz et al

(2010) prescribed an enormous and useful result of budgetary advancement on energy utilization in Pakistan. The causality examination demonstrated bidirectional relationship between financial improvement and energy use. In Malaysia, Islam et al. (2011) found that financial improvement moreover, economic development have positive outcome on consumption usage. Not exactly the same as Pakistan, a unidirectional causality was found running from economic growth to energy utilization in Malaysia.

Karanfil (2008) says that the causal relationship among the growth of a nation and the nation's energy use cannot be simply defended just with a straightforward bivariate model. He says that domestic credit provided to private sector as one among the variables for financial development. Additionally, loan fee, swapping scale influences the utilization of energy by its coast. This model also shows in line with Stern (2000) and it demonstrated an oversight applicable variable. Moreover, Lee, Chang (2008) found a positive and critical relationship between the economic growth of a country and it energy utilization. Estimating to overall causality between energy use and the growth of an economy is seen by Bartleet, Gounder (2010). They concluded that there exist a co-integration between the growth of an economy, job and its use of energy. This causal relationship shows that energy utilization is caused by it nation's economic growth and the monetary action decides its expansion of vitality interest. They also investigated that capital stock assumes important role when deciding on the relationship between the consumption of energy and the growth of an economy using a neoclassical production function. Effects of a nation's growth, development in finance and the use of energy on natural pollution, the case of china from the time period of 1953-2006.Jalil and Feridun (2011) an Autoregressive Distributed lag (ARDL) bound testing was used to see the effect.

They found that the coefficient of growth advancement shows a negative relationship and its recommending that the china economy development has not occurred to the detriment of natural contamination. Despite what might be expected, it is found that economic growth has prompted a reduction in natural contamination. Likewise, the discoveries affirmed the presence of an EKC (Environmental Kuznets Curve) in China. Also the causal relationship between the development of the Turkish finance and its openness, growth of it economy and the energy utilization was discussed by Ozturk and Acaravci (2013) for the time period (1960 to 2007). They discovered that there exists a negative relationship between CO2 emission and financial development. However the experimental results confirmed the presence of the EKC speculation in the Turkish economy.

Erdal et al (2008) related the causality test between essential Energy consumption and the economic growth in Turkey for the period 1970 to 2009. Despites the fact that natural gas and coal are limited which causes the price of energy to increase led to alternative sources of energy. Developing countries tends to use more energy to achieve the nation's growth. A unit root test was carried out using Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP). Also Johansen co-integration test was used to check if variables are co-integrated. Furthermore, Granger Causality test was used in checking the relationship between Energy consumption verses real GDP. Results show that EC and real GDP are co-integrated and a unidirectional causality from EC to real GDP and also from real GDP to EC, and also he examined a bi-directional causality from EC to real GDP.

3.1 The Use of Energy, Urbanization and Industrialization

In global energy, urbanization and population are seen among the drivers of global pollution. It is assumed that more populated area or urbanization could lead to a more usage of energy. Nevertheless, the ecological concepts for urban places can change and it shows that urbanization could have both good and negative consequences on the use of energy (Poumanyvoung and Kaneko 2010 andSadorsky2014). Urbanization advancement is related with advanced growth of an economy this could lead to a higher per capita income. Developing nations could use more energy and richer energy users could demand and consume more energy since they use more electrical appliances. Also wealthier consumers care more about the environment and this leads to a more regulations for environmental hygiene in the economy. In all income groups, urbanization increases CO2 emissions. An ARDL model is used by Adom et al (2012) to analyse the demand for energy in Ghana. The outcome of the study shows that income, the growth of industry and urbanization are the leading indicators that affect energy utilization in Ghana. Another study by Shahbaz and Lean (2012) shows that there exists a relationship between energy use, urbanization, development of finance and industrialization in Tunisia covering the year 1971-2008. The outcome of their study shows that there is a positive relationship between the variable mostly in the long-run. Industrialization increases economic growth, it supports the activities for a nation's growth and this in turn raises the demand for energy.

Essential energy is needed for a stable economic growth and this will be achieved due to an increase in the value of GDP as a result of increase in the share of industrial sector. A nation can advance industrial sector by improving their machineries and this shows the quantity of energy used. In China Jiang and Gao (2007) report shows that a development in industry is also as a result of energy demand. Urbanization includes changing the structure of an entire economy also since urbanization is seen as a vital economic development indicator. Urbanization has as an important impact on use of energy, it shows population and reflects the nations activities for growth. An expansion in the activities of a nation due to urbanization also affects energy use positively.

Mishra et al. (2009) shows that in the short run, consumption of energy is instigated by urbanization for pacific islands. Gross domestic product is by utilization of more energy and urbanization in the long run.

Study on the relationship between development of finance and the growth of a country, accumulation of wealth and its total product factor. Literature indication shows that development of stock market affects financial development. Development of the financial sectors like banks increases foreign direct investment as well as the domestic investment, regulation of finance through finance liberalization means, this helps to promote an economy. Levine R. (2002) mentioned that at the very beginning stage, banking sector helps to improve the economy. The financial mediators provide services like diversification of risk, project evaluation, these helps in improving the technology and development of the economy.

Effective and a well-established intermediate of finance helps in the distribution of loans form savers to borrowers, borrowers are mainly businesses, and this also helps in the growth of an economy (Levine 2000). Reducing the cost of finance by distributing the risk attached also aggregated asset as well as reserves are easily transmitted by a constructive financial liberalization this could also have an effect on growth (Ang JB, 2008).

Nevertheless, an increase of financial risk instability is due to a countries inability to regulate capital frame work and this has a negative effect local capital flight (Ahmad AD 2013). Both positive and negative influence of the long run relationship between development of finance and the nation’s growth has been seen or analysed by many studies. Also, different results are pulled through on the causal relationship between the variables. Payne (2010) previous studies are based on using a time series while few studies are on a panel data model. He based his research study on a panel data model and the results are similar to the previous studies hence provides insights for the relationship that exists between demand for energy and FDI growth. Another study by Apergis and Payne (2009) is shown by using a panel data to examine the causal relationship that exists among energy utilization and economic growth of 11 sovereign countries of common wealth, using a panel data from 1991 to 2005. In their study the employ a panel unit root, panel co-integration and lastly a panel error correction models. The results showing a unidirectional causal relationship form energy use to economic growth in the long run. Additionally, Chen et al (2007), Pedroni (1999, 2004) examined 10 industrial Asian countries form the period of 1971 to 2001 and he found that there is a bidirectional causal relationship in the long-run between energy use and the nation’s economic development.

Chapter 4

WORLD ENREGY TREND

For a long time, the utilization of energy has dependably been an important field of speculation particularly for advancement and for other financial exercises which are vital for development and improvement around the world. The previous chapters show that different studies have examined that the countries which experience an extensive level of economic development are mostly countries with higher level of energy consumption. So to say that utilization of energy is very important to growth of a country most importantly for countries that are still developing. Thus, to accomplish a specific level of advancement, a productive increment in energy utilization is important.

For decades, the study on the use of energy worldwide has increased and this increase in total energy usage is mostly from developing countries (non OECD) or emerging economies. Changes in the Energy business sector are continually controlled by these developing economies. Case in point the fast development in the utilization of vitality in Asia has secured that of North America and has been considered as the most energy demand region in the world. The increase mostly in this region is from the large Asian countries, India and China. The need for constant energy use is increasing and hence, China is fast developing (BP statistics, 2014) Globally, the main essential Energy use is assessed to have expanded by 2.31% starting 2013, which is after an expansion by +1.8% in 2012. Nuclear power sector, coal and oil were speed up. In spite of the growth in 2013; the 10-year aggregate growth was at the average of 2.53%. With 32.9% worldwide energy utilization, oil still remains the world's driving fuel. The utilization of oil was higher starting 2011 with around 88milloin barrel oil for each day yet just 7% was devoured internationally in 2010. (World Energy Statistics Review, 2014)

Table 4.1: Energy use in four major Regions of the World

	National Income	Energy	Population
China	3.6	2.5	1.4
Other Asia	2.9	1.8	1.4
Africa	**1.5**	**2.8**	**1.5**
Latin America	1.5	2.1	1.5
OECD	1.6	1.2	1.15

Source: Levine and Hirose, 1995:9

4.2.1 Energy Trend in South Africa

As stated in the previous chapter, for instance, South Africa is saidto have the most noteworthy production of energy and utilization in Africa. A parasternal responsible for the supply of power in South Africa (Eskom), to create around 66% of the whole sub-Saharan African power generation as assessed and 80% of its aggregate production in southern African.

By way, its generating capacity is about 40 000MW, and Eskom has been graded among the top 5 energy consumption in the globe. Mostly, the increase in the South African GDP is due to its energy sector that contributes about 15% to its GDP, besides it employs about 250 000 people. Coal remains the key energy resource in South Africa; contributing around 88% of the nation's aggregate power. Nonetheless, the nation as of late encountered a decline in its store edge, which constrained it to get on various impedances in mid2008.

