Energy-growth nexus and energy demand in Ghana: A review of empirical studies

Kwakwa, Paul Adjei

Presbyterian University College, Ghana Okwahu Campus, Abetifi

24 March 2014

Energy-growth nexus and energy demand in Ghana: A review of empirical studies

Paul Adjei Kwakwa

Presbyterian University College, Ghana
Okwahu Campus, Abetifi
Email: pauladkwa@yahoo.com

Abstract

The paper reviews and assesses empirical studies on the causal relationship between energy and growth, and energy demand in Ghana over the years. It is found through the review that studies have not reached a consensus on the direction of causality between energy and growth, an outcome which could be attributed to the differences in the period for study, source of data and estimation methods. Generally, socioeconomic factors particularly affect demand for energy at the micro level, while the level of industrialization, urbanization, policy regime and industrial efficiency have been identified to influence demand for energy at the macro level. For policy purposes, other areas like intensity of energy use, conservation behavior and willingness to pay for energy services need to be researched into.

Key words: Energy consumption; Economic growth; Households, Granger causality; Ghana

JEL Classification: C3, O4, Q43, Q4, Q5

I. Introduction

The role of energy in the lives of individuals and the growth and development of economies is well stated in the academic literature (see for instance Garg & Halnes 2008; United Nations (UN), 2005). By virtue of its position in the growth and development of countries, energy related issues have received a lot of attention from policy makers and researchers. Such areas of concern include the relationship between energy and growth, the effect of energy on the environment (Apergis and Payne 2009, 2010; Ang 2007; Lean and Smyth 2010; Arouri et al. 2012 Paul and Bhattacharya 2004), energy conservation (Mills and Schleich 2012; Ek and Soderholm 2010; Ma et al 2013; Wang et al 2011; Banfi et al 2008), willingness to pay for improved power service, production of renewable energy (Abdullah & Jeanty 2011; Akura 2013; Gunatilake et al 2012; Devicienti et al 2004) and energy demand intensity (Shi 2002 and Zhang and Chen 2009; Eskeland and Harrison 2003; Hubler 2009; Poumanyvong and Kaneko 2010)

Research on the above energy related issues in Ghana has until recently received little attention. Meanwhile the country since 1984 has been hit by at least five major energy crises attributed to a number of reasons including the trends in climate change, the advancing Sahara, the complacency in policy-making, and the chronic avoidance of tough decisions in the energy sector even when national security is at stake (Amoako-Tuffour 2007). Government officials have also mentioned erratic gas supply from Nigeria as a major contributor to the recent energy crises. The effect of such power crises is the power rationing and frequent power outages that have been identified to have serious implication on businesses and the entire economy (See Wijayatunga & Jayalath, 2004; Pokharel, 2010; Tsehaye *et al.*, 2010; and ISSER, 2008). Again the country has not been spared of shortage of fossil fuels that is often attributed to high crude price on the world market. Many Ghanaians are hoping to see an improvement in their access to energy (fossil fuel) now that the country has started oil production in commercial quantities.

The aftermath of each crises and the discovery and subsequent production of oil in the country seem to have generated debate among policy makers, researchers, industrialists and research institutions on matters that center on the importance of energy to the economy and energy security for the future. Though such debate is healthy, an empirical study is necessary to come out with an inform policy implementation. In the light of this some researchers have studied on such issues mentioned above. But since not all areas of interest have been covered, this paper seeks to review and critically assess the existing studies on these issues in the country to know which areas may deserve attention.

This paper is structured as follows. Section 2 reviews the literature that deals with causality issues on electricity and energy in Ghana, section 3 also looks at studies on energy demand and forecasting in Ghana and section 4 finally, concludes the study.

II. Relationship between energy and growth

Following the oil crises in the 1970s when energy gained the attention of policy makers as an important input for an economy's performance various studies have been examined globally to establish the causality between energy and growth which has serious implication for energy policy (Inglesi-Lotz and Pouri 2013). Throughout the literature, four possible outcomes are always expected from energy-growth nexus namely,

1. Unidirectional causality from energy to growth, meaning that energy consumption has effect on growth and that a conservation of energy will negatively affect growth. It is also known as the Growth hypothesis
2. Unidirectional causality from growth to energy, where growth affects energy consumption. This also known as the conservation hypothesis
3. Bilateral causality between energy and growth. This is Feedback hypothesis explaining that energy consumption has effect on growth and growth affects energy consumption; and
4. Independence. This is the neutrality hypothesis where there is no granger causality.

