A Review of Energy Consumption and Financial Development Nexus

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Abstract
The paper contribute to the body of knowledge in the area of energy and finance by reviewing empirical works to assess the link and causality between energy consumption and financial development. This paper is of paramount importance in the face of energy crisis in both developed and developing economies. These findings have been mixed or inconsistent. In some studies there is unidirectional causality while as in other studies there is bidirectional causality. This calls for further studies to contribute to the debate using multiple models in a single study.

Keywords: Financial Development; Stock market; Energy; Uni-directional causality; Bi-directional Causality.

Jet Classification: 011; 016

1. Introduction
The role of energy as input in economic growth cannot be over looked as this has been established by theory and empirical studies. Researchers have indicated that policy on energy management that does not take into account of financial development may create energy crisis in an economy both developed and developing (Faridul, Muhammad & Mahmudul, 2011; Sadorsky, 2010; Yan & Zhang, 2009).

There are two arguments on financial development and energy consumption. One argument is that financial development is positively related to energy consumption and that finance cause energy consumption. Another argument is that energy consumption rather causes financial development.

The financial sector in many economies has developed and as such it is important to assess empirically the role it plays in energy consumption and economic growth. Yet few empirical works have been done on the role the financial sector (Bank, stock market and Insurance) play in energy consumption. The insurance sector has been neglected in these few empirical works that have been done.

Financial liberalisation leads to savings mobilization for investment and hence economic growth. It is also explained by researchers (Shahbaz, 2011; Bekaert & Harvey, 2000; Bekaert et al., 2001, 2002, 2005) that increase in income leads to more use of energy. Hence, financial development leads to more energy use via income. With financial development people are able to afford high technologies, high energy devices and hence more energy usage (Shahbaz, 2011).

2. Statement of problem/Motivation/Significance
The findings from the very few published works have been mixed. In some studies the results have revealed significant short and long run effects whiles in other studies there has been no significant effect. The results on causality direction have also been mixed. In some studies there has been feedback effect while in some other studies the results have been unidirectional and neutral effect.

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The paper is motivated by the fact that very few empirical studies can be cited in literature. In view of these the researchers review the very little existing empirical works to contribute to the body of knowledge that exist in literature since in the knowledge of the researchers no such detail review exists currently.

The findings provide understanding on theories of growth and development by explaining the role of finance in energy consumption and economic growth. The review also provides information to policy makers on how to manage energy consumption to ensure effective and efficient energy use. Students and researchers in finance, energy and economics will find the review very useful.

3. General objective/specific objectives

The global objective of the paper is to contribute to the body of knowledge in the area of finance, energy demand and economic growth by reviewing the existing empirical works. Specifically, the review assesses the link between financial development and energy consumption and the direction of causality.

4. Research questions/ Assumptions

The review provides answers to these research questions. What is the nature of relationship between financial development and energy consumption and why? What is the direction of causality between finance and energy consumption and why? The assumption underlying the paper is that financial development matters for energy consumption and that finance cause energy use in an economy.

5. Limitations/Scope

Since not much empirical works have been done the review is limited to the few ones. But the review has been done in more detailed. The findings may lack external validity since articles were selected using non probability sample method and that fact that few works have been review.

Articles not based on time series econometric analysis have not been reviewed since the findings in such papers are spurious and are biased. The rest of the paper looks at the research methodology, literature, and summary of findings, conclusions and recommendations.

6. Methodology

The paper is a review and as such is based on secondary data obtained through archival study of existing articles in Journals. These articles well selected purposively and analysed using content analysis method.

7. Literature review

This section of the paper contains the review of studies on finance and energy. These studies have been written by researchers such as Shahbaz and Lean (2012); Shahbaz (2011); Faridual et al. (2011); Sadorsky (2010); Dan and Lijun (2009) and Yan and Zhang (2009).

In a study by Shahbaz and Lean (2012) on the topic does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia, it was established through descriptive statistics and correlation matrix a statistical significant and positive link between financial development and energy consumption over the study period of 1971 to 2008. The analysis was based on bounds testing approach to cointegration (ARDL).