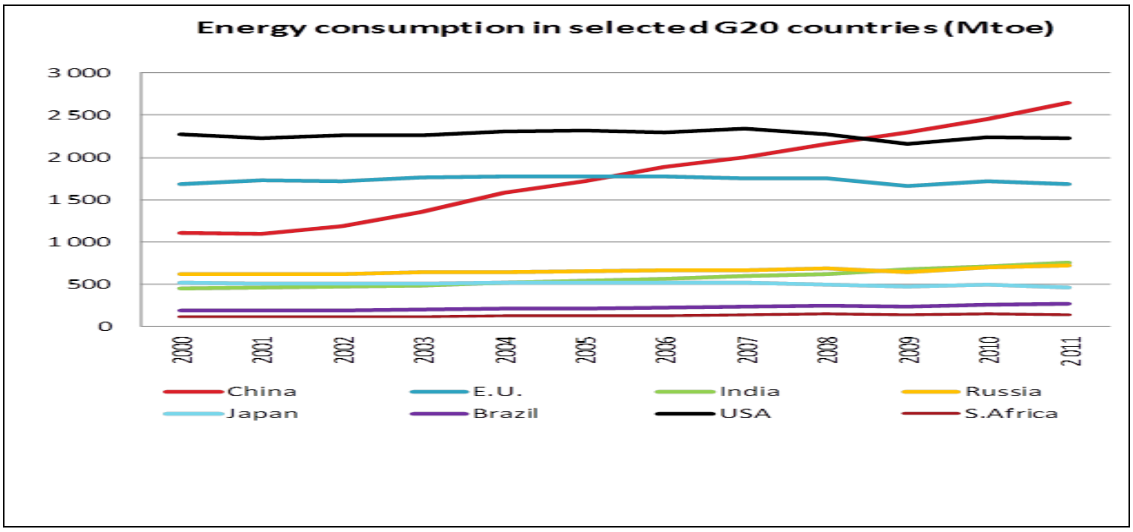

Figure 4.2: Global energy consumption by regions. (1992-2011)

The diagram above also shows that South Africa consumes more energy than other G20 countries. After 2008 that was the point it equalizes with USA and then continued to increase more than the rest of the country. The selected country includes; China, Japan USA, South Africa, India, Brazil, Russia and E.U. From the year 2000 to 2011.The diagram also shows that form 2000 to 2005 South Africa Energy consumption is bellow that E.U. and for USA its was below until 2008 which after then South Africa consumes more than the other countries.

4.2.2 A Strong Increase in Electricity Consumption in South Africa.

Comparing South Africa's energy consumption per capita with the world average: 2.8 toes against 1.9 toe. From 2002 to 2008, the total energy consumption increased at a rate of 4.9% per year, but has reduced by 2% since then. From 29% in 1990 the share of industry (non-energy use inclusive) decreased to 19 in 2011, meanwhile the share of the power sector constantly remain the same at about 40%.

South Africa's electricity consumption per capita is around 60% per capita with is more than the average (compared with the world average 2,800kWh as of 2011 it was 4,500kWh) form 1990 to 2007 the total electricity consumption in raised at an increasing pace of 3% per year. Afterword's, supply constraints affected the electricity consumption in 2009 by global crisis. 60% of the country's electricity use is consumed by the industrial sector. (South Africa Energy efficiency Report 2013)

4.2.3 Energy Efficiency Trends

The South Africa Energy efficiency Report (2013) shows the total energy intensity or total energy consumption per GDP is measured at purchasing power parity and it's around 50% higher than the world average. Due to the importance of coal and industrial energy intensity in supply of energy, this is higher, the South Africa's energy intensity decreased by 1.2% per year since 2000. Two-third of this decrease was caused by the industrial sector. Most of the power generation is produced from coal (more than 90%) close to that of thermal generation, the overall efficiency power generation is low. Since 2000 the thermal power generation has fallen and in 2011 it declined from 34% to 33%. (South Africa Energy efficiency Report 2013)

4.3 South Africa Energy Sector

As indicated by BP Statistical Review of World Energy (2014). The energy sector for South Africa is basic to its economy; the nation depends intensely on its expansive scale, coal mining industry energy force. South Africa utilizes it vast coal stores to address the issues for energy particularly in the power segment, because of its restricted store in normal gas and oil. The economy of South Africa has become quickly since the end of 1994 (the politically-sanctioned racial segregation time) and in Africa it's a standout among the most created nation. Furthermore, as the second biggest economy in Africa, regarding GDP, and on the mainland its energy utilization is the most elevated, recording 30% of the aggregate essential energy use in Africa. In 2013, the aggregate essential energy utilization of South Africa originated from coal which around 72%, oil has 22% offer, characteristic gas 3% offer atomic 3% offer and renewable is under 1%. South Africa has become the leading carbon dioxide emitter because of it depends mainly on coal in Africa it takes about 40% share of emission in Africa, also the largest 13th largest emitter in the world (2012) EIA estimates.

Chapter 5

DATA AND METHODOLOGY

In this study, a time series econometrics technique is used to verify the objective of this research. An annual data is used, the research covers the year period of 1970-2014. Data is collected from World Development Indicators (WDI-CD, 2015) and from Global Financial Development Database (GFDD). 'We measure Financial Development as Domestic credit provided by financial sector as share of GDP.'[1] Real GDP per capita indicates economic growth, the total energy consumption per capita (kg of oil equivalent) measures the energy consumption, the proxy for Industrialization is industrial value added as share of GDP, and the proxy for Urbanization is urban population growth (annual %). Economic growth, Industrialization and Urbanization are employed as control variable.

The log of variables provides a better result when comparing the log-linear specification to the linear function. Therefore, we change all data to its natural logarithm. The fundamental system for vitality demand for energy as modified by Sadorsky (2010), is

$$ENCt = f(FDt, GDPCt, INDt, URBt) \quad (1)$$

- ENC is or indicates the logarithmic form for total use of energy per capita,
- logarithmic form of domestic credit provided by financial sector is FD,

[1] Domestic credit provided by financial sector is measured as percentage of GDP. Domestic credit provided by financial sector includes gross credits to different sectors with the exception of net credits to central government. This financial sector includes deposit money banks and monetary authorities and also other financial corporations (Money lenders, finance and leasing corporations, pension funds and foreign exchange companies)

- logarithmic form for real GDP per capita is GDPC, IND is logarithmic form
- For industrial value added as share of GDP, and UPG is logarithmic form of urban population growth rate (annual %).

Real cash to be utilized on undertaking investment is presented by improvement of finance. At the point when there is a higher estimation financial advancement, this suggests the created monetary business sector that is the bank and value markets, for investment, assets are accessible (Sadorsky, 2010; Minier, 2009). The level effect that develops the financial markets or sector is one of the two tools that improve the financial market and this is connected to the activities towards investment, likewise channel budgetary assets to an exceptional yield ventures. Investor's confidence is enhanced regulations which set a better reporting and accounting system and attracts foreign direct investment (Sadorsky, 2010). The second mechanism is that financial development increases liquidity, raises funds for ventures and asset diversification by means of efficiency effect. Therefore, the impact on energy consumption by money related improvement as a consequence of economic development ought to be sure. Through sectorial development, industrialization is a spine for growth of an economy through economic activities and thusly builds a higher demand for energy. Additionally, Ghosh (2002) for India, Aqeel and Butt (2001) for Pakistan, Altinay and Karagol (2005) for Turkey, Ang (2008) for Malaysia, Odhiambo (2009) for Tanzania, Morimoto and Hope (2004) for Sri Lanka, Bowden and Payne (2009) for USA, Halicioglu (2009) for Turkey; recommended that financial development has beneficial outcome on energy utilization. As the offer of the value of industries to GDP increases, it requires more energy to keep financial development steady on the same pace. The capacity of a country to enhance hardware to propel their modern parts varies will depict the power of energy use. Jiang and Gao (2007) result indicated an increment in industrial development is connected with the demand for the utilization of energy in China.

One of the main features of developing a nation's economy is urbanisation and throughout the economy it includes many structural changes which have an important implementation to energy use. Urbanisation measured population and in turn economic activities. An increase in economic activities as a result of urbanization raises demand in the use of energy. Mishra et al. (2009) shows in the short run, electricity consumption is caused by urbanisation for the Pacific Island nations. In the drawn out stretch of time, urbanization and power utilization causes the total national output to increase.

To check for stationarity of all variables and to check the order of integration, we utilize the ADF and PP unit root tests. For us to quantify the long-run relationship between variables, we utilize Johansen co-integration test. Likewise to quantify the way of the relationship among variables, we utilize Vector Error Correlation Model (VECM). Additionally to see the course of causality between variables we utilize the granger causality test.

5.1 Model Specification

To examine if financial development increases energy consumption in South Africa, economic growth, Industrialization and Urbanisation are the control variables used in the study.

The equation below shows the log-linear model:

$$\text{Ln}EC=\alpha+\beta_1(\text{Ln}FD)+\beta_2(\text{Ln}GDPC)+\beta_3(\text{Ln}IND)+\beta_4(\text{Ln}URB)+\varepsilon i \qquad (2)$$

Where:

- EC = Energy consumption
- FD = Financial development
- $GDPC$ = Economic growth
- IND = Industrialization
- URB = Urbanisation
- εi= Error Term
- Ln = Natural Logarithm

5.2 Stationarity Test

Stationarity test helps to show if data within a model are in the same order of integration. Gujarati (2009) explains that when time series are non-stationary it means that its variance is not constant likewise the covariance not constant over time and this could lead to a spurious and misleading result for the estimated regression. There are several techniques used in checking for stationary, but for this study we employ the ADF basically.