Although elsewhere such studies have been carried out for over three decades, empirical studies in Ghana on the subject matter can be considered very new since such studies seem to have been conducted after the year 2000. These studies have either examined the relationship for Ghana alone or used a panel data framework. Again various methodologies, time periods and variables of growth and energy have been used for such studies and the general results show that there is a unidirectional causality from growth to energy though there are some few exceptions. The difference in the outcome can be attributed to the periods used for studies and the kind of methodology used (Paul, and Bhattacharya, 2004). Again, most of the studies have used aggregate energy or electricity and aggregate gross domestic product for the analysis which does not offer the opportunity to ascertain the effect of specific energy on growth.

For instance Lee (2005), finds between 1975-2001, an energy-led-growth for Ghana. The author's estimation method was the Vector errror correction model granger causality. Wolde-Rufael (2006) centers on 16 African countries including Ghana. The author uses data from 1971-2001 and employs the Toda and Yomamoto granger causality test. His finding was growth-led-energy. Akinlo (2008), uses data from 1980-2003 and employs the Full Modified OLS for Ghana and other west African countries. He unlike the previous studies obtains a birectional causality between energy and growth. Twerefo et al (2008), like Lee (2005) employs the Vector error correction model granger causality for the period 1975-2006 but find a growth-led-energy. Esso (2010) also uses the threshold cointegration approach to examine the relationship between energy consumption and economic growth for seven sub-Saharan African countries during the period 1970–2007 including Ghana and finds that energy consumption is cointegrated with economic growth in Ghana. Again he finds that a unidirectional causality running from real GDP to energy use in Ghana.

Adom (2011) was motivated by the fact that there is scanty research on the electricity-economic growth nexus in Ghana for his study. The author used data that spanned from 1971 to 2008 that were sourced from EnerData, Global Energy and CO_2 Data Research Services and Africa Development Indicators. The unit root test using the test statistics by ADF and PP both reveals that the variables are I (1) and the Toda and Yomamoto Granger Causality test showed that there exist a unidirectional causality running from real per capita GDP to electricity consumption. The author explanation for the outcome of the result is that the Ghanaian economy relies a lot on biomass than electricity and again the productive sectors of the economy are found not to be energy intensive. Concerned about the effects of structural breaks, Dramani et al (2012) investigate the relationship between electricity consumption and economic growth for Ghana during the period 1970 to 2010. The authors find that the data series had structural breaks in 1979 and 1983. Accounting for the structural breaks in the unit root test, a long–run relationship between the two series was established. On the causality test, they find a unidirectional directional causality from economic growth to electricity consumption.

Realizing that a lot of studies on the energy-growth nexus have focused on total energy and growth with little known about the relationship between the different types of energy and growth from the other sectors of the economy, Kwakwa (2012) researches into the disaggregate energy

and growth for Ghana. The author relies on data that covered the period of 1971 to 2007 sourced from the World Bank's Development Indicator to examine the relationship between electricity and fossil fuel and the agricultural as well as the industrial sector proxied by the manufacturing sector. The ADF unit root test indicates that all variables are integrated of the order 1 and the Johansen cointgerating test showed a long run relationship exist among the variables. The granger causality informs that there is a unidirectional causality from overall growth to electricity consumption in the short run, and fossil consumption in both the short run and long run. Again, a unidirectional causality from agricultural growth to electricity consumption both in the short and long run was observed. No significant relationship was established between fossil and agricultural growth in any of the periods. However, for manufacturing sector and energy, there was a unidirectional causality from manufacturing to fossil consumption in the short and the long run, and bidirectional causality between manufacturing and electricity consumption in both runs. The conclusion was that the energy's contribution to the economy is relevant through the manufacturing sector. The short fall of the study is the fact that the service sector was not included in the study. An inclusion of that sector would have revealed the relationship between all the sectors of the Ghanaian economy and energy. Again, even though the study is among the few ones to examine various energies and growth, the fossil fuel could still have been disaggregated into petrol and diesel. Bildirici (2013) also investigates the relationship between electricity consumption and economic growth by using the Autoregressive Distributed Lag (ARDL) bounds testing approach and vector error-correction models (VECM) in Ghana and other nine African countries for the period 1970-2010. The causality analysis reports a bidirectional causality for Ghana. The source of data was World Bank World Development Indicators, IEA, OECD and U.S. Energy Information Administration.

Ackah and Adu (2014) recognizing the importance of energy to growth recently, examines the impact of energy consumption on economic growth for ten oil producing countries in Africa including Ghana. The period for the study was 1971 to 2011 and data was from UNESCO databank and World Bank development indicators. The model of estimation decomposed energy into renewal and non renewable energy and it was found through the fixed effect estimation that an increase in both renewable and non renewable energy consumption would increase economic growth at statistical significant levels. When the VECM Granger causality test was done for the non-renewable energy consumption– growth relationship and renewable energy-growth relation, it was noted that in the short run there is no relationship between growth and renewable and non-renewable energy. In the long run however, a unidirectional causality from non-renewable energy to growth and a bidirectional causality between renewable and growth are observed. As part of the recommendations the authors suggest the need to divide renewable energy into commercial and traditional sources to ascertain the impact of especially the commercial sources to growth.