From the analysis, financial development is positively related to energy consumption and statistically significant at the 5% level. The researchers reported that “A 10% increase in domestic credit to private sector is expected to raise energy demand by 1.4%, ceteris paribus”.

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The long run coefficient was smaller (coefficient=0.1352; t-values=2.0699). The short run coefficient (Coefficient=0.0800; t-value=1.5116) was not significant. This means financial development is positively related to energy consumption not in the short run but in the long run.

Shahbaz and Lean (2012) in explanation of their results stated that “Financial development promotes investment, which raises energy demand due to economic growth. The easy access of credit enables consumers to purchase big ticket durable consumer items, and the usage of consumer items directly increases the energy demand”.

On the direction of causality between financial development and energy consumption, the analysis using VECM Granger causality test, produce value [-0.7420t (-4.1282)] and [-0.5009 (-1.8965)] that is statistical significant in finance-equation, and energy-equation respectively.

This indicates bidirectional causality between financial development and energy consumption. That is financial development causes energy consumption while as energy consumption also causes financial development. The researchers commented that Offering affordable credit to individuals will increase the purchase of electrical home appliances and more usage of these electrical products will increase the energy consumption. On the other hand, increase of energy consumption will lead to more economic and investment activities. This raises the demand for financial services and leads to financial development.

The study by Shahbaz and Lean (2012) is of interest since the analysis follows standard econometric

Faridul, et al. (2011) examined the link between financial development and energy consumption in Malaysia in a multivariate time series analysis using Auto regressive distributed lag (ARDL). The variables in the model were energy consumption, population, aggregate production, and financial development.

The analysis on unit root shows that the series were not stationary in levels but became stationary after first differenced using the Ng-Perron (2001) method. The unit root test performed help avoid spurious results. In the bound test analysis the observed F-test value of 6.479 exceeded the upper value at the 5% significant level which is an indication that there is significant cointegration link among the series.

There was statistical significance long run effect of financial development (coefficient of 0.07 and significant at 5%) on energy consumption. This means if financial development increase by 1% energy consumption will increase by 7%. Though this value is small it is significant.

There was also statistical significant short run effect of financial development (coefficient 0.12 and significant at 5%) on energy demand. That is 1% increase in financial development will results in 12% increase in energy consumption. Looking at the values of the coefficients for the short run and long run variables, that of the long run is smaller than the short run.

Faridul et al. (2011) indicated that financial development help make people get access to credits which are spend on energy consuming products such as automobiles, home and appliances. The study by Faridul et al. (2011) also established positive significant effect of population on energy demand.

Energy demand increase by 0.4% when population increase by 1%. This show that demand for energy increase with increase in population growth. This finding was also established by other researchers such as Shahbaz (2011) for Pakistan. The short run effect of population on energy demand is not significant which also support the findings of researchers such as Shahbaz (2011) for Pakistan. That is in the short run population growth does not affect energy consumption.

Granger causality test by Faridul et al. (2011) revealed bidirectional link between financial development and energy consumption in the long run. This means that in the long run financial development cause energy demand while energy demand at the same time causes financial development. In the short run there is unidirectional causality from financial development to energy demand. This means financial development causes increase in energy consumption without feedback.
There is feedback causality between financial development and population in the long run at the 1% level of significant. This means population growth cause increase in energy consumption while energy consumption also causes population growth.

There was unidirectional causality from population to financial development at 5% significant level in the short run.

Population growth causes increase in energy consumption without energy consumption causing increase in population growth. Faridul et al. (2011) concluded that “emerging economies that continue to develop financial markets should see energy demand rise above and beyond those caused by rising income”.

The study by Faridul et al. (2011) followed standard econometric estimation procedures such as unit root test to avoid spurious results. The estimated model also included control variables such as population income to avoid omitted variable bias.

Further study should extend that of Faridul et al. (2011) by including Johansen and the Toda Yamamoto models of cointegration and causality respectively. But the proxies for financial development did not include variables from the stock market which is also part of the financial system. Future model should include variables from the stock market to fully capture the effect of the financial development on energy consumption.

