Energy Consumption, Financial Development and Growth: Evidence from Cointegration with unknown Structural breaks in Lebanon

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Abstract
This paper investigates the dynamic causal relationship between financial development, energy consumption and economic growth in Lebanon over the period 1993M1-2010M12.Our findings confirm the existence of cointegration among the variables. The results indicate that financial development and energy consumption, contribute to economic growth in Lebanon. The impact of energy consumption on economic growth is positive showing the significance of energy as a main stimulant of economic growth. Financial development is also found to play a vital role in enhancing economic growth. Economic growth and financial development also add in energy consumption. The study, therefore, recommends that in short run, policy makers should put more emphasis in developing strategies that would result in achieving higher mobilization of savings in order to boost Lebanese investors' confidence and to also attract more foreign investment in Lebanon. Furthermore, desired financial policy to encounter the rising demand for energy by enhancing the process of capitalization of the energy sector is also very desirable. Our results further cautions of the use of policy tools geared towards restricting energy consumption in short run, something that is called for as part of national energy policy, as these may result in lower economic growth. Such conservation policies should be taken gradually and carefully as to not negatively impact the growth of the economy. However, in long run, the Lebanese government should shift its focus towards achieving higher economic growth, in order to boost its financial development and to sustain a steady flow of needed energy. In this regards, policymakers should put emphasis on the development of domestic energy resources to protect the country from any undesirable external energy shock given its extensive dependence on energy imports.

Keywords: Economic growth, financial development, energy consumption

I. Introduction

Energy economics has drawn substantial attention from academicians in recent times. A number of studies have investigated the causal relationship between energy consumption and economic growth. This issue is important because energy drives the wheels of economic growth since it is a key factor of production, along with capital, labour and raw materials. In addition, the higher GDP per capita, the more is the energy demand, is a relation that is intuitively appealing. The pioneering study by Kraft and Kraft (1978) confirms this intuition by providing evidence of unidirectional causality from GNP to energy use for the US over the period 1947-1974.

Much of the research aimed at exploring the long run relationship and the direction of causality between economic growth and energy use has included several other variables e.g. population, urbanization, financial development etc., to better understand the underlying dynamics of the relation. Lee et al. (2008) included capital stock and labor to explain energy use for some Asian nations. They found that the positive link between economic growth and energy demand gets stronger as relevant variables are included. Ang, (2007) explored the dynamic causal relationships between GDP and energy consumption in France. He found that economic growth influences energy consumption (and pollution) in the long run, but the relation reverses in the short run in case of France. Apergis and Payne, (2009a, 2009b, 2010) and Wolde-Rufael, (2009a) argued that rise in energy demand in emerging economies is closely linked to income. Population growth creates pressure on rural resources, forces people to move to urban areas and thus increases energy demand. For sustained economic growth, the increased energy demand over a long period must be met from new sources, or by developing cost-effective alternative energy. Using both bi-and-multivariate models for New Zealand, Bartleet and Gounder, (2010) found causality running from real GDP to energy use. They also found that real GDP and employment exert significant impact on capital formation, where capital stock plays an important role in determining the direction of causality.

The objective of this paper is to examine the existence of long run relationship among energy consumption ($\ln E_t$), financial development ($\ln F_t$), and economic growth ($\ln Y_t$) for Lebanon using monthly data over the period of 1993-2010. The ARDL bounds testing approach to cointegration is used to examine a long run relation among the series. The Innovative Accounting Technique (Variance Decomposition Approach and Impulse Response Function)[1] shows the response of dependent variable to shocks arising in independent variables. We use this method to examine the short run dynamics and the direction of causality. This method is helpful in determining the relative strength of causal relation beyond the chosen time frame (Shan, 2006; Shahbaz et al. 2010), and the magnitude of the feedback among the series.

The rest of the paper is organized as follows. Section-II reviews the relevant literature with focus on the link between economic growth and energy consumption, economic growth and financial development, and financial development and energy consumption. Section-III describes data and empirical strategy. Results are reported in section-IV. Conclusion and policy issues are reported in section-V.

[1] The methodological framework is based on Shan (2006) and Shahbaz et al. (2013)

II. Literature Review

The question of whether energy consumption and or financial development sway the rate of economic growth of a country or a region has shaped an important query among economists in the literature for some time. This interest is driven primarily from the important policy implications that can be obtained from such studies in relation to the desired action(s) that can accelerate the rate of economic growth and prosperity. Empirical studies on this regards, however, provided conflicting results so economists' views on this issue have not been unanimous. Below, we will provide a brief review the studies that addressed the impacts of these variables on economic growth.

II.1 Economic Growth and Energy Consumption

Energy forms the lifeblood of the world economy as it is an essential input to almost all of the goods and services of the modern global economy. It contributes to economic growth directly as it creates jobs and value by extracting, transforming and distributing of energy goods and services throughout the economy. Furthermore, and more importantly, this sector's activities relate to and strength the rest of the economy as energy forms an input for almost all production processes of goods and services. Supply interruptions of many sources of energy are known to have a great impact as it can shake whole economies. In addition, stable and lower energy prices are known to help stimulate the growth rate of any economy. This is because lower energy prices result in increasing disposable income for consumers and lowering costs for firms. The resulting improved profit margins for firms and higher disposable income for consumers provide incentives for accelerated rates of growth.

One can distinguish between four different hypotheses explaining relationship between the energy consumption and economic growth based on the type of the relationship between both variables (see Jumbe, 2004):

i) Neutrality hypothesis implies no causality between energy consumption and economic growth. It means neither energy conservation nor energy expensive may not adversely affect economic growth.

ii) Conservation hypothesis advocates for an implementation of conservative energy policy, as the economic growth would not be slowed down. Econometrically, it can be translated by unidirectional causality running from economic growth to energy consumption.

iii) Growth hypothesis is supported when unidirectional causality is running from energy consumption to economic growth. The latest indicates that energy conservation may reduce investment and negatively influence economic growth.

iv) Feedback hypothesis confirms the interdependence between energy consumption and economic growth and both variables affect each other. This encourages the implementation of energy expansionary policies for long run sustainable economic growth.

The energy-growth nexus has been extensively investigated since the pioneer work of Kraft and Kraft (1978). The authors examined the relationship between energy consumption and economic growth in case of United States. The empirical results revealed that economic growth Granger causes energy consumption. Later on, a large number of empirical studies using different approaches, time periods, and proxy variables have tested this causal relationship in a number of countries. Abosedra and Baghestani (1991), Cheng and Lai (1997), Soytas and Sari (2003), Oh and Lee (2004), Jumbe, (2004), Fatai et al. (2004), Lee (2005, 2006), Al-Iriani (2005), Chontanawat et al. (2008), Narayan and Smyth (2008), Apergis and Payne (2009a), Bowden and Payne (2009), and Apergis and Payne (2010b) among others have examined this issue for different countries and over various sample periods. Evidences from these empirical studies are still mixed at best and controversial results in terms of the direction of the causality and the strength of impact of energy use on economic growth are reported. Some papers documented unidirectional causality from energy consumption to economic growth (growth hypothesis). Narayan and Smyth (2008), Apergis and Payne (2009a), Odhiambo, (2009); Bowden and Payne (2009), Tsani, (2010); Apergis and Payne (2010b); Wang et al. (2011) and Yazdan and Hossein, (2012) found evidence supporting this view.