Augmented Dickey-Fuller (ADF) Test

ADF test is an altered type of Dickey-Fuller test for stationarity proposed by Dickey and Fuller (1981). The ADF is adjusted to rectify for the restrictions of the Dickey-Fuller test for a higher request autocorrelation function. The ADF procedure takes into consideration a higher request auto regressive process (Greene, 2003). Condition for the ADF can be completed as for the most part utilized model with Drift and Trend or as just Trend. None, with neither trend nor intercept is the least used. The ADF test equation for unit root is shown below.

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta * Y_{t-1} + \sum_{i=1}^{n} \alpha i \, \Delta Y_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

With,

$$\alpha i = -\sum_{i=0+1}^{n} \delta k \qquad and \qquad \delta = \left(\sum_{i=1}^{n} \delta t\right) - 1$$

e_t indicates Gaussian white noise disturbance while $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$.

t denote the time while β stands for intercept. To avoid serial correlation problem between variables, we determine the lagged number empirically, doing so avoid a biased estimation of δ.

Null hypothesis for ADF test is *Ho*: δ=0 which means that there is a unit root in the series (not stationary).

The alternative *H1*:δ < 0 that is to say that series is stationary.

The ADF and PP are employed to check if variables have a random walk or not. Mostly the null hypothesis shows that there exists a unit root, and that series is not stationary. At level, failure to reject the null hypothesis (δ=0) then we need to take the first difference to make non stationary series stationary. Rejecting the null hypothesis shows that series is stationary.

Phillips-Perron Test

Phillip (1987) and Perron (1988) developed the PP unit root testing. The PP unit root test which is a contrasting option to the (ADF) Augmented Dickey-Fuller is utilized for stationarity testing. PP is utilized to decide the procedure of creating AR (1) (first request autoregressive model). It computes the residual fluctuation utilizing the Newey-west technique for adjusting autocorrelation and heteroscedasticity. The Barlett (newey-west) condition for PP unit root coefficient is shown below.

$$\omega_x = \frac{1}{T}\sum_{s=x+1}^{n} \ell t \ell t - s \text{ k} = 0, \ldots \ldots, \text{p} \;=\; \text{kth} \quad \text{auto covariance of residuals}$$

$$\omega_o = [(T-K)/T]\text{s}^2 \qquad , \qquad \text{s}^2 = \frac{\sum_{t=1}^{T} \ell^n t}{T-K}$$

$$\gamma \;=\; \omega_o \;+ 2\sum_{i=0+1}^{n}\left(1-\frac{k}{n+1}\right)\omega_x \quad (4)$$

From the above condition, n shows restrictive lag structure for evaluating the PP measurement while ω_x shows the correlation coefficient of the adjustment in residuals.

To check if there is a random walk between variables or it is a pure walk, we utilize both the ADF and the PP to test for unit root.

Mostly The null hypothesis for the unit root test states that, there is a unit which means series are not stationary. On the other hand, if we do not reject the null hypothesis at level we will have to take the first difference to make it stationary. The alternative hypothesis states that there is no unit root and that means that the series is stationary. Therefor when we reject the null hypothesis it means that the series is stationary.

5.3 Co-integration Test

Since variables in this literature are not stationary at levels form, they may show trend or seasonality, or trend and seasonality. In this model, for the long run analysis and for us to be able to analyse variables relationship we introduce the co-integration test. Then we employ the co-integration test for us to check if there exist any relationship between the used variables in this study Granger (1981) and Engel and

Granger (1993). Johansen and Juselius (1990) trace statistics indicates there is a co-integration vector between various variables. Another co-integration strategy, Engel-Granger (1987) is a co-integration method by and large acknowledged to be substandard to Johansen test. To fathom the issue of endogeneity of multiple explanatory variables, the Johansen and Juselius statistics (J&J) is used and the endogeneity issue is resolved by allowing the vector auto regressive and error correction model with restrictions of lags. The following defines the J&J co-integration test with lags.

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{n-1} \Delta X_{t-n+1} + \Pi X_{t-n} + \mu + e_t \qquad (5)$$

From the equation above, Π shows the quantity of co-integrating vector rank (r) found by testing if the eigenvalue (λi) are not quite the same as zero factually. For calculating the trace statistic, Johansen and Juselius (1990) and Johansen (1988) proposed that utilizing the eigenvalues of Π extents from most extreme to least. A long-run relationship utilizing the Johansen co-integration test, we look at the estimated and critical trace statistics value and compare it with the Ho started by Osterwald-Lenum (1992). At the point when the statistical value found is more than the critical point, we then reject the H0 implying there exist a co-integration in the series; else we fail to reject HO meaning we there is no co-integrating vector. λtrace is shown as per the following equation:

$$\lambda trace = -T\Sigma Ln(1-\lambda i) \qquad (6)$$

5.4 Error Correction Model

For variables to exist a likely convergence in the long-run, they should be co-integrated at same level form for a long-run relationship. Also by adjusting with time, equilibrium in the short-run is prone to meet over the long run with time. With error correction model, VECM technique is utilized. The error correction term (ECT) is required to be unique in relation to zero which demonstrates the usefulness of ECM. These show how fast the variables are adjusted towards their long-run values. Assuming variables are all I(1).

Yt variation towards the trend in the long-run pattern is appeared in the stated equation above, the variation is brought about by the comparing variation in Xt, and near to its long run trend. ECT is given:

$$\approx (Yt\text{-}\ \theta X\ t - 1).$$

The discrepancy between the long run and short run is shown using the error correction model:

$$\Delta X = \mu + \alpha\beta'\mathrm{X}t{-}1 + \sum_{i=0}^{k-1} \alpha i \Delta \mathrm{X}t{-}1 + \varepsilon t, \qquad (7)$$

$$\Delta lnECt = \beta_{o} + \sum_{i=0}^{k-1} \beta_1 \Delta lnENCt{-}j + \sum_{i=0}^{k-1} \beta_2 \Delta lnFDt{-}j + \sum_{i=0}^{k-1} \beta_3 \Delta lnGDPCt - j + \sum_{i=0}^{k-1} \beta_4 \Delta lnI\mathrm{ND}\ t - j + \sum_{i=0}^{nk-1} \beta_5 \Delta lnU\mathrm{RB}t - j + \varepsilon t$$

Chapter 6

EMPIRICAL INTERPRITATION OF RESULTS

In this Chapter, we demonstrate the outcome and examinations of the study. A unit root test is utilized as a part of this study. This study likewise utilizes a co-integration test and VECM test. We show the stationarity properties of series like the unit root, we utilize the Augmented Dickey Fuller (ADF) and the (KPSS) Kwiatkowski Phillips Schmidt and Shin's test to know whether the variables are stationary. This is to keep away from an insignificant or spurious regression. Additionally to demonstrate the long run relationship between the variables in this study, the Johansen co-integration test is directed alongside we conducted the Error Correction Model.

6.1 The Unit Root Test Result

As stated before, both at level and at 1st deference, the Augmented Dickey Fuller test is used. Its results are shown in table 6.1 bellow; it indicates that the variables are non-stationary; hence it has a unit root at level. Using the first difference to test, result shows that at first difference, it is stationary and the variables are integrated of order 1.

Table 6.1: ADF unit root test

Variables	Level	1st Difference	Results
LNFD	-2.336954	-7.535791*	I(1)
LNENC	-1.889063	-6.317481*	I(1)
LNGDPC	-1.229395	-4.368106*	I(1)
LNIND	-2.188388	-5.439104*	I(1)
LNURB	-2.143065	-4.236102*	I(1)

Note: LNFD means natural log value of Domestic credit to private sector by banks, LNEC is natural log value for energy consumption, LNGDPC is natural log value for GDP per capita, LNIND is natural log value for industrial value added, and LNURB is natural log value for urban population growth. * Means stationarity at 1% and it stands for rejection of null at 1%. E-view 8.0 is used for the calculations and results.

6.2 Co-integration Result

At level, the variables were not stationary using the ADF unit root test, so we need to take the first difference of the variables. After the first difference we observed that the variables were stationary. To see the long run relationship we employed the Johansen co-integration test here.

Table 6.2: Johansen co-integration test. (A): Statistical Trace.

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.89776	209.4261	88.80380	0.0000
At most 1 *	0.821186	125.0444	63.87610	0.0000
At most 2*	0.581618	61.35227	42.91525	0.0003
At most 3*	0.419315	29.11190	25.87211	0.0191
At most 4	0.215933	9.000661	12.51798	0.1803

Trace test indicates 4 co-integrating equ(s) at the 0.05 level,
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

(B): Maximum Eigen Values

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.897776	84.38169	38.33101	0.0000
At most 1*	0.821186	63.69217	32.11832	0.0000
At most 2*	0.581618	32.24036	25.82321	0.0062
At most 3*	0.419315	20.11124	19.38704	0.0392
At most 4	0.215933	9.000661	12.51798	0.1803

Max-eigenvalue test indicates 4 co-integrating equ(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Johansen co-integration test in Table 6.2 (A) and 6.2(B) shows use both the trace and the maximum eigenvalues. For the Trace statistics, it's indicated 4 co-integrated equations at 0.05 levels and the Maximum eigenvalue show 4 co-integrated equation. Thus we conclude that the variables are co-integrated and have a long run relationship. Since there is co-integration, we proceed to run the restricted VECM.