Shahbaz (2011) used bound testing approach to cointegration to examine the impact of financial development on energy consumption for Pakistan over the period 1971-2008. The variables in the model are economic growth, financial development, population, capital stock and energy consumption.

The unit root test on the series based on Ng-Perron unit tests revealed that in levels all the series except population were non stationary and contain different orders of integration. Some were integrated of order one, I (1), while others were integrated of order zero, I (0). This allowed for the use of the bound testing approach.

The results from the correlation matrix established statistical significant positive relationship among the series in the model such as real capital, population, real GDP, financial development, and energy consumption, with a weak linear link between real capital and energy consumption.

There was strong significant relation between energy demand and economic growth, energy demand and financial development. Economic growth is significant and positively related to capital stock, with capital stock negatively related to energy demand though statistically insignificant. Financial development also is negatively link with population but the link is insignificant. There is weak positive significant link between capital stock and population.

The cointegration analysis based on the ARDL model with energy demand as the dependent variable produced F calculated value of 21.67606 which was significant at 1% level of significant.

This indicates statistical significant cointegration among the series in the model which are capital stock, population, energy consumption, financial development, and economic growth.

In the presence of cointegration among the variables the long run elasticities were estimated. The coefficients and the probability values of the variables were: financial development, 0.0169 (p=0.0334); real GDP, 0.2707 (p=0.0118); population, 0.1354 (p=0.0000); capital stock, 0.0952 (p=0.0515).

The results show that all the independent variables in the model positively affect energy consumption in the long run though the effects are weak. Improvements in the financial sector significantly increase energy demand in the long run; increase in income leads to increase in energy consumption; population growth leads to increase in energy consumption; increase in capital stock also leads to increase in energy consumption. Shahbaz (2011) stated that Stock market based financial development promotes investment, raises energy demand due to economic growth. High stock market capitalisation enhances investors’ confidence which in turn stimulates economic growth and thus energy consumption. Financial institutions
make credit easier which helps consumers to purchase big ticket durable consumer items, and these directly increase energy demand.

Economic growth significantly affects energy consumption. Energy consumption is increase by 0.271% when economic growth increases by 1%. Population growth also positively and significantly affects energy demand at the 1% level of significance. As the population increase energy is needed to help the activities of people.

The short run elasticities also revealed positive significant relationship between financial development energy demand and energy demand and economic growth. The coefficients and the probability values of the variables were: financial development, 0.00726 (p=0.0194); real GDP, 0.17936 (p=0.0547).

Energy demand increase by 0.1794% when real GDP increase by 1%. This shows that economic growth is a determinant of energy consumption. Financial development also statistically positively and significantly affects energy demand. When the financial sector increase by 1% energy demand increase by 0.0073%. In the short run population and capital stock significantly did not affect energy demand.

The study by Shahbaz (2011) is of interest for the use of current data, embarking on unit root test to avoid spurious results and also including enough control variables to avoid omitted variable bias. But the study only looks at correlation issues without analysing causality issues. His study also did not include any variable from the banking sector which is also part of the financial sector.

Sadorsky (2010) used dynamic panel demand models to examine the effect of financial development on energy demand for Central and Eastern European Frontier economies. Several financial development proxies related to both bank and stock market were used. Analysis on the unit root test revealed that the some of the series were non stationary. The estimation was based on system GMM estimation approach.

It was revealed that financial development (the ratio of financial system deposits to GDP; liquid liabilities as a percentage of GDP; the ratio of deposit money bank assts to GDP; stock market turnover to GDP) has positive statistical significant effect on energy demand at the 10% level of significance. Sadorsky (2010) stated that Larger values of deposit money bank assets as a percentage of GDP or financial system deposits to GDP indicate that more funds are available for loaning out, which should stimulate consumption, investment, economic growth, and energy demand. Higher values of liquid liabilities to GDP also increase energy demand. Private credit by deposit money banks relative to GDP does not have much of an effect on energy demand.