Other researchers have documented unidirectional causality running from economic growth to energy consumption (conservation hypothesis). This hypothesis is supported by Lise and Montfort (2007); Erdal et al. (2008); Huang et al. (2008); Mallick, (2009); Sa'ad (2010); Binh, (2011); Qazi et al. (2012) and Soile, (2012). Next, the feedback hypothesis is supported if bidirectional causality between energy consumption and growth is found. This is supported by Glasure, (2002); Lee and Chang, (2007); Apergis and Payne (2010a), Belke et al. (2011), Eggoh et al. (2011), Marques et al. (2011); Kaplan et al (2011); Shahbaz et al. (2012); Fuinhas and Marques, (2012); Zeshan, (2013) and Shahbaz et al. (2013).The final hypothesis is that of neutrality, where no causality between energy consumption and growth is found, is supported by Soytas et al. (2007) and Gross, (2012). In case of Lebanon, Dagher and Yacoubian (2012) applied the cointegration developed by Johansen, (1988) and Granger causality by Toda and Yamamoto, (1995) as well as the VECM Granger causality to examine cointegration and causality relationship between energy consumption and economic growth. Their results indicated that long run exists between the variables and energy consumption and economic growth are bidirectional Granger caused.

II.2 Financial Development and Economic Growth

Since pioneering works of Schumpeter (1932), Goldsmith (1969) and recently of McKinnon (1973) and Shaw (1973), the relation between financial development and economic growth has attracted interest of both theorists and practitioners. Demirguc-Kunt and Levine (1996), Levine (1997) provided an extensive literature survey on this topic. Gruyay et al. (2007), Maswana (2008), Wolde-Rufael (2009), and Shahbaz (2009), among others, have used both cross-country and time series data to investigate the relationship between financial development and economic growth.

Financial development has a positive effect on economic growth as it may increase the efficiency of capital accumulation (Goldsmith, 1969) and or augment the level of saving and consequently the investment level (McKinnon, 1973; Shaw, 1973). This means that by increasing the size of savings and improving the efficiency of investment, financial development leads to higher economic growth [Townsend (1979), Greenwood and Jovanovic (1990) and Levine (1997)]. Further, it would support financial innovation and promote the adoption of advanced technology (Abu-Bader and Abu-Qarn, 2008; Shahbaz, 2012). In the related literature, this is known as “supply-leading”. In other words; financial development causes economic growth in the sense of

Granger. Ibrahim (2007) observed that financial development stimulates economic growth in Malaysia. Jalil and Ma, (2008) found that financial development contributes to economic growth by increasing capital formation in Pakistan and China. Shahbaz (2009) showed the same results in case of Pakistan. Coccorese, (2008) used Sims' causality to test the directional of causality between both variables and reported that economic growth is Granger cause of financial development. Masih et al. (2011) applied long-run structural modeling (LRSM) to examine the causality between financial development and economic growth in Saudi Arabia. They validated the existence of supply-side hypothesis. Kar and Mandal, (2012) also noted that financial development promotes economic growth by enhancing capitalization in India.

"Demand-following" hypothesis suggests that financial development follows economic growth. Patrick, (1966) pointed out that 'demand-following' relationship indicates that real economic activity Granger causes financial development by generating demand for financial services as economy develops. Liang and Teng, (2006) investigated the relationship between financial development and economic growth using VAR approach in case China. They noted cointegration between the variables and economic growth Granger causes financial development. Fung, (2009) finds that positive impact of economic growth on financial development is due to productivity boost. Chukwu and Agu, (2009) also supported demand-side hypothesis in case of Nigeria. Amarathunga, (2010) also confirmed the presence of demand-side hypothesis in case of Sri Lanka. In case of South Africa, Odhiambo (2010) investigated the relationship between financial development and economic growth by applying the ARDL bounds testing and the VECM Granger causality approaches. The results indicated that variables are cointegration and financial development is Granger cause of economic growth. Odhiambo (2011) investigated the causality between financial development, foreign capital inflows and economic growth for Tunisia. The empirical results reveal that financial development follows economic growth; and that financial development and foreign capital inflows are interdependent. Hasan et al. (2011) also reported unidirectional causality running from economic growth to financial development in developing economies. Odhiambo (2011) used trivariate model to examine causality between financial development and economic growth by incorporating foreign capital inflows. The empirical evidence validated the existence of demand-side hypothesis in Tanzania.

The feedback effect between financial development and economic growth is also found in exiting literature. For example, Ilhan (2007) applied cointegration and error correction method for the relationship between financial development and economic growth. He noted that cointegration exists and the feedback effect is validated in case of South Africa. Zheng et al. (2010) used bivariate framework model and reported that financial development and economic growth are complementary in case of China. The same exercise was conducted by Husam-Aldin et al. (2012) in case of UAE and results found the feedback effect between financial development and economic growth. Latter on, Eslamloueyan and Sakhaei, (2011) applied Generalized Least Square (GLS) method with cross-section Seemingly Unrelated Regression (SUR) to probe the relationship between financial development and economic growth and confirmed the findings of Husam-Aldin et al. (2011). On contrary, Bakhouche (2007) reported that financial development does not promote economic growth and in resulting economic growth does not contribute to financial development i.e. neutral hypothesis. Ernesto and Dabós, (2012) also supported the view by Bakhouche (2007) that financial development and economic growth are independent.

II.3 Financial Development and Energy Consumption

Given the above showing that financial development can drive economic growth and the obvious impact of growth of income on energy demand, several studies pointed possible linkages between these variables. Love and Zicchino, (2006) reported that financial development impacts on real variables i.e. real interest can possibly result in increase in investment. This in turn can promote economic growth and generate employment opportunities which further increase income. Such impact will increase consumers purchases especially of durable items e.g. auto, home, refrigerators, air-conditioners, etc. (Sadorsky, 2010, Mankiw and Scarth, 2008), which adds further to energy use. This shows that the linkages between energy use and economic growth are better understood when we go beyond a simple bivariate framework. Karanfil, (2009) suggested using stock market capitalization, liquid liabilities, and domestic credit to the private sector; each as share of GD among the financial variables. Dan and Lijun, (2009) examined the impact of financial development on primary energy consumption in Guangdong (China). Their study finds Granger-causality running from energy consumption to financial development, while the reverse is insignificant. Sadorsky, (2010) examined 22 emerging economies (1990-2006) using different indicators of financial development. This included, FDI, bank deposits as share of GDP, stock market capitalization as share of GDP, stock market turnover ratio and total stock market value traded over GDP. His results confirmed that energy consumption is positively linked to economic growth but the impact is small.