6.3 Error Correction Model (VECM) Estimation

Running VECM is necessary after the variables are all at same level I(1) showing a long run relationship. We have to check the short run causality and dynamics and this is done using VECM test. The speed of the adjustment in the variables is shown by VECM technique and their equilibrium path in long run equilibrium. The ECT coefficients have to be significant and negative showing the causal effects in the long run, also it's likely to convergence and the error term correction mechanism efficiency. Bannerjee et al. (1998)

If there is a presence of co-integration it means there exists a long run relationship between the variables in thus study. We observed that there exists an error correction model, the error correction model combines the short run effects with the long run and show how much the previous disequilibrium is removed in the present year. The table below presents the VECM results for the variables used in this study.

Table 6.3: Error Correction Model

CointegratingEq:	CointEq1	CointEq2	CointEq3
LENC(-1)	1.000000	0.000000	0.000000
LFD(-1)	0.000000	1.000000	0.000000
LGDPC(-1)	0.000000	0.000000	1.000000
LIND(-1)	-0.672222	1.157020	-0.430197
	(0.12022)	(0.02954)	(0.12349)
	[-5.59141]	[39.1620]	[-3.48360]
LURB(-1)	0.339909	-0.125211	0.818264
	(0.09046)	(0.02223)	(0.09292)
	[3.75762]	[-5.63261]	[8.80636]
@TREND(70)	-0.010723	-0.013583	-0.004955
	(0.00138)	(0.00034)	(0.00142)
	[-7.75877]	[-39.9946]	[-3.49056]
C	-5.526538	-8.516656	-7.716028

Error Correction:	D(LENC)	D(LFD)	D(LGDPC)	D(LIND)	D(LURB)
CointEq1	-2.030083	-2.158559	-0.038132	-0.122204	0.242179
	(0.44232)	(0.61767)	(0.40076)	(0.48368)	(0.70716)
	[-4.58967]	[-3.49469]	[-0.09515]	[-0.25266]	[0.34247]
CointEq2	1.936623	-2.840129	0.810236	0.971337	0.384862
	(0.60329)	(0.84246)	(0.54661)	(0.65970)	(0.96452)
	[3.21010]	[-3.37123]	[1.48230]	[1.47238]	[0.39902]
CointEq3	1.887709	1.975126	-0.001239	-0.114603	-0.909415
	(0.50538)	(0.70574)	(0.45790)	(0.55264)	(0.80799)
	[3.73520]	[2.79866]	[-0.00271]	[-0.20737]	[-1.12553]
D(LENC(-1))	0.185439	1.955671	-0.486207	-0.231107	0.463437
	(0.22927)	(0.32016)	(0.20773)	(0.25071)	(0.36655)
	[0.80883]	[6.10841]	[-2.34061]	[-0.92182]	[1.26433]
D(LENC(-2))	0.164335	2.390392	-0.348518	-0.564697	-0.047909
	(0.28016)	(0.39122)	(0.25383)	(0.30635)	(0.44790)
	[0.58658]	[6.11008]	[-1.37302]	[-1.84329]	[-0.10696]
D(LENC(-3))	-0.287835	1.518549	-0.271970	-0.402988	-0.237783
	(0.28981)	(0.40471)	(0.26258)	(0.31691)	(0.46334)
	[-0.99318]	[3.75223]	[-1.03575]	[-1.27161]	[-0.51319]
D(LENC(-4))	-0.221458	0.509615	-0.248889	-0.150607	0.229523
	(0.21727)	(0.30340)	(0.19685)	(0.23758)	(0.34736)
	[-1.01929]	[1.67967]	[-1.26433]	[-0.63391]	[0.66076]
D(LFD(-1))	-1.570962	1.460217	-0.557168	-0.577359	-0.761134
	(0.48040)	(0.67085)	(0.43526)	(0.52532)	(0.76805)

	[-3.27010]	[2.17666]	[-1.28007]	[-1.09906]	[-0.99099]
D(LFD(-2))	-1.180668	1.385342	-0.596291	-0.646048	-0.476428
	(0.38003)	(0.53069)	(0.34432)	(0.41557)	(0.60758)
	[-3.10678]	[2.61046]	[-1.73178]	[-1.55463]	[-0.78414]
D(LFD(-3))	-0.264253	1.269851	-0.258306	-0.498186	-0.676565
	(0.31247)	(0.43634)	(0.28311)	(0.34169)	(0.49957)
	[-0.84569]	[2.91020]	[-0.91239]	[-1.45802]	[-1.35430]
D(LFD(-4))	-0.028591	0.649735	-0.050767	-0.120281	-0.591047
	(0.20857)	(0.29126)	(0.18898)	(0.22808)	(0.33346)
	[-0.13708]	[2.23076]	[-0.26864]	[-0.52737]	[-1.77245]
D(LGDPC(-1))	-0.026364	-0.674743	0.631018	0.109696	-1.182249
	(0.29891)	(0.41741)	(0.27082)	(0.32686)	(0.47789)
	[-0.08820]	[-1.61650]	[2.32999]	[0.33561]	[-2.47391]
D(LGDPC(-2))	-0.468152	-0.760331	-0.219977	0.475555	0.350725
	(0.32895)	(0.45936)	(0.29804)	(0.35971)	(0.52592)
	[-1.42317]	[-1.65520]	[-0.73807]	[1.32205]	[0.66688]
D(LGDPC(-3))	0.748269	-0.035109	0.084729	-0.469655	-0.161251
	(0.34249)	(0.47827)	(0.31031)	(0.37451)	(0.54756)
	[2.18480]	[-0.07341]	[0.27305]	[-1.25404]	[-0.29449]
D(LGDPC(-4))	0.208660	0.178641	0.116233	0.549057	-0.718864
	(0.38629)	(0.53943)	(0.34999)	(0.42241)	(0.61758)
	[0.54017]	[0.33117]	[0.33210]	[1.29983]	[-1.16400]
D(LIND(-1))	-2.919529	1.704808	-0.754816	-0.853789	-1.137170
	(0.76705)	(1.07114)	(0.69498)	(0.83877)	(1.22633)
	[-3.80619]	[1.59158]	[-1.08610]	[-1.01790]	[-0.92729]
D(LIND(-2))	-2.958576	1.040542	-0.895423	-1.396362	-0.768906
	(0.69419)	(0.96939)	(0.62896)	(0.75910)	(1.10984)
	[-4.26194]	[1.07340]	[-1.42365]	[-1.83950]	[-0.69281]
D(LIND(-3))	-1.573558	0.603488	-0.588154	-0.775909	-0.554936
	(0.60944)	(0.85105)	(0.55218)	(0.66643)	(0.97436)
	[-2.58197]	[0.70911]	[-1.06515]	[-1.16428]	[-0.56954]
D(LIND(-4))	-1.340540	-0.224375	-0.137021	-0.431687	-1.782588
	(0.39744)	(0.55500)	(0.36009)	(0.43460)	(0.63541)
	[-3.37298]	[-0.40428]	[-0.38052]	[-0.99330]	[-2.80542]
D(LURB(-1))	0.007473	-0.409415	0.049721	0.132241	0.941741
	(0.13771)	(0.19231)	(0.12477)	(0.15059)	(0.22017)
	[0.05426]	[-2.12897]	[0.39849]	[0.87816]	[4.27735]
D(LURB(-2))	-0.330503	-0.875995	0.100055	0.337722	-0.075566
	(0.19347)	(0.27017)	(0.17529)	(0.21156)	(0.30932)
	[-1.70828]	[-3.24237]	[0.57079]	[1.59632]	[-0.24430]
D(LURB(-3))	-0.081393	-0.399395	0.101137	0.001022	0.445902
	(0.14913)	(0.20826)	(0.13512)	(0.16308)	(0.23843)
	[-0.54577]	[-1.91780]	[0.74849]	[0.00626]	[1.87016]
D(LURB(-4))	-0.304196	-0.851379	-0.080698	0.352931	0.274899
	(0.18833)	(0.26299)	(0.17063)	(0.20594)	(0.30109)
	[-1.61527]	[-3.23736]	[-0.47294]	[1.71380]	[0.91302]

C	0.003374	-0.099105	0.024518	0.012874	0.026322
	(0.01729)	(0.02414)	(0.01566)	(0.01890)	(0.02764)
	[0.19516]	[-4.10514]	[1.56530]	[0.68102]	[0.95231]
R-squared	0.872076	0.907990	0.724760	0.754713	0.853379
Adj. R-squared	0.645749	0.745203	0.237796	0.320744	0.593971
Sum sq. Resids	0.007152	0.013947	0.005871	0.008552	0.018281
S.E. equation	0.023456	0.032754	0.021252	0.025649	0.037500
F-statistic	3.853167	5.577771	1.488324	1.739093	3.289726
Log likelihood	105.6976	93.34229	109.3484	102.3901	88.33594
Akaike AIC	-4.416089	-3.748232	-4.613427	-4.237305	-3.477618
Schwarz SC	-3.371169	-2.703312	-3.568508	-3.192385	-2.432698
Mean dependent	0.005496	0.019585	0.003416	-0.008805	0.000312
S.D. dependent	0.039409	0.064889	0.024342	0.031121	0.058851
Determinant resid covariance (dof adj.)		3.39E-17			
Determinant resid covariance		1.82E-19			
Log likelihood		535.8057			
Akaike information criterion		-21.50301			
Schwarz criterion		-15.49472			

E-view 8.0 is used for the calculations and results.