III. Demand for energy

The next sets of studies on energy in Ghana are those that seek to examine the determinants of energy choice. Such studies are very important for policy making as their outcomes could serve

as guidelines in final implementation of an action. The determinants of energy in Ghana have been researched into at both the micro level and the aggregate level which provides somewhat a better way of analyzing demand for energy in the country. The micro studies include those that use secondary data from the Ghana Statistical Services (Mensah and Adu 2013; Karimu 2013) and those that used field survey (Kwakwa et al 2013; Manyo-Plange 2011; Kuunibe et al. 2013). The general outcome of the micro based study show that family size, income, education among others influence the choice of particular energy. The macro based studies have also focused on electricity consumption than any other energy.

Kwakwa et al (2013) rationale for the study is that Government of Ghana's effort to increase the national electricity gridlines in the country as well subsidizing Liquefied Petroleum Gas (LPG) for home use with the twofold objectives of reducing poverty, and the dependence and usage of fuel wood(firewood and charcoal) is not yielding much results. The reason is that despite these measures, majority of Ghanaians still rely on fuel wood. As a result 507 household heads from the forest and savannah zones of the country were sampled for the study. A multiple response from respondents showed that, 74.2% of households use electricity, 72.6% use charcoal, 57% used firewood, 32.5% used kerosene and 36.1% used LPG. These energy choice were used for activities such cooking, warming house, cooling the house, lighting, ironing, entertainment, heating water and washing. A logistic regression was estimated to identify the determinants of energy choice and the results indicated that for electricity, the choice was influenced positively by employment but negatively by of income, education, if the respondent resides in rural area and if household uses kerosene. For kerosene, income, education and if household uses electricity had negative influence on its usage. Meanwhile employment and family size were the positive determinants of kerosene usage. Similarly for charcoal, income had negative effect on its usage likewise the effects of employment and family size. Again, employment and household using firewood had negative effect on the choice of LPG as energy. The determinants of firewood were income, family size and LPG usage. The authors' conclusion was the need to encourage afforestation to help in the sustenance of the forest. A number of challenges were identified to be associated with the use of cleaner energy (power outages, high bills, shortage and fear of getting the house burnt) and biomass (smoke, slowness in cooking and inability to use when wet)

For Mensah and Adu (2013), the concern is that minority of Ghanaians used LPG as their primary source of fuel for cooking (Ghana Statistical Service (GSS), 2006) whiles the majority rely on biomass energy at a time that the rate of a deforestation rate of 2% (22,000 hectares) per annum, suggest that there is a serious threat to the socioeconomic well being of the citizens. The authors thus use a secondary data from the Ghana Statistical Service's the fifth round of the Ghana Living Standards Survey (GLSS V) conducted within 2005/06 by the GSS. From a sample households heads totaling 8,262 the results show that as high as 89.2% use biomass as a main cooking source and the rest use modern energy. The breakdown is that 56.1% of households use firewood , 31.9% use charcoal, 1.2% rely on crop residue for cooking energy, 9.9% use LPG while kerosene and electricity are used by only 0.6% and 0.3% of households respectively. A rural urban comparison show that the rural folks tend to rely more on firewood and crop residue but the urban households rely on Charcoal, Kerosene, LPG and Electricity. When an Ordered Probit model was estimated to examine the factors influencing households

choice of energy it was found that household size, age of the household head and male households heads have significant negative effects on the probability of using clean and efficient fuels over the inefficient fuels. The effect of education is found to increase the tendencies of using cleaner energy source so do income and urban households. Again, access to kerosene and firewood reduces the probability of using cleaner energy choices such as LPG.

Karimu (2013) also uses the GLSS V for his study and finds that income, household size, education, availability of other energy and urban dwellers significantly determine the probability of choosing modern, transition and solid fuels. In their study, Kuunibe et al. (2013) link factors affecting households' fuel choice and environmental sustainability in the country. A total of 200 households were selected through a multistage sampling in the Wa Municipality of Ghana; and the needed information was solicited by means of questionnaire. The results indicate that only 1% and 29% of the households interviewed use modern clean fuels of electricity and LPG respectively for cooking purpose. For the unclean fuel, 60% rely on charcoal while 10% use firewood. Although the authors explain that 60% rely on charcoal because it is cleaner than firewood, no reason was assigned to the few 30% using LPG and electricity for cooking activities. They again find from a cross tabulations that there is significant positive relationship between a choice for modern fuel and level of schooling and household income as well as significant positive results between traditional fuel types and household size. A logistic regression show the level of education, income and relative price reduce the probability a household would use biomass while the size of a household is found to have a positive effect. A number of challenges similar to that of Kwakwa et al (2013) are identified by the researchers. Relating the findings to the sustainability of the environment, the authors reveal that the present trend of biomass energy consumption may affect the environment.