Sadorsky, (2011) investigated the impact of financial development on energy consumption using data of 9 Central and Eastern European frontier economies. He reported that financial development increases energy demand once deposit money bank assets to GDP, financial system deposits to GDP, liquid liabilities to GDP, stock market capitalization are used as measures of financial development. Similarly; Shahbaz and Lean, (2012) examined energy demand for Tunisia and reported results show that financial development increases energy demand resulting from economic growth. In case of Malaysia; Tang and Tan (2012) examined the relationship between financial development and energy consumption by incorporating relative prices and foreign direct investment (FDI) in then energy demand function. They report bidirectional causality between financial development and energy consumption both in short and long runs. Islam et al. (2013) reported that financial development; economic growth and population are driving forces to increase energy demand in Malaysia. The feedback effect is also reported between financial development and energy consumption in long run but financial development was found Granger causes energy demand in short run. Al-mulai and Sab, (2012) studied the impact of energy consumption on economic growth and financial development. Their results show that energy consumption is an important variable in improving economic growth and financial development.

III. Motivation of the Study

This paper provides an investigation of the relationship between economic growth, financial development and energy consumption using monthly data over the period of 1993-2010 in case of Lebanon. This is a country with a sectarian-based parliamentary republic located in the Middle East, with a population of approximately 4.2 Million. The Lebanese economy is service oriented, with tourism and banking sectors being the main driving force, contributing over 70% of GDP and therefore considered the primary sectors for growth. The banking sector is one of the main pillars of Lebanese economy with a size equivalent to 350% of GDP as of 2009. Lebanese banks benefit from a strong net inflow from both expats and the Gulf States; domestic private sector credit growth has been 19% until October 2011 and the banking System's foreign assets have also grown rapidly, supporting the fact that the banking industry is not affected by the political unrest. About 18% of GDP is contributed by the industrial sector and about 5% by the agriculture. Net remittances from the Lebanese Diaspora living abroad, mainly in the Gulf region, also contribute 5% to the GDP. Tourism industry development in Lebanon dates back to the 1960s when Lebanon's capital, Beirut, was known as "The Paris of the Middle East". This sector contributes notably to the employment in the economy. Employment in that sector as a share of total employment stood at 31.2% in 2005, and is estimated at 38% in 2010. This is not surprising giving that the percentage of tourism and travel in GDP stood at 31.2% in 2005, and is estimated at 37.6% in 2010 (Lanquar, 2011). This is not surprising in a country that is known for its diverse atmosphere, its earliest history, ancient Roman ruins, preserved castles, notable Mosques and Churches, as well as its stunning beaches in the Mediterranean Sea and rugged ski resorts.

The country's economy has faced much challenge owing to its continuous political unrest. The civil war (1975-1990) had a heavy unconstructive impact on the nation, causing the country to have a high budget deficit. Even more recent, the assassination of ex-Prime Minister Rafik Hariri in Feb 2005, the July 2006 war between Lebanon and Israel, the sit ins, protests and clashes between the opposing government alliances in 2006 till 2008 and the constant instability and corruption within Lebanon contributed to the huge deficit and the increase in sectarianism. In 2010, growth in Lebanon was stimulated by rising non-resident deposits, an elevated number of tourist arrivals and a vigorous real estate market. However, due to the regional political chaos, both tourist arrivals as well as expat's housing demand in the real estate sector have slowed down in 2011. Furthermore, the continued unrest in Syria seems to challenge Lebanon's economic prospects in 2012, especially when 25% of Lebanon's exports are to Syria and 11% of its imports are from Syria.

We think that examining the possible linkages between economic growth, financial development and energy consumption in Lebanon is justified and needed for three reasons. First, the above features of Lebanese economy justify the need for this study as it will assist the policy makers in the country in assessing their priorities for resource allocations for the country's development. Second, the clear interface of tourism and energy use, in Lebanon, where tourism demands for energy occurs at various functions ranging from travel, lodging, entertainment, catering, and activity sub-sectors management of tourist attraction is another important factor for policy makers to consider given the outages of electricity and shortages of some fuels in the country. Third, the authors are not aware of any study of this issue for Lebanon with the exception of Dagher and Yacoubian (2012) mentioned earlier .Our study improves upon theirs, however, since we do not employ a bivariate framework as they did, and since our sample is larger than theirs (1980–2009) and excludes the years of the civil war in Lebanon (1975-1990).

The findings should help better understand this relationship that underlies energy use, financial development and economic growth nexus for Lebanon which will and help to identify an appropriate policy mix for the sectors in future economic planning for economic growth of that county.

IV. The Hypothesis, the Data and Estimation Strategy

IV.1The Hypothesis

In this study our primary interest lies in the energy consumption-economic growth nexus; financial development-economic growth nexus and, energy consumption-financial development nexus.

The prime hypothesis of energy consumption-economic growth causality postulates that economic growth is impeded by energy conservation policies if causality runs from energy consumption to economic growth or feedback effect is existed between energy consumption and economic growth. Energy conservation policies do not have adverse impact on economic growth if causality is running from economic growth to energy consumption or no causality is found between both the variables.

The second hypothesis deals with financial development and economic growth. Financial development boosts investment activities by directing financial resources to new and existing potential ventures which not only enhances domestic production but also raises the arte of economic growth. This implies that financial development drives economic growth i.e. unidirectional running from financial development to economic growth is called supply-side hypothesis. The rise in per capita income or economic growth will increases the demand of financial services both for customer (consumption purpose) and producer (investment purpose) which in resulting raises financial development. This shows that economic growth leads financial development is called demand-side hypothesis.

Financial development promotes stock market capitalization. A high stock market capitalization reflects a developed, active and efficient equity market where funds are channeled to high return projects (the level effect). This is pro-economic growth. Developed financial markets require sound accounting and reporting standards. These enhance investor confidence, attract FDI, and boost economic growth which in resulting increases energy demand. These are further advanced by the *efficiency effect* which insures stock market's role in channeling liquidity, diversifying assets, and raising finance for relevant projects. Financial sector directly provides funds to investors for new and existing investment and consumers to purchase ticket items which directly increase energy demand. In turn, rise in demand for such financial services leads financial development.

IV.2 The Data

We have monthly frequency data over the period of 2000-2010.We use M2as a measure of financial development. Economic growth is measured by the index of coincident indicator as a measure for real economic activity in Lebanon. The coincident indicator is a broad measures for real economic activity in Lebanon .It is based upon a linear combination of a set of indirect indicators. These consist of imports of petroleum products (18.2 per cent), electricity production (18.6 per cent), cement deliveries (16.5 per cent), number of foreign passengers (11 per cent), total international trade (11.8 per cent), value of checks clearance (12 per cent) and M3 money supply (12 per cent). Finally, we use energy use in millions of KWH as proxy energy consumption. We convert all series into natural logarithm to avoid sharpness and variations in the data. The log-linear specification provides efficient results as compared to simple linear specification. F_t denotes financial development, energy consumption is indicated by E_t and Y_t is for economic growth in time period t. The data of on M2 and index of coincident indicator are obtained from The Central Bank of Lebanon while energy consumption data is obtained from the Central Administration of Statistics -Lebanon.