In this study, we used 4 lag lengths and the result above shows that in the short run, FD is significant in lag 1 and 2, GDPC is significant in lag 3, IND is significant in all lags. Our empirical result shows that the ECT which shows the speed of adjustment is negative and statistically significant. This shows that the short run value of ENC will converge to its long run by 2.0301% every year or annually. The R-squared is 87.2076% this shows that the coefficient of determination accounts for 87.2076% of the variation in Energy consumption as explained by financial development, GDP, Industrialization and Urbanization. This suggests that the remaining 12.7924% is determined by other factors which are not included in the model. All the variables are significant in the long-run. Also the F-statistics shows that the variables are jointly significant.

6.4 Short-run Granger Causality Test

After the co-integration test and ECM analysis was carried out, we found that the variables are co-integrated. Next step is the Granger causality test, Table 6.4 bellow shows the result. The null hypothesis concludes that there exists no causal relationship between variables against its alternative, the alternative concludes that independent variable Granger cause the dependant variable. If we reject the null hypothesis which mean we accept the alternative that states that independent variable Granger cause the dependant variable.

To see the direction of causality between the variables, we utilize the Granger causality test. The results are shown in the table below.

Table 6.4: Granger Causality Test Result

Null Hypothesis	Observations	F-Statistic	Probability
LNFD does not Granger Cause LNENC	40	0.21387	0.8085
LNENC does not Granger Cause LNFD		1.28709	0.2888
LNGDPC does not Granger Cause LNENC	40	0.50310	0.6090
LNENC does not Granger Cause LNGDPC		1.11023	0.3408
LNIND does not Granger Cause LNENC	40	0.25185	0.7788
LNENC does not Granger Cause LNIND		2.92992	0.0666
LNURB does not Granger Cause LNENC	40	1.25055	0.2988
LNENC does not Granger Cause LNURB		0.25234	0.7784
LNGDPC does not Granger Cause LNFD	43	1.18580	0.0575
LNFD does not Granger Cause LNGDPC		1.632207	0.0034
LNIND does not Granger Cause LNFD	43	3.08213	0.1676
LNFD does not Granger Cause LNIND		6.63302	0.0013
LNURB does not Granger Cause LNFD	43	1.85586	0.1702
LNFD does not Granger Cause LNURB		1.42415	0.2533
LNIND does not Granger Cause LNGDPC	43	4.74050	0.0145
LNGDPC does not Granger Cause LNIND		0.26330	0.7699
LNURB does not Granger Cause LNGDPC	43	4.03145	0.0258
LNGDPC does not Granger Cause LNURB		0.42076	0.6596
LNURB does not Granger Cause LNIND	43	2.18410	0.1265

LNIND does not Granger Cause LNURB		1.87793	0.1668

E-view 8.0 is used for the calculations and results.

We have different methods for lag selection and it includes Schwartz information criteria (SIC), Akaike information criteria (AIC) and Hsiao's (1979) consecutive methodology. Pindyck and Rubinfield (1991) proposed that it is best to utilize diverse lag structure. In this study we attempt the lag lengths somewhere around (1) and (4) since we have limited observation.

From the ECT_{t-1} results obtain form the previous table, it show that ECT_{t-1} is significant and also has a negative sign in the energy-equation, financial-equation and industrialization-equation. Financial development and the use of energy bidirectional causal relationship is shown by the granger causality result in table 6.4 above. This indicates that when domestic credit provided by financial sector is easy and affordable for individuals, this increases the acquisition of electrical appliances and in turn increases the usage of electricity there by increasing the use of energy. Likewise, an increase in energy consumption prompts more monetary and speculation exercises subsequently, increases the demand for financial services which additionally prompts financial improvement.

The bidirectional relationship between financial development and energy utilization demonstrates that industrialization is caused by financial development by giving simple access of monetary assets to commercial ventures or firm. Meanwhile, increment in industrialization expands the demand for financial assets thus prompt financial development. Additionally a development in industrialization builds need for energy. The outcome likewise demonstrates a bidirectional relationship between energy utilization and economic development.

Results also show a bidirectional causal relationship between energy consumption and economic growth in the short-run. This implies that energy conservation polices may not adversely affect the economic growth. The result also shows that energy use also Granger causes urbanization so economic and urbanization also has feedback effect. The demand-side hypothesis is confirmed as economic growth Granger causes financial development.

Chapter 7

CONCLUSION, RECOMMENDATION

This study examines if energy use increases as a result of a change in financial development in South Africa. This study also inquiries if there exist a long run relationship among variables. Data was collected form World Development Indicator (WDI) covering the period 1970 to 2014 (44years). The unit root test of the ADF was used to check the stationarity properties also KPSS technique is also used for the unit root test.

From the above 6.1 table, which shows the unit root results shows that all variables are non- stationary at level but at first difference. The table demonstrates that all variables are integrated at the same level, I(1). The Johansen co-integration demonstrates the presence of four co-integrating vectors, which means there exists a long run relationship between the variables in this study. It tells that over the long run, all variables will converge together. Table 6.3 shows the speed of adjustment and the effects in the long run. The values are negative showing how far we are from the equilibrium value.

In the activities of an economy, the importance of finance is shown in the study of the relationship between financial development and the nation's growth, also the literature on energy shows why energy is important in improving the growth of an economy. In high return projects, developed financial system provides a way to reallocate financial resources. Meanwhile, investments enhance the growth of an economy therefore the demand for energy utilization will increase.

The results found in this study is not far from the preceding expectation in other words, this study supports Shahbaz, M and Lean, H (2012) and Zeheer, Bashir and Muhammad (2011). Who also study different countries like Tunisia and Pakistan respectively.

From the result in the previous chapter, the Granger causality shows there exists a bidirectional causality between improving finance and the use of energy, so policymakers alongside the Government should introduce financial development measure which includes efficient allocation of financial resources, strengthening the financial institution etc. will improve the utilization of energy in the long-run. Government should make provisions for incentives to consumers in other to use energy efficiently. Lastly, Improving industrialization and urbanization is necessary for development. Industrial sector like coal and mining industries is one of the key economic sectors in South Africa. The South African government should invest in small industries, which in turn promotes the nation’s growth as well as increasing the utilization of energy.

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APPENDICES

Appendix A: ADF Test

Null Hypothesis: LENC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.889063	0.6420
Test critical values:	1% level	-4.198503	
	5% level	-3.523623	
	10% level	-3.192902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LENC)
Method: Least Squares
Date: 07/22/16 Time: 09:36
Sample (adjusted): 1972 2012
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LENC(-1)	-0.145355	0.076945	-1.889063	0.0665
C	1.141822	0.593121	1.925109	0.0617
@TREND("1970")	0.000205	0.000667	0.306774	0.7607

R-squared	0.125863	Mean dependent var	0.006970
Adjusted R-squared	0.079856	S.D. dependent var	0.038102
S.E. of regression	0.036549	Akaike info criterion	-3.709946
Sum squared resid	0.050763	Schwarz criterion	-3.584563
Log likelihood	79.05390	Hannan-Quinn criter.	-3.664288
F-statistic	2.735726	Durbin-Watson stat	1.943888
Prob(F-statistic)	0.077626		

Null Hypothesis: LFD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.336954	0.4061
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LFD)
Method: Least Squares
Date: 07/22/16 Time: 09:38
Sample (adjusted): 1971 2014
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFD(-1)	-0.194285	0.083136	-2.336954	0.0244
C	0.837495	0.355210	2.357750	0.0232
@TREND("1970")	0.004850	0.002040	2.377418	0.0222

R-squared	0.122870	Mean dependent var	0.016814
Adjusted R-squared	0.080083	S.D. dependent var	0.061402
S.E. of regression	0.058892	Akaike info criterion	-2.760479
Sum squared resid	0.142199	Schwarz criterion	-2.638830
Log likelihood	63.73053	Hannan-Quinn criter.	-2.715365
F-statistic	2.871671	Durbin-Watson stat	2.182600
Prob(F-statistic)	0.068048		

Null Hypothesis: LGDPC has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.229395	0.8915
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDPC)
Method: Least Squares
Date: 07/22/16 Time: 09:39
Sample (adjusted): 1972 2014
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDPC(-1)	-0.058690	0.047739	-1.229395	0.2263
D(LGDPC(-1))	0.407712	0.150116	2.715980	0.0098
C	0.497600	0.407230	1.221912	0.2291
@TREND("1970")	0.000326	0.000281	1.160585	0.2529

R-squared	0.195223	Mean dependent var	0.004176
Adjusted R-squared	0.133317	S.D. dependent var	0.023391
S.E. of regression	0.021776	Akaike info criterion	-4.727607
Sum squared resid	0.018494	Schwarz criterion	-4.563774
Log likelihood	105.6435	Hannan-Quinn criter.	-4.667191
F-statistic	3.153541	Durbin-Watson stat	1.920273
Prob(F-statistic)	0.035495		

Null Hypothesis: LIND has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.188388	0.4840

Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIND)
Method: Least Squares
Date: 07/22/16 Time: 09:41
Sample (adjusted): 1971 2014
Included observations: 44 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIND(-1)	-0.120221	0.054936	-2.188388	0.0344
C	0.464414	0.210052	2.210948	0.0327
@TREND("1970")	-0.001693	0.000654	-2.588926	0.0133

R-squared	0.140521	Mean dependent var	-0.005887
Adjusted R-squared	0.098595	S.D. dependent var	0.031537
S.E. of regression	0.029942	Akaike info criterion	-4.113389
Sum squared resid	0.036756	Schwarz criterion	-3.991740
Log likelihood	93.49456	Hannan-Quinn criter.	-4.068276
F-statistic	3.351658	Durbin-Watson stat	1.558663
Prob(F-statistic)	0.044856		