From the estimation the bank variables are smaller in the short run (between 0.022 and 0.069) than the values for the long run (ranging between 0.117 and 0.276). Sadorsky (2010) indicated that “in the case of financial system deposits to GDP, for example, a 1% increase in financial system deposits to GDP increases energy demand by 0.054% in the short run and 0.231% in the long run”. These results show that empirically the financial sector has positive effect on the consumption of energy. If the finance sector grows energy consumption will also increase.

Sadorsky (2010) stated that “for Central and Eastern European frontier economies the demand for energy is most sensitive to energy prices, followed by four out of seven of the financial development variables studied”. This findings show that increase in energy price will lead to a decrease in energy consumption.

The study by Sadorsky (2010) did not established significant support for the effect of income on the demand of energy. That is, energy consumption is not affected by the economic growth. Whether the economy grows or does not energy consumption is not affected. This is contrary to what the theories indicate. Sadorsky (2010) concluded on policy issues and stated that Energy demand projections in Central and Eastern European frontier economies, which do not include financial development as an explanatory variable, may underestimate actual energy demand. This can lead to unplanned energy shortages if actual energy demand exceeds planned energy demand. It is also likely that energy conservation policies may fall short of their intended targets if policy targets do not include the additional impact of financial development.
on energy demand. Meeting greenhouse gas emissions targets may also be harder to meet if these targets are formulated without taking into account the impact of financial development on energy demand.

In support of the methodology used by Sadorsky (2010) is the panel cointegration analysis which allowed for the estimation of the short run and long run effects, and the unit root test performed avoiding spurious results. But Sadorsky (2010) did not examine that causality link among the variables.

Sadorsky (2009) earlier on examined the impact of financial development on energy consumption in emerging economies using panel data over the period 1990-2006. It was established that positive significant link exist between financial development (stock market value traded to GDP, stock market capitalisation to GDP, and stock market turnover) and energy demand.

That is if the financial sector develops energy consumption will also increase while as if the sector does not develop energy consumption will not increase. These findings show that policy for energy consumption should take into consideration the operations of the stock market else target might not be met.

Sadorsky (2009) did not examine the causality direction among the variables and only looks at correlational issues. Also the financial variables used did not include variables from the bank sector which is part of the financial sector. Future study may need to extend that of Sadorsky (2009) study by examining the causality issues, including variables from the bank sector and also using ARDL model and Johansen cointegration approach.

In Guangdong (China) it has been established that energy use significantly causes financial development using Granger causality test without a feedback. This means, more use of energy leads to financial development.

It was also established that financial development is positively related. These findings were established by Dan and Lijun (2009). In support of the analysis by Dan and Lijun (2009) is the fact that standard econometric procedure. Hence the results may be robust.

8. Summary of findings

The review has been based on current empirical studies using time series econometric analysis for various economies. From the review very few econometric works have been done. Based on the review the following findings are established.

- Some studies have found statistical significant bidirectional causality between financial development and energy consumption (Shahbaz & Lean, 2012; Faridul et al. 2011; for Malaysia; Faridul, 2010 for Pakistan).
- Other studies have identified Long run relationship between energy consumption and financial development (Shahbaz & Lean, 2012; Sadorky, 2010 for Central and Eastern European frontier Economies; Sadorsky, 2010 for emerging economies).
- While some researcher’s also established Un-directional causality from energy consumption to financial development (Dan & Lijun, 2009 for China).

9. Conclusions and Recommendations

The findings have been mixed or inconsistent. In some studies there is unidirectional causality while as in other studies there is bidirectional causality. Studies have yielded different kinds of findings supporting different hypotheses in literature such as energy-led, finance –led and feedback hypothesis.

In the face of these inconsistencies, further empirical studies to contribute to the debate are far-fetched. In order to aid the resolution of the inconsistencies further empirical studies should be based on multiple used of models in a single study. Models such as ARDL; Johansen-Juselius cointegration; Granger causality test, Toda –Yamamoto causality test and panel studies could be used.
Again, large sample sizes should be used including economies at different stages of development to check if results could be collaborated. In all future studies causality issues need to be addressed in addition to the correctional studies.

References