IV.3The ARDL Bounds Testing Approach

We employ the autoregressive distributed lag (ARDL) bounds testing approach to cointegration developed by Pesaran et al. (2001) to explore the existence of long run relationship between economic growth, financial development, urbanization and electricity consumption in the presence of structural break. This approach has multiple econometric advantages. The bounds testing approach is applicable irrespective of whether variables are I(0) or I(1). Moreover, a dynamic unrestricted error correction model (UECM) can be derived from the ARDL bounds testing through a simple linear transformation. The UECM integrates the short run dynamics with the long run equilibrium without losing any long run information. The UECM is expressed as follows:

$$\Delta \ln E_t = \alpha_1 + \alpha_T T + \alpha_E \ln E_{t-1} + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln F_{t-k} \; \alpha_D D_1 + \mu_t \quad (1)$$

$$\Delta \ln F_t = \alpha_1 + \alpha_T T + \alpha_E \ln E_{t-1} + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \sum_{i=1}^{p} \vartheta_i \Delta \ln F_{t-i} + \sum_{j=0}^{q} \vartheta_j \Delta \ln E_{t-j} + \sum_{k=0}^{r} \vartheta_k \Delta \ln Y_{t-k} + \vartheta_D D_3 + \mu_t \quad (2)$$

$$\Delta \ln Y_t = \alpha_1 + \alpha_T T + \alpha_E \ln E_{t-1} + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln F_{t-k} + \beta_D D_2 \mu_t \quad (3)$$

where Δ is the first difference operator, $\ln Y_t$ is natural log of index of coincident indicator (economic growth), $\ln F_t$ is natural log of M_2 (financial development) and $\ln E_t$ is natural log of energy consumption. D is dummy for structural break point and μ_t is error term assumed to be independently and identically distributed. The optimal lag structure of the first differenced regression is selected by the Akaike information criteria (AIC). Pesaran et al. (2001) suggests F-test for joint significance of the coefficients of the lagged level of variables. For example, the null hypothesis of no long run relationship between the variables is $H_0 : \alpha_E = \alpha_F = \alpha_Y = 0$ against the alternative hypothesis of cointegration $H_a : \alpha_E \neq \alpha_F \neq \alpha_Y \neq 0$ [3]. Accordingly Pesaran et al. (2001) computes two set of critical value (lower and upper critical bounds) for a given significance level. Lower critical bound is applied if the regressors are I(0) and the upper critical bound is used for I(1). If the F-statistic exceeds the upper critical value, we conclude in favor of a long run relationship. If the F-statistic falls below the lower critical bound, we cannot reject the null hypothesis of no cointegration. However, if the F-statistic lies between the lower and upper critical bounds, inference would be inconclusive. When the order of integration of all the series is known to be I(1) then decision is made based on the upper critical bound. Similarly, if all the series are I(0), then the decision is made based on the lower critical bound. To check the robustness of the ARDL model, we apply diagnostic tests. The diagnostics tests are checking for normality of error term, serial correlation, autoregressive conditional heteroskedasticity, white heteroskedasticity and the functional form of empirical model.

IV.4TheVECM Granger Causality Test

After examining the long run relationship between the variables, we use the Granger causality test to determine the causality between the variables. If there is cointegration between the series then the vector error correction method (VECM) can be developed as follows:

$$\begin{bmatrix} \Delta \ln E_t \\ \Delta \ln Y_t \\ \Delta \ln F_t \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix} + \begin{bmatrix} B_{11,1} \; B_{12,1} \; B_{13,1} \\ B_{21,1} \; B_{22,1} \; B_{23,1} \\ B_{31,1} \; B_{32,1} \; B_{33,1} \end{bmatrix} \times \begin{bmatrix} \Delta \ln E_{t-1} \\ \Delta \ln Y_{t-1} \\ \Delta \ln F_{t-1} \end{bmatrix} + ... + \begin{bmatrix} B_{11,m} \; B_{12,m} \; B_{13,m} \\ B_{21,m} \; B_{22,m} \; B_{23,m} \\ B_{31,m} \; B_{32,m} \; B_{33,m} \end{bmatrix} \times \begin{bmatrix} \Delta \ln E_{t-1} \\ \Delta \ln Y_{t-1} \\ \Delta \ln F_{t-1} \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_3 \\ \zeta_3 \end{bmatrix} \times (ECM_{t-1}) + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{bmatrix} \qquad (4)$$

where difference operator is Δ and ECM_{t-1} is the lagged error correction term, generated from the long run association. The long run causality is found by significance of coefficient of lagged error correction term using t-test statistic. The existence of a significant relationship in first differences of the variables provides evidence on the direction of short run causality. The joint χ^2 statistic for the first differenced lagged independent variables is used to test the direction of short-run causality between the variables. For example, $a_{12,i} \neq 0 \forall_i$ shows that economic growth Granger causes energy consumption and economic growth is Granger of cause of energy consumption if $a_{11,i} \neq 0 \forall_i$. A same hypothesis can be drawn between financial development and energy consumption and, economic growth and financial development.

V. Results and their Discussion

The results of descriptive statistics and correlation matrix are reported in Table-1. The Jarque-Bera test statistics reveal that the series of economic growth, energy consumption and financial development have normal distributions while mean is zero with constant variance. Our empirical evidence finds that correlation between the variables is positive and strong. For instance, a positive correlation is found between energy consumption and economic growth. Financial development and economic growth are positively correlated. Financial development and energy consumption have positive correlation. The normal distribution of the series leads us to peruse for further analysis.

Table-1: Descriptive Statistic and Correlation Matrix

Variable	Mean	Median	Maxi.	Mini.	Skewness	Kurtosis	Jarq.Bera	$\ln E_t$	$\ln Y_t$	$\ln M_t$
$\ln E_t$	6.7773	6.7719	7.0707	6.5132	0.2122	2.7366	1.3722	1.0000		
$\ln Y_t$	5.1574	5.1439	5.5861	4.7858	0.4778	2.3847	0.7105	0.7197	1.0000	
$\ln M_t$	10.1706	10.1084	10.9920	9.6700	0.9432	3.0181	1.9575	0.7017	0.9118	1.0000

The next is to test the unit root properties of the variables. The stationarity level of the variables is very important for policy implications. For example, if energy consumption series is stationary at level, it shows that innovations in energy use have transitory effects and series returns to its trend path otherwise innovations show permanent effect on energy consumption if energy consumption series follows unit root problem. Similarly, the impact of financial policies adopted to improve financial sector efficiency has temporary effect on financial development if financial development series is stationary at level. Financial policies will have permanent impact on financial development if series is found to be integrated at I(1). The shocks to economy by economic policies have permanent effects if economic growth series is non-stationary which implies that fiscal and/or monetary or any other stabilization policies would only have permanent effects on the real output levels. If economic growth series is stationary then shocks to economy have transitory effect. So, it is necessary to check the order of integration of the variables before applying the ARDL bounds testing to investigate the long run relationship among the series of interest. So, we have applied ADF and Ng-Perron unit root tests and results are disclosed in Table-2. The results reveal that energy consumption, economic growth and financial development have unit root problem at level. All the variables are stationary at 1st difference with intercept and trend. This indicates that the series have unique order of integration i.e. I(1).