Null Hypothesis: LURB has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.154264	0.5020
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LURB)
Method: Least Squares
Date: 07/22/16 Time: 09:42
Sample (adjusted): 1972 2014
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LURB(-1)	-0.093336	0.043326	-2.154264	0.0375
D(LURB(-1))	0.590665	0.128776	4.586770	0.0000
C	0.100074	0.045982	2.176380	0.0356
@TREND("1970")	-0.000369	0.000555	-0.665447	0.5097

R-squared	0.388720	Mean dependent var	-0.000576
Adjusted R-squared	0.341698	S.D. dependent var	0.054610
S.E. of regression	0.044308	Akaike info criterion	-3.306880
Sum squared resid	0.076566	Schwarz criterion	-3.143048

Log likelihood	75.09793	Hannan-Quinn criter.	-3.246464
F-statistic	8.266849	Durbin-Watson stat	1.673404
Prob(F-statistic)	0.000223		

Null Hypothesis: D(LENC) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.317481	0.0000
Test critical values:	1% level	-4.205004	
	5% level	-3.526609	
	10% level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LENC,2)
Method: Least Squares
Date: 07/22/16 Time: 09:42
Sample (adjusted): 1973 2012
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LENC(-1))	-1.035744	0.163949	-6.317481	0.0000
C	0.025312	0.013751	1.840746	0.0737
@TREND("1970")	-0.000788	0.000535	-1.472694	0.1493

R-squared	0.519711	Mean dependent var	-0.000558
Adjusted R-squared	0.493749	S.D. dependent var	0.054032
S.E. of regression	0.038445	Akaike info criterion	-3.607156
Sum squared resid	0.054686	Schwarz criterion	-3.480490
Log likelihood	75.14313	Hannan-Quinn criter.	-3.561358
F-statistic	20.01846	Durbin-Watson stat	1.968865
Prob(F-statistic)	0.000001		

Null Hypothesis: D(LFD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.535791	0.0000
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LFD,2)
Method: Least Squares
Date: 07/22/16 Time: 09:44
Sample (adjusted): 1972 2014

Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFD(-1))	-1.172461	0.155586	-7.535791	0.0000
C	0.008001	0.020092	0.398222	0.6926
@TREND("1970")	0.000499	0.000770	0.647844	0.5208

R-squared	0.586738	Mean dependent var	-0.000187
Adjusted R-squared	0.566075	S.D. dependent var	0.094801
S.E. of regression	0.062448	Akaike info criterion	-2.641747
Sum squared resid	0.155991	Schwarz criterion	-2.518872
Log likelihood	59.79756	Hannan-Quinn criter.	-2.596435
F-statistic	28.39545	Durbin-Watson stat	1.966610
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LGDPC) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.368106	0.0062
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDPC,2)
Method: Least Squares
Date: 07/22/16 Time: 09:44
Sample (adjusted): 1972 2014
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDPC(-1))	-0.638696	0.146218	-4.368106	0.0001
C	-0.002973	0.007050	-0.421693	0.6755
@TREND("1970")	0.000238	0.000273	0.870738	0.3891

R-squared	0.323103	Mean dependent var	-0.000453
Adjusted R-squared	0.289258	S.D. dependent var	0.025994
S.E. of regression	0.021915	Akaike info criterion	-4.736097
Sum squared resid	0.019210	Schwarz criterion	-4.613222
Log likelihood	104.8261	Hannan-Quinn criter.	-4.690784
F-statistic	9.546598	Durbin-Watson stat	1.880589
Prob(F-statistic)	0.000408		

Null Hypothesis: D(LIND) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-5.439104	0.0003

Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIND,2)
Method: Least Squares
Date: 07/22/16 Time: 09:45
Sample (adjusted): 1972 2014
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIND(-1))	-0.816175	0.150057	-5.439104	0.0000
C	0.009057	0.009802	0.924016	0.3610
@TREND("1970")	-0.000565	0.000381	-1.482609	0.1460

R-squared	0.426630	Mean dependent var	0.000707
Adjusted R-squared	0.397961	S.D. dependent var	0.039181
S.E. of regression	0.030401	Akaike info criterion	-4.081463
Sum squared resid	0.036969	Schwarz criterion	-3.958588
Log likelihood	90.75145	Hannan-Quinn criter.	-4.036150
F-statistic	14.88146	Durbin-Watson stat	1.802722
Prob(F-statistic)	0.000015		

Null Hypothesis: D(LURB) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.225580	0.0092
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LURB,2)
Method: Least Squares
Date: 07/22/16 Time: 09:45
Sample (adjusted): 1973 2014
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LURB(-1))	-0.612889	0.145042	-4.225580	0.0001
D(LURB(-1),2)	0.348910	0.151962	2.296036	0.0273
C	0.011714	0.015180	0.771681	0.4451
@TREND("1970")	-0.000500	0.000577	-0.866748	0.3915

R-squared	0.320839	Mean dependent var	0.000288
Adjusted R-squared	0.267221	S.D. dependent var	0.051835
S.E. of regression	0.044372	Akaike info criterion	-3.302031
Sum squared resid	0.074817	Schwarz criterion	-3.136538

Log likelihood	73.34264	Hannan-Quinn criter.	-3.241371
F-statistic	5.983805	Durbin-Watson stat	1.960973
Prob(F-statistic)	0.001916		

Appendix B: Unrestricted Co-integration Test.

Date: 05/20/16 Time: 18:27
Sample (adjusted): 1976 2012
Included observations: 37 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: LENC LDCBS LGDPC LIND LURB
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.897776	209.4261	88.80380	0.0000
At most 1 *	0.821186	125.0444	63.87610	0.0000
At most 2 *	0.581618	61.35227	42.91525	0.0003
At most 3 *	0.419315	29.11190	25.87211	0.0191
At most 4	0.215933	9.000661	12.51798	0.1803

Trace test indicates 4 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.897776	84.38169	38.33101	0.0000
At most 1 *	0.821186	63.69217	32.11832	0.0000
At most 2 *	0.581618	32.24036	25.82321	0.0062
At most 3 *	0.419315	20.11124	19.38704	0.0392
At most 4	0.215933	9.000661	12.51798	0.1803

Max-eigenvalue test indicates 4 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LENC	LDCBS	LGDPC	LIND	LURB	@TREND(71)
99.05011	-31.97929	-89.00260	-65.29567	-35.15545	-0.186692
-9.712929	-95.52240	24.26048	-114.4289	28.51047	1.281433
-57.02841	119.7084	93.09736	136.7906	41.80490	-1.475829
30.00649	-12.77677	7.474617	-47.56168	-0.763137	-0.495436
61.81013	-54.39699	-57.41687	-53.44665	-25.73962	0.492782

Unrestricted Adjustment Coefficients (alpha):

D(LENC)	-0.018665	-0.008274	0.004589	-0.006653	-0.001973
D(LDCBS)	-0.024378	0.026591	-0.009020	0.000313	-0.004566
D(LGDPC)	-0.000123	-0.006487	0.001559	-0.005202	-0.004239
D(LIND)	-0.003069	-0.010826	-0.001344	0.007499	-0.003864
D(LURB)	-0.005258	-0.015687	-0.010707	-0.005520	0.007806

1 Cointegrating Equation(s): Log likelihood 487.8395

Normalized cointegrating coefficients (standard error in parentheses)

LENC	LDCBS	LGDPC	LIND	LURB	@TREND(71)
1.000000	-0.322860	-0.898561	-0.659219	-0.354926	-0.001885
	(0.11984)	(0.05556)	(0.13424)	(0.02910)	(0.00179)

Adjustment coefficients (standard error in parentheses)

D(LENC)	-1.848734
	(0.43010)
D(LDCBS)	-2.414654
	(0.87305)
D(LGDPC)	-0.012222
	(0.36456)
D(LIND)	-0.304008
	(0.47856)
D(LURB)	-0.520805
	(0.74773)

2 Cointegrating Equation(s): Log likelihood 519.6856

Normalized cointegrating coefficients (standard error in parentheses)

LENC	LDCBS	LGDPC	LIND	LURB	@TREND(71)
1.000000	0.000000	-0.949393	-0.263796	-0.436945	-0.006018
		(0.05694)	(0.03682)	(0.03061)	(0.00051)
0.000000	1.000000	-0.157441	1.224750	-0.254039	-0.012803
		(0.07428)	(0.04803)	(0.03993)	(0.00067)

Adjustment coefficients (standard error in parentheses)

D(LENC)	-1.768367	1.387254
	(0.37624)	(0.38080)
D(LDCBS)	-2.672928	-1.760417
	(0.55013)	(0.55680)
D(LGDPC)	0.050785	0.623591
	(0.32618)	(0.33014)
D(LIND)	-0.198860	1.132245
	(0.39221)	(0.39697)
D(LURB)	-0.368438	1.666609
	(0.63402)	(0.64171)

3 Cointegrating Equation(s): Log likelihood 535.8057

Normalized cointegrating coefficients (standard error in parentheses)