Table-2: Unit Root Analysis

Variable	**ADF unit root at Level**		**ADF unit root at 1st Difference**	
	T-statistic	Prob. value	T-statistic	Prob. value
$\ln E_t$	-2.9832 (3)	0.1394	-11.3974 (2)*	0.0000
$\ln F_t$	-2.2992 (4)	0.4321	8.8743 (4)*	0.0000
$\ln Y_t$	-1.9300 (4)	0.2547	-17.4153 (3)*	0.0000
	Ng-Perron unit root test			
Variable	MZa	MZt	MSB	MPT
$\ln E_t$	-8.0367 (5)	-1.9982	0.2486	11.3579
$\ln F_t$	-4.2960 (4)	-1.4656	0.3411	21.2112
$\ln Y_t$	-9.6893 (5)	-2.1405	0.2209	9.6774

$\Delta \ln E_t$	-46.2855(2)*	-4.8075	0.1038	1.9851
$\Delta \ln F_t$	-25.3303 (4)	-3.5588	0.1405	3.5975
$\Delta \ln Y_t$	-24.4338 (5)*	-3.4612	0.1416	3.9365
Note: * and ** represent significant at 1% and 5% levels respectively. Lag order is shown in parenthesis.				

The results of these traditional tests may be biased. These unit root test do not have information about unknown structural break occurring in the series. The appropriate information about unknown structural breaks would help policy makers in designing a comprehensive energy, financial and economic policy to enhance economic growth for long run by considering these structural breaks. This issue is resolved by applying Clemente-Montanes-Reyes unit root test with single and two unknown structural breaks arising in the variables. Our empirical exercise indicated that all the series are non-stationary at level with single structural break in energy consumption, financial development and economic growth in 2008M1, 2009M1 and 2006M6 respectively[2].We conclude that all the variables are stationary at first difference accommodating single and two unknown structural breaks confirmed by Clemente-Montanes-Reyes unit root test.

[2]In this regards, we note that the 2006 Lebanon War, started on July 12, 2006, and continued until a United Nations-brokered cease fire on August 14, 2006.Furthermore, Lebanon witnessed a series of protests and sit-ins that began on December 1, 2006.This was led by groups in Lebanon that opposed the US and Saudi-backed government of Prime Minister Fouad Siniora. This ended on May 21, 2008 following the Doha Agreement. On January 25, 2008, a bombing in the Lebanese capital, Beirut, killed a senior intelligence officer, who was involved in the investigation of assassination of former Prime Minister Rafiq Hariri who was killed in 2005. This was followed by a series of bombings and assassinations which have struck Lebanon, most of them occurring in and around the capital, Beirut during the last few years. Finally, we note that the 27 January 2009 marked a historical event in which Syria accepted Lebanon’s first ambassador ever to Damascus.

Table-3: Clemente–Montanes–Reyes structural break unit root analysis

Model: Trend Break Model								
Variable	Level data				First difference data			
	T_{B1}	T_{B2}	Test statistics	K	T_{B1}	T_{B2}	Test statistics	K
$\ln E_t$	$2008M_4$	---	-2.053	3	$2006M_6$	----	-8.346*	2
	$2004M_4$	$2008M_4$	-2.909	1	$2006M_6$	$2009M_8$	-7.510*	1
$\ln F_t$	$2009M_1$	---	-2.372	3	$2005M_1$	----	-4.224**	5
	$2003M_1$	$2008M_9$	-3.487	4	$2005M_1$	$2008M_1$	-5.643**	6
$\ln Y_t$	$2006M_6$	---	-2.450	3	$2006M_6$	----	-6.465*	5
	$2003M_9$	$2008M_3$	-5.270	4	$2006M_5$	$2006M_9$	-5.711**	6
Note: T_{B1} and T_{B2} are the dates of the structural breaks; *k* is the lag length.* and ** show significant at 1% and 5% levels respectively.								

Given that the computation of ARDL bounds testing is known to be sensitive to lag length selection. As such, inappropriate selection of lag length may produce biased results. Therefore, it is necessary to have exact information about lag order of the series to avoid the problem of biasedness of ARDL F-statistics (Shahbaz, 2010). We follow AIC criteria for selection of lag length where we found that lag order 4 is suitable for our data sample (2006). The information about lag order is given in Table-4 following AIC criterion.

Table-4: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	245.5326	NA	4.02e-06	-3.911816	-3.843584	-3.884099
1	585.0314	657.0944	1.94e-08	-9.242442	-8.969512*	-9.131571
2	600.3055	28.82361	1.76e-08	-9.343637	-8.866008	-9.149613
3	615.0278	27.07002*	1.60e-08	-9.435932	-8.753605	-9.158755*
4	624.1486	16.32916	1.60e-08*	-9.437880*	-8.550856	-9.077550
5	627.3032	5.495216	1.76e-08	-9.343600	-8.251878	-8.900117
6	633.6844	10.80681	1.85e-08	-9.301361	-8.004941	-8.774725
7	635.0608	2.264400	2.10e-08	-9.178400	-7.677282	-8.568610
8	642.5061	11.88850	2.16e-08	-9.153324	-7.447509	-8.460382

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The Table-5 reports the results of the ARDL bounds testing approach to cointegration. We followed the critical bounds produced by Pesaran et al. (2001). The critical bounds generated by Pesaran et al. (2001) are suitable large sample size (T = 500 to T = 40, 000). Our findings reveal that calculated F-statistics seem to exceed upper critical bounds at 1% and 5% respectively once we treated energy consumption, financial development and economic growth as dependent variables. This shows that there are three cointegrating vectors confirming the existence of long run relationship among the series in the presence of structural breaks. The ARDL models fulfill the assumptions of normality, ARCH and functional forms of models. The findings note that error terms are normally distributed, no evidence of ARCH and models are well articulated.

Table-5: The Results of ARDL Cointegration Test

Bounds Testing to Cointegration				Diagnostic tests		
Estimated Models	Optimal lag length	F-statistics	Structural break	χ^2_{NORMAL}	χ^2_{ARCH}	χ^2_{RESET}
$F_E(E/F,Y)$	4, 4, 4	6.577**	2008M4	0.8936	[1]: 0.3263	[3]: 1.7586
$F_F(F/E,Y)$	4, 4, 4	4.730**	2009M1	0.1449	[1]: 0.2831	[2]: 0.4828
$F_Y(Y/E,F)$	4, 4, 4	8.719*	2006M6	0.1229	[1]: 0.2005	[1]: 0.0237
Significant level	Critical values (T= 132)					
	Lower bounds $I(0)$	Upper bounds $I(1)$				
1 per cent level	4.40	5.70				
5 per cent level	3.47	4.57				
10 per cent level	3.03	4.06				
Note: The asterisks * and ** denote the significant at 1 and 5 per cent levels, respectively. The optimal lag length is determined by AIC. [ ] is the order of diagnostic tests.						

The next step is to examine the long run relationship between the variables and results are shown in Table-6. In energy consumption demand function, we find that financial development adds in energy consumption. A 1 per cent increase in financial development is linked with 0.1272 per cent in energy demand, all else is same. The impact of economic growth on energy consumption is positive and statistically significant at 5 per cent level of significance. We find that 0.2003 per cent energy consumption is increased due to 1 per cent increase in economic growth by keeping other things constant. In financial development empirical model, energy consumption has positive effect on financial development and it is statistically significant at 10 per cent level. A 1 per cent increase in energy demand raises financial development by 0.30 per cent if other factors remain constant. Economic growth has positive and statistically significant impact on financial development. Keeping other things constant, 1 per cent increase in economic growth is positively linked with financial development by 1.6 per cent. In economic growth empirical model, we find that energy consumption stimulates economic growth and it is statistically significant at 1 per cent level of significance. We note that a 1 per cent increase in energy consumption boosts economic growth by 0.2620 per cent. The positive relationship exists from financial development to economic growth at 1 per cent significance level. A 0.4239 increase in financial development leads economic growth by 1 per cent. We find that energy consumption and financial are complementary but energy consumption has strong impact on financial development and same inference is for economic growth to financial development. Energy consumption and economic growth are interdependent but economic growth depends on energy consumption. The assumptions of classical linear regression model (CLRM) are fulfilled by energy consumption, financial development and economic growth models successfully. There is no evidence of non-normality of error terms, serial correlation, no evidence of ARCH and white heteroskedasticity. The functional form of all the models is well-specified.

Table-6: Long Run Results

Variable	Dependant Variable = $\ln E_t$		Dependant Variable = $\ln M_t$		Dependant Variable = $\ln Y_t$	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Constant	4.4502*	22.1637	-0.0714	-0.0876	-0.9305**	-2.2596
$\ln E_t$	….	….	0.2968***	1.8336	0.2620*	3.3233
$\ln M_t$	0.1272*	2.6974	….	….	0.4239*	16.4255
$\ln Y_t$	0.2003**	2.2226	1.5958*	16.4255	….	….
R^2	0.5111		0.8358		0.8440	
$Adj-R^2$	0.5035		0.8332		0.8416	
F-statistic	67.4413*		32.8348*		34.9205*	
Diagnostic Test	F-statistic	Probability	F-statistic	Probability	F-statistic	Probability
$\chi^2 NORMAL$	0.2536	0.8808	0.5604	0.6066	4.0656	0.1309
$\chi^2 SERIAL$	1.0040	0.8870	0.9786	0.8900	0.6545	0.5507
$\chi^2 ARCH$	1.5812	0.1704	1.0796	0.4490	0.1962	0.9860
$\chi^2 WHITE$	1.3436	0.2576	0.9372	0.4405	0.5576	0.5060
$\chi^2 REMSAY$	0.1598	0.6899	0.8042	0.7659	2.6240	0.1077

Note: *, ** and *** denote the significant at 1%, 5% and 10% levels respectively. $\chi^2 NORMAL$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.

In theshort run, we find that financial development and economic growth have positive on energy consumption at 5 per cent significance level. The impact of energy consumption and economic growth is also positive and it is statistically significant at 5 per cent level of significance. Finally, energy consumption stimulates economic growth at 1 per cent level of significance. Financial development also adds in economic growth at 5 per cent level. The negative and significant statistically estimates for each of the ECM_{t-1}, 0.6450, 0.0419 and -0.2693 (energy consumption, financial development and economic growth) lend support to a long run relationship among the series. The short run deviations from the long run equilibrium are corrected by 66.50%, 4.19% and 26.93% towards long run equilibrium path each month. The diagnostic tests show that error terms of short run models are normally distributed; and free of serial correlation, heteroskedasticity, and ARCH problems for all models. The Ramsey reset test suggests that functional form for the short run models is well specified.

Table-7: Short Run Results

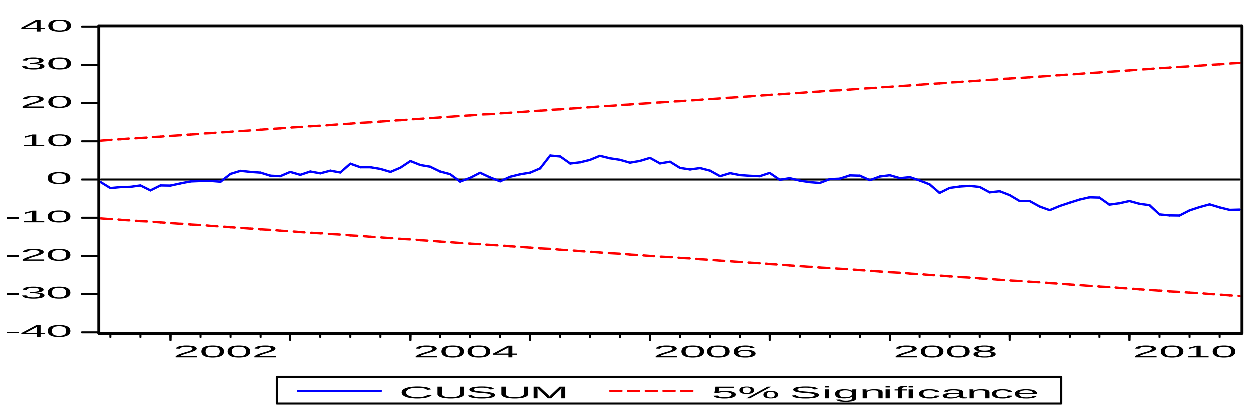
Variable	Dependant Variable = $\Delta \ln E_t$		Dependant Variable = $\Delta \ln M_t$		Dependant Variable = $\Delta \ln Y_t$	
	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Constant	-0.0037	-0.5813	0.0073*	2.3969	0.0023	0.5188
$\Delta \ln E_t$	….	….	0.0639**	2.4847	0.1311*	2.6318
$\Delta \ln M_t$	0.4539**	2.5264	….	….	0.3246**	2.6012
$\Delta \ln Y_t$	0.2735**	2.3395	0.1442**	2.5082	….	….
ECM_{t-1}	-0.6450*	-7.9533	-0.0419*	-2.9695	-0.2693*	-4.5419
R^2	0.3756		0.0904		0.2002	
$Adj-R^2$	0.3608		0.0689		0.1813	
F-statistic	25.4650*		4.2105*		10.5974*	

Diagnostic Test	F-statistic	Probability	F-statistic	Probability	F-statistic	Probability
$\chi^2 NORMAL$	0.9044	0.6362	0.3808	0.6776	0.1352	0.9212
$\chi^2 SERIAL$	0.2916	0.7416	0.2260	0.8500	0.8703	0.4212
$\chi^2 ARCH$	0.0291	0.8646	1.6659	0.1931	0.5830	0.6065
$\chi^2 WHITE$	0.7954	0.5752	0.2217	0.9691	0.4754	0.4012
$\chi^2 REMSAY$	2.2072	0.1142	0.5671	0.5681	1.6040	0.1175

Note: *, ** and *** denote the significant at 1%, 5% and 10% levels respectively. $\chi^2 NORMAL$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.