LENC	LDCBS	LGDPC	LIND	LURB	@TREND(71)
1.000000	0.000000	0.000000	-0.672222	0.339909	-0.010723
			(0.11192)	(0.08421)	(0.00129)
0.000000	1.000000	0.000000	1.157020	-0.125211	-0.013583
			(0.02750)	(0.02069)	(0.00032)
0.000000	0.000000	1.000000	-0.430197	0.818264	-0.004955
			(0.11496)	(0.08650)	(0.00132)

Adjustment coefficients (standard error in parentheses)

D(LENC)	-2.030083	1.936623	1.887709
	(0.41177)	(0.56163)	(0.47049)
D(LDCBS)	-2.158559	-2.840129	1.975126
	(0.57502)	(0.78429)	(0.65701)
D(LGDPC)	-0.038132	0.810236	-0.001239
	(0.37308)	(0.50886)	(0.42628)
D(LIND)	-0.122204	0.971337	-0.114603
	(0.45028)	(0.61415)	(0.51448)
D(LURB)	0.242179	0.384862	-0.909415

	(0.65833)	(0.89792)	(0.75220)

4 Cointegrating Equation(s):		Log likelihood	545.8614

Normalized cointegrating coefficients (standard error in parentheses)

LENC	LDCBS	LGDPC	LIND	LURB	@TREND(71)
1.000000	0.000000	0.000000	0.000000	1.676793	0.011479
				(0.52140)	(0.00511)
0.000000	1.000000	0.000000	0.000000	-2.426241	-0.051796
				(0.82005)	(0.00804)
0.000000	0.000000	1.000000	0.000000	1.673821	0.009253
				(0.35361)	(0.00347)
0.000000	0.000000	0.000000	1.000000	1.988755	0.033027
				(0.70920)	(0.00695)

Adjustment coefficients (standard error in parentheses)

D(LENC)	-2.229707	2.021623	1.837983	3.109704
	(0.37374)	(0.49481)	(0.41380)	(0.61714)
D(LDCBS)	-2.149177	-2.844124	1.977463	-2.699619
	(0.59429)	(0.78680)	(0.65799)	(0.98133)
D(LGDPC)	-0.194239	0.876707	-0.040126	1.211063
	(0.35121)	(0.46498)	(0.38886)	(0.57995)
D(LIND)	0.102800	0.875530	-0.058554	0.898665
	(0.40488)	(0.53603)	(0.44828)	(0.66856)
D(LURB)	0.076543	0.455390	-0.950675	0.936263
	(0.65917)	(0.87269)	(0.72982)	(1.08846)

Appendix C: Granger Causality Test

Pairwise Granger Causality Tests
Date: 05/20/16 Time: 18:15
Sample: 1970 2014
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LDCBS does not Granger Cause LENC	40	0.21387	0.8085
LENC does not Granger Cause LDCBS		1.28709	0.2888
LGDPC does not Granger Cause LENC	40	0.50310	0.6090
LENC does not Granger Cause LGDPC		1.11023	0.3408
LIND does not Granger Cause LENC	40	0.25185	0.7788
LENC does not Granger Cause LIND		2.92992	0.0666
LURB does not Granger Cause LENC	40	1.25055	0.2988
LENC does not Granger Cause LURB		0.25234	0.7784
LGDPC does not Granger Cause LDCBS	43	1.18580	0.3166
LDCBS does not Granger Cause LGDPC		1.63207	0.2089
LIND does not Granger Cause LDCBS	43	3.08213	0.0575
LDCBS does not Granger Cause LIND		6.63302	0.0034
LURB does not Granger Cause LDCBS	43	1.85586	0.1702
LDCBS does not Granger Cause LURB		1.42415	0.2533
LIND does not Granger Cause LGDPC	43	4.74050	0.0145
LGDPC does not Granger Cause LIND		0.26330	0.7699
LURB does not Granger Cause LGDPC	43	4.03145	0.0258
LGDPC does not Granger Cause LURB		0.42076	0.6596
LURB does not Granger Cause LIND	43	2.18410	0.1265
LIND does not Granger Cause LURB		1.87793	0.1668

Appendix D: Error Correction Model Test

Vector Error Correction Estimates
Date: 07/21/16 Time: 08:35
Sample (adjusted): 1976 2012
Included observations: 37 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1	CointEq2	CointEq3
LENC(-1)	1.000000	0.000000	0.000000
LFD(-1)	0.000000	1.000000	0.000000
LGDPC(-1)	0.000000	0.000000	1.000000
LIND(-1)	-0.672222	1.157020	-0.430197
	(0.12022)	(0.02954)	(0.12349)
	[-5.59141]	[39.1620]	[-3.48360]
LURB(-1)	0.339909	-0.125211	0.818264
	(0.09046)	(0.02223)	(0.09292)
	[3.75762]	[-5.63261]	[8.80636]
@TREND(70)	-0.010723	-0.013583	-0.004955
	(0.00138)	(0.00034)	(0.00142)
	[-7.75877]	[-39.9946]	[-3.49056]
C	-5.526538	-8.516656	-7.716028

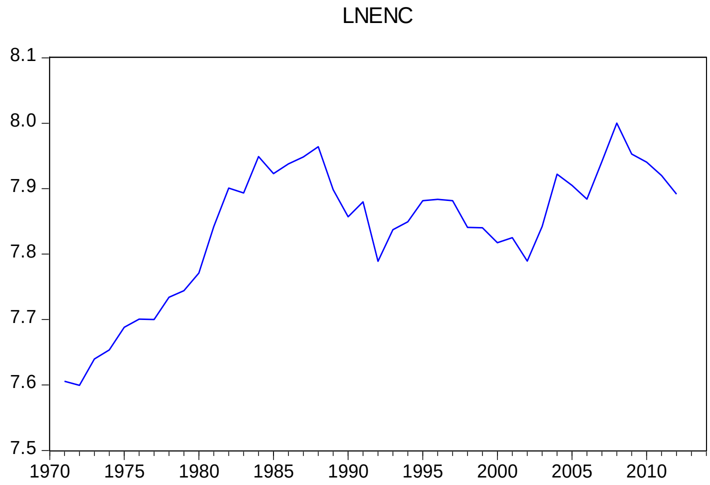
Error Correction:	D(LENC)	D(LFD)	D(LGDPC)	D(LIND)	D(LURB)
CointEq1	-2.030083	-2.158559	-0.038132	-0.122204	0.242179
	(0.44232)	(0.61767)	(0.40076)	(0.48368)	(0.70716)
	[-4.58967]	[-3.49469]	[-0.09515]	[-0.25266]	[0.34247]
CointEq2	1.936623	-2.840129	0.810236	0.971337	0.384862
	(0.60329)	(0.84246)	(0.54661)	(0.65970)	(0.96452)
	[3.21010]	[-3.37123]	[1.48230]	[1.47238]	[0.39902]
CointEq3	1.887709	1.975126	-0.001239	-0.114603	-0.909415
	(0.50538)	(0.70574)	(0.45790)	(0.55264)	(0.80799)
	[3.73520]	[2.79866]	[-0.00271]	[-0.20737]	[-1.12553]
D(LENC(-1))	0.185439	1.955671	-0.486207	-0.231107	0.463437
	(0.22927)	(0.32016)	(0.20773)	(0.25071)	(0.36655)
	[0.80883]	[6.10841]	[-2.34061]	[-0.92182]	[1.26433]
D(LENC(-2))	0.164335	2.390392	-0.348518	-0.564697	-0.047909
	(0.28016)	(0.39122)	(0.25383)	(0.30635)	(0.44790)
	[0.58658]	[6.11008]	[-1.37302]	[-1.84329]	[-0.10696]
D(LENC(-3))	-0.287835	1.518549	-0.271970	-0.402988	-0.237783
	(0.28981)	(0.40471)	(0.26258)	(0.31691)	(0.46334)
	[-0.99318]	[3.75223]	[-1.03575]	[-1.27161]	[-0.51319]
D(LENC(-4))	-0.221458	0.509615	-0.248889	-0.150607	0.229523
	(0.21727)	(0.30340)	(0.19685)	(0.23758)	(0.34736)
	[-1.01929]	[1.67967]	[-1.26433]	[-0.63391]	[0.66076]