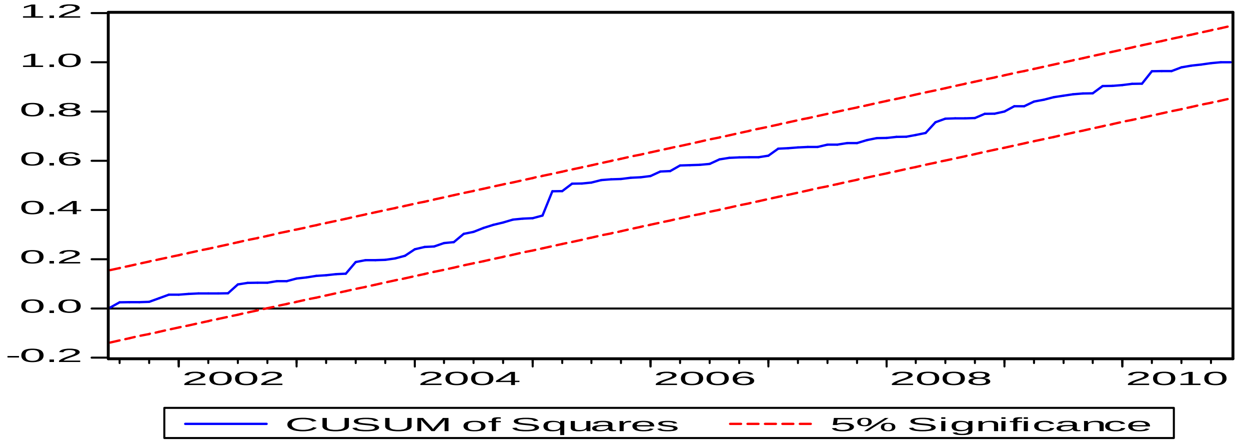
The cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMsq) tests suggest stability of the long and short run parameters (Figures 1 – 2). The graphs of the CUSUM and CUSUMsq test lie within the 5 per cent critical bounds which confirm stability of parameters (Brown et al. 1975). The model is also well specified.

Figure 1: Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

The VECM Granger Causality

If cointegration is confirmed, there must be uni- or bidirectional causality between/ among the series. We examine this relation within the VECM framework. Knowledge about causality can help to craft appropriate energy and financial policies for sustainable economic growth. Table-8 reports results on the direction of long and short run causality. We find feedback relation between energy consumption and economic growth. This implies that economic growth depends upon energy consumption and rise in income per capita further increases energy demand. So, adoption of energy conservation polices will have detrimental impact on economic growth. Our findings suggest the importance of encouraging energy exploring policies. In this regards, we praise the Lebanon's government in concluding its first offshore oil and gas rights auction which has drawn interest from about 100 companies. They have bought geophysical data in preparation for an upcoming bid round for Lebanese offshore energy production rights, which should occur soon[3]. Furthermore, given that Lebanon is very close to some of the major producers of LNG in the world (Qatar, Nigeria and Egypt), Lebanon should explore this option to meet its energy needs via this source in the short term given the close geographical location of these sources and the low cost of shipment as well as the good relations with these countries.

Financial development and energy consumption Granger causes each other supporting bidirectional causal relationship. Financial development provides cheaper loans to consumers and producers for big durable items and setting up existing and new business which raises energy demand and energy consumption leads economic growth. Such offerings, attract consumers and raises the demand for financial services and hence financial development. This supports for implementing easy monetary policy to enhance energy consumption and improve the efficiency of financial sector. The bidirectional causality between financial development and economic growth also could show the importance of directing monetary policy to enhance capitalization, especially in the energy sector which is highly capital intensive. This is important given our earlier observation of the importance of encouraging energy exploring policies.

Table-8: VECM Granger Causality Analysis

Dependent Variable	Direction of Causality						
	Short Run			Long Run	Joint Long-and-Short Run Causality		
	$\Delta \ln E_{t-1}$	$\Delta \ln F_{t-1}$	$\Delta \ln Y_{t-1}$	ECT_{t-1}	$\Delta \ln E_{t-1}, ECT_{t-1}$	$\Delta \ln F_{t-1}, ECT_{t-1}$	$\Delta \ln Y_{t-1}, ECT_{t-1}$

[3]Lebanon Explores Offshore Energy, By April Yee, 2/25/2013.
www.moneyshow.com/investing/article/1/TheNational-30654/Lebanon-Explores-Offshore-Energy/

$\Delta \ln E_t$	….	3.7677* [0.0068]	2.5274** [0.0444]	-0.8753* [-6.2656]	….	9.7481* [0.0000]	8.5766* [0.0000]
$\Delta \ln F_t$	2.2240*** [0.0707]	….	3.0709** [0.0191]	-0.0491** [-2.2649]	2.3876** [0.0422]	….	2.5597** [0.0301]
$\Delta \ln Y_t$	2.8445** [0.0256]	1.5706 [0.1868]	….	-0.2735* [-3.6323]	4.2855* [0.0013]	3.5162* [0.0054]	….
Note: *, ** and *** show significance at 1, 5 and 10 per cent levels respectively.							

In short run, bidirectional relationship between financial development and energy consumption is found. The feedback effect exists between energy consumption and economic growth and economic growth Granger causes financial development.

Variance Decomposition Method (VDM)

We have used the generalized forecast error variance decomposition method (GFEVDM) using vector autoregressive (VAR) system to test the strength of causal relationship between energy consumption, financial development and economic growth in case of Lebanon. This is due to the limitations associated with VECM Granger causality test which cannot capture the relative strength of causal relation between the variables beyond the selected time period. The (GFEVDM) indicates the magnitude of the predicted error variance for a series accounted for by innovations from each of the independent variable over different time-horizons beyond the selected time period. The main advantage of this approach is that it is insensitive with ordering of the variables because such ordering is uniquely determined by VAR system. Further, the (GFEVDM) estimates the simultaneous shock affects. Engle and Granger (1987) and Ibrahim