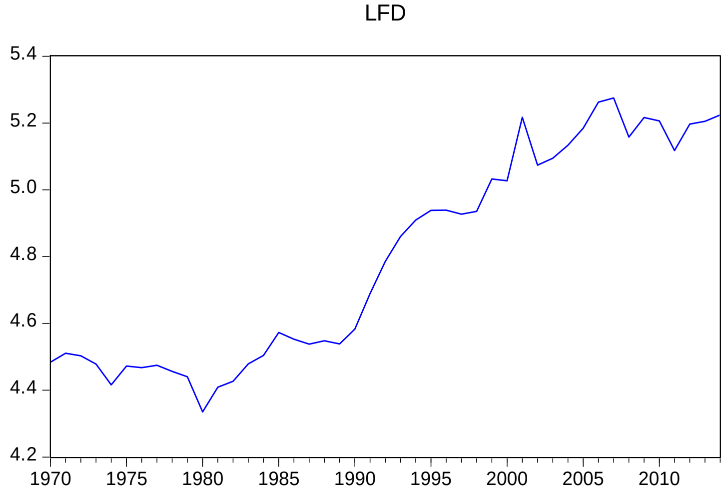
D(LFD(-1))	-1.570962	1.460217	-0.557168	-0.577359	-0.761134
	(0.48040)	(0.67085)	(0.43526)	(0.52532)	(0.76805)
	[-3.27010]	[2.17666]	[-1.28007]	[-1.09906]	[-0.99099]
D(LFD(-2))	-1.180668	1.385342	-0.596291	-0.646048	-0.476428
	(0.38003)	(0.53069)	(0.34432)	(0.41557)	(0.60758)
	[-3.10678]	[2.61046]	[-1.73178]	[-1.55463]	[-0.78414]
D(LFD(-3))	-0.264253	1.269851	-0.258306	-0.498186	-0.676565
	(0.31247)	(0.43634)	(0.28311)	(0.34169)	(0.49957)
	[-0.84569]	[2.91020]	[-0.91239]	[-1.45802]	[-1.35430]
D(LFD(-4))	-0.028591	0.649735	-0.050767	-0.120281	-0.591047
	(0.20857)	(0.29126)	(0.18898)	(0.22808)	(0.33346)
	[-0.13708]	[2.23076]	[-0.26864]	[-0.52737]	[-1.77245]
D(LGDPC(-1))	-0.026364	-0.674743	0.631018	0.109696	-1.182249
	(0.29891)	(0.41741)	(0.27082)	(0.32686)	(0.47789)
	[-0.08820]	[-1.61650]	[2.32999]	[0.33561]	[-2.47391]
D(LGDPC(-2))	-0.468152	-0.760331	-0.219977	0.475555	0.350725
	(0.32895)	(0.45936)	(0.29804)	(0.35971)	(0.52592)
	[-1.42317]	[-1.65520]	[-0.73807]	[1.32205]	[0.66688]
D(LGDPC(-3))	0.748269	-0.035109	0.084729	-0.469655	-0.161251
	(0.34249)	(0.47827)	(0.31031)	(0.37451)	(0.54756)
	[2.18480]	[-0.07341]	[0.27305]	[-1.25404]	[-0.29449]
D(LGDPC(-4))	0.208660	0.178641	0.116233	0.549057	-0.718864
	(0.38629)	(0.53943)	(0.34999)	(0.42241)	(0.61758)
	[0.54017]	[0.33117]	[0.33210]	[1.29983]	[-1.16400]
D(LIND(-1))	-2.919529	1.704808	-0.754816	-0.853789	-1.137170
	(0.76705)	(1.07114)	(0.69498)	(0.83877)	(1.22633)
	[-3.80619]	[1.59158]	[-1.08610]	[-1.01790]	[-0.92729]
D(LIND(-2))	-2.958576	1.040542	-0.895423	-1.396362	-0.768906
	(0.69419)	(0.96939)	(0.62896)	(0.75910)	(1.10984)
	[-4.26194]	[1.07340]	[-1.42365]	[-1.83950]	[-0.69281]
D(LIND(-3))	-1.573558	0.603488	-0.588154	-0.775909	-0.554936
	(0.60944)	(0.85105)	(0.55218)	(0.66643)	(0.97436)
	[-2.58197]	[0.70911]	[-1.06515]	[-1.16428]	[-0.56954]
D(LIND(-4))	-1.340540	-0.224375	-0.137021	-0.431687	-1.782588
	(0.39744)	(0.55500)	(0.36009)	(0.43460)	(0.63541)
	[-3.37298]	[-0.40428]	[-0.38052]	[-0.99330]	[-2.80542]
D(LURB(-1))	0.007473	-0.409415	0.049721	0.132241	0.941741
	(0.13771)	(0.19231)	(0.12477)	(0.15059)	(0.22017)
	[0.05426]	[-2.12897]	[0.39849]	[0.87816]	[4.27735]
D(LURB(-2))	-0.330503	-0.875995	0.100055	0.337722	-0.075566
	(0.19347)	(0.27017)	(0.17529)	(0.21156)	(0.30932)
	[-1.70828]	[-3.24237]	[0.57079]	[1.59632]	[-0.24430]
D(LURB(-3))	-0.081393	-0.399395	0.101137	0.001022	0.445902
	(0.14913)	(0.20826)	(0.13512)	(0.16308)	(0.23843)
	[-0.54577]	[-1.91780]	[0.74849]	[0.00626]	[1.87016]
D(LURB(-4))	-0.304196	-0.851379	-0.080698	0.352931	0.274899

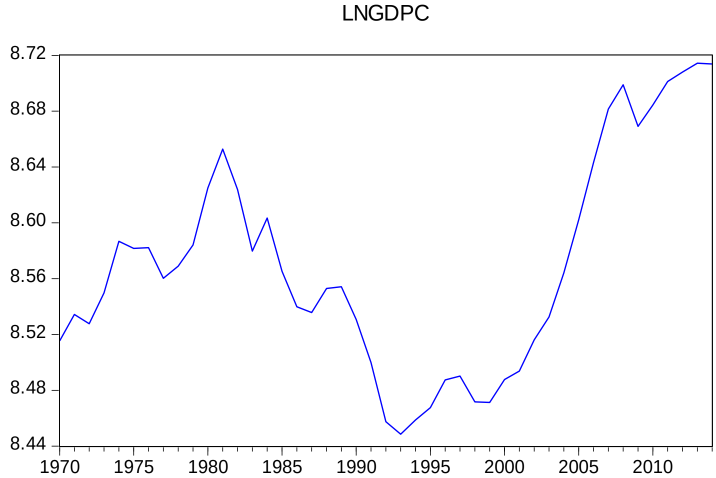
	(0.18833)	(0.26299)	(0.17063)	(0.20594)	(0.30109)
	[-1.61527]	[-3.23736]	[-0.47294]	[1.71380]	[0.91302]
C	0.003374	-0.099105	0.024518	0.012874	0.026322
	(0.01729)	(0.02414)	(0.01566)	(0.01890)	(0.02764)
	[0.19516]	[-4.10514]	[1.56530]	[0.68102]	[0.95231]
R-squared	0.872076	0.907990	0.724760	0.754713	0.853379
Adj. R-squared	0.645749	0.745203	0.237796	0.320744	0.593971
Sum sq. resids	0.007152	0.013947	0.005871	0.008552	0.018281
S.E. equation	0.023456	0.032754	0.021252	0.025649	0.037500
F-statistic	3.853167	5.577771	1.488324	1.739093	3.289726
Log likelihood	105.6976	93.34229	109.3484	102.3901	88.33594
Akaike AIC	-4.416089	-3.748232	-4.613427	-4.237305	-3.477618
Schwarz SC	-3.371169	-2.703312	-3.568508	-3.192385	-2.432698
Mean dependent	0.005496	0.019585	0.003416	-0.008805	0.000312
S.D. dependent	0.039409	0.064889	0.024342	0.031121	0.058851

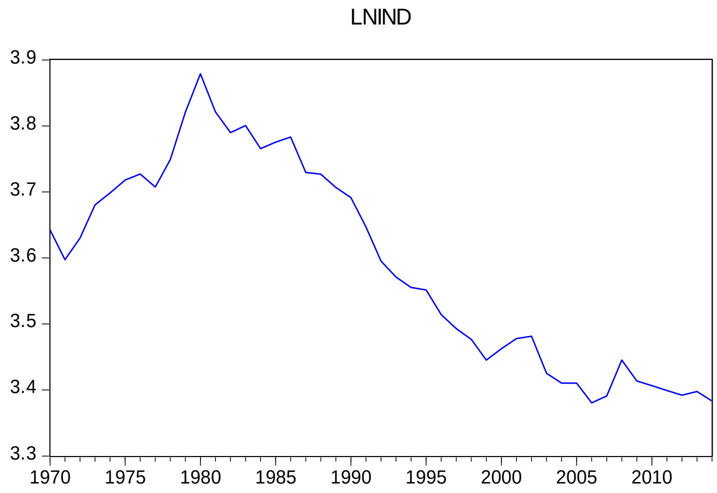
Determinant resid covariance (dof adj.)	3.39E-17
Determinant resid covariance	1.82E-19
Log likelihood	535.8057
Akaike information criterion	-21.50301
Schwarz criterion	-15.49472

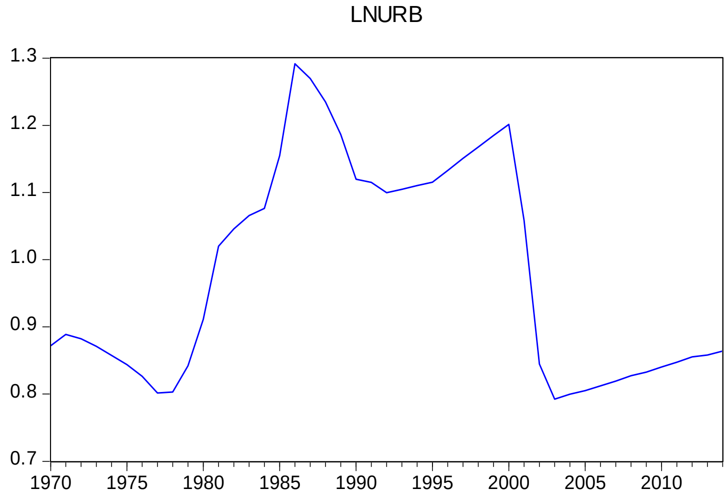
Appendix E: Graphical Representation of Variables








LNIND
3.9
3.8
3.7
3.6
3.5
3.4
3.3
1970
1975
1980
1985
1990
1995
2000
2005
2010


LNURB
1.3
1.2
1.1
1.0
0.9
0.8
0.7
1970
1975
1980
1985
1990
1995
2000
2005
2010