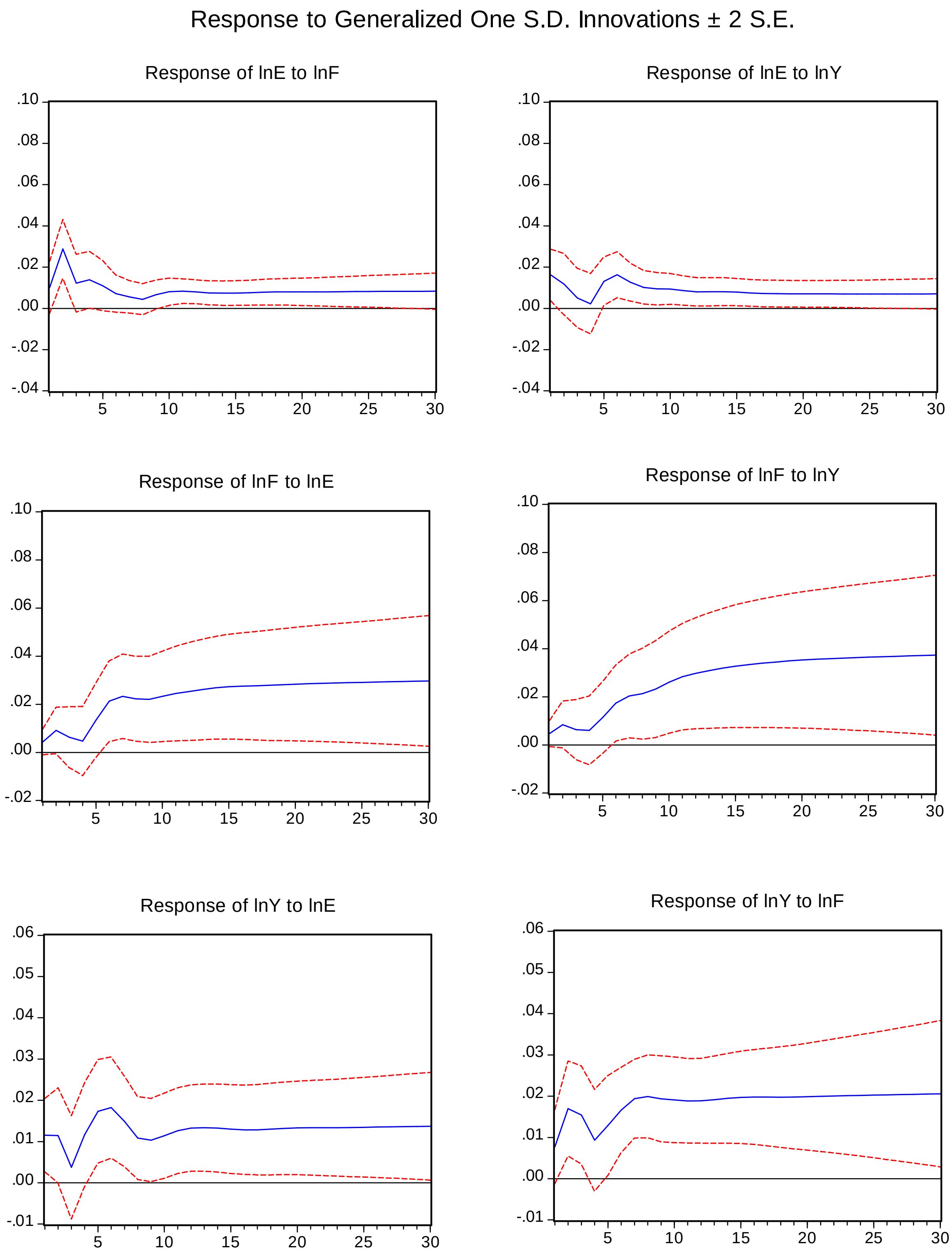
(2005) argued that with VAR framework, variance decomposition approach produces better results as compared to other traditional approaches.

The results of variance decomposition approach are reported in Table-9.The results indicate that a 67.16 percent portion of energy consumption is explained by its own innovative shocks while innovative shocks of financial development and economic growth contribute to energy consumption by 21.44 percent and 11.39 percent respectively. The innovative shocks stemming in energy consumption contributes to financial development by 23.37 percent. The contribution of economic growth to financial development is 15.68 percent and rest is explained by innovative shocks on financial development. Economic growth is 23.35 percent and 39.78 percent is explained by innovative shocks in energy consumption and financial development. Overall our results show that the feedback effect is found between financial development and energy consumption but strong from energy consumption to financial development. The unidirectional causality is found running from energy consumption and financial development to economic growth i.e. energy-led growth and finance-led growth hypothesis.

Table-9: Variance Decomposition Method (VDM)

Horizon	Variance Decomposition of $\ln E_t$			Variance Decomposition of $\ln F_t$			Variance Decomposition of $\ln Y_t$		
	$\ln E_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln F_t$	$\ln Y_t$	$\ln E_t$	$\ln F_t$	$\ln Y_t$
1	100.0000	0.0000	0.0000	2.0421	97.9578	0.0000	5.1366	1.4692	93.394
5	83.1278	14.6550	2.2170	4.0701	95.7476	0.1821	11.9018	11.2447	76.8533
10	77.8984	14.5835	7.5180	14.1938	81.9566	3.8495	17.8004	23.7391	58.4604
15	74.4234	16.3723	9.2042	18.5622	72.7660	8.6716	20.3784	30.3791	49.2424
20	71.7926	18.1021	10.1052	20.9817	66.9868	12.0313	21.6981	34.7860	43.5157
25	69.3898	19.8089	10.8012	22.4392	63.3360	14.2246	22.6609	37.7032	39.6358
26	68.9305	20.1451	10.9243	22.6571	62.7784	14.5644	22.8160	38.1738	39.0101
27	68.4776	20.4773	11.0450	22.8580	62.2635	14.8784	22.9631	38.6143	38.4224
28	68.0320	20.8044	11.1634	23.0436	61.7872	15.1691	23.1020	39.0285	37.8693
29	67.5941	21.1265	11.2793	23.2154	61.3459	15.4386	23.2326	39.4193	37.3480
30	67.1634	21.4439	11.3926	23.3747	60.9362	15.6890	23.3553	39.7885	36.8561

Figure-3: Impulse Response Function



The results of IRF are shown in Figuer-3. Figure-3 reveals that the response of energy consumption is positive but minimal after $10^{th}$and 6^{th}time horizon due to one standard deviation shock stemming financial development and economic growth. The response in financial development is positive and strong due to one standard deviation shock in energy consumption and economic growth. Energy consumption and financial development seem to contribute in economic growth. Overall our results are consistent with findings of variance decomposition approach.

VI. Conclusion and Policy Implications

This paper explored the relationship between economic growth, financial development and energy consumption in Lebanese economy. The data period of our study is $2000M_1$-$2010M_{12}$. We have applied unit root test accommodating single unknown structural break stemming in the series. The ARDL bounds testing is applied to find out cointegration among the variables in the presence of structural breaks. The direction of causal relationship between economic growth, financial development and energy consumption has examined by applying the VECM Granger causality and robustness of causality results has been tested by using innovative accounting approach.

Our results showed that cointegration is found between the series in the presence of structural breaks arising in the variables. We found that economic growth raises energy demand. Financial development enhances energy consumption. Energy consumption boosts economic growth and financial development also contributes to economic growth by capitalization enhancing-effect.

Energy consumption and economic growth increases financial development. This implies that economic growth, financial development and energy consumption are complementary.

The VECM Granger causality analysis revealed that bidirectional causality is found between energy consumption and economic growth. The feedback effect exists between financial development and energy consumption. Economic growth and financial development are Granger causes of each other. The results by innovative accounting approach are different from the VECM Granger causality test. This may be due to difference in the methodological backgrounds of both techniques. The empirical analysis by innovation accounting approach shows the bidirectional causal relationship between financial development and energy consumption. Economic growth is Granger cause of energy consumption and financial development.

Our findings show the importance of encouraging energy exploring policies. In this regards, we praise the Lebanon's government in concluding its first offshore oil and gas rights auction, which has drawn interest from about 100 companies. They have bought geophysical data in preparation for an upcoming bid round for Lebanese offshore energy production rights. We stress the need for government actions to ease this process. Furthermore, given that Lebanon is very close to some of the major producers of LNG in the world (Qatar, Nigeria and Egypt), Lebanon should explore this option to meet its energy needs via this source in the short term given the close geographical location of these sources and the low cost of shipment as well as the good relations with these countries. This is important as our results caution of the use of policy tools geared towards restricting energy consumption in the country in short run , something that is called for as part of national energy policy to, as these may result in lower economic growth. Finally, our results necessitate the need for the development and implementation of appropriate financial policy tools to encounter the rising demand for energy by enhancing the process of capitalization of the energy sector. This is very important for the long run growth of the Lebanese economy and may become be essential element in this regards.

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