Appreciating that women play important role in matters of energy use, Manyo-Plange (2011) examines among other things, the attitudes and behaviours of women in Ghana regarding their choice of cooking fuel. The authors interview 100 women from Axim and finds that 63% wish to use non-biomass fuel for their household cooking, and 18% are satisfied with LPG as their main fuel. Again, it was reported that institutional, environmental, cultural and economical reasons influence fuel switching. When asked how they would respond to energy stress and uncertain climate, 41% indicate they will use lower fuels on the energy ladder, another 41% said they would do nothing, or do not know what to do or believe it will not occur and 13% said they will move up the ladder.

The next set of studies on demand for energy are those analyzed at the aggregate level. They include Adom and Bekoe (2012), Adom (2013), Adom et al (2012), Adom and Bekoe (2013), and Adu and Ackah (2013). Adom et al. (2012) sensing danger for the electricity power sector in Ghana to meet consumption investigate what could be responsible for the increasing demand for electricity consumption. Following Houthakker (1951), Houthakker and Taylor (1970), Amusa et al. (2009); Zuresh and Peter (2007) and Lin (2003), the authors model Ghana's electricity demand as a function of GDP, industry efficiency, structural changes in the economy and degree of urbanization. They again use data from Ener Data Global Energy, CO2 Data

Research Services and the African Development Indicators covering the period from 1975-2005. The estimation from ARDL Bounds cointegration approach revealed that real per capita GDP, industry efficiency, structural changes in the economy, and degree of urbanisation significantly explain aggregate domestic electricity demand in the long while in the short-run, real per capita GDP, industry efficiency, and degree of urbanisation significantly explains aggregate domestic electricity demand in Ghana.

Adom and Bekoe (2013), seem to have built upon Adom et al (2012) by incorporating the role of policy regime changes since they argue such changes do influence demand behaviour. Annual time series data were obtained from the same source as Adom et al (2012) to run regression analysis based on data for full-sample (1971-2008), pre ERP (1971-1983) and post ERP (1983-2008). The result was that the industry efficiency, industry value added, and real per capita GDP significantly affect long-run demand for the full-sample estimate. The effect of policy regime was found to change the level of effects of those variables affecting demand for electricity as the estimation reveal that income elasticity of demand for electricity increases from 0.22 (pre-reform) to 1.93 (post-reform); output elasticity changes from 0.20 (pre- reform) to 0.53 (post-reform); urbanization elasticity jumps from −0.34 (pre-reform) to 0.66 (post-reform) and, the efficiency elasticity evolves also from −0.86 (pre-reform) to −0.47 (post-reform). The Chow breakpoint test confirmed that there exists a difference in the long run demand elasticities prior to 1983 and the period after 1983. Ackah et al (2014) also study the determinants of electricity by incorporating non-economic factors. The authors use the Structural Time Series Model and time series data for the period 1971 to 2011 sourced from IEA and the world bank. The results indicate a positive income elasticity effect on electricity demand (both short and long runs), education reduces electricity consumption(in the long run), and a long run positive price elasticity of demand.

Recognizing that previous studies on electricity demand have not forecasted electricity demand for policy making, Adom & Bekoe (2012) examine the conditional dynamic forecast of electrical energy consumption requirements in Ghana. Using the same variables and of the same source used in Adom et al (2012) and Adom and Bekoe (2013), for the time period of 1975 – 2008, a short and long run estimation from ARDL and PAM show that positive industrial output, urbanisation, and income positively affect electricity demand and they exceed the negative effect of the negative efficiency. The dynamic forecast from three scenario case of low growth scenario, medium growth scenario and high growth scenario, based on four conditions namely,- a) Real per capita GDP predicted to grow at 8 percent per annum from 2009 to 2020; b) degree of urbanisation predicted to be 3.11 percent from 2009 to 2015 and 2.8 percent from 2015 to 2020 for Ghana; c) industry value-added predicted to grow at annual average of 1.9% ; and d) industrial electricity intensity projected to grow annually at 1.5% - reveal that electricity demand is estimated to fall within 20,453 and 34,867 GWh by the year 2020.

All the above research on electricity demand are based on time-invariant models that assume fixed parameters within the sample of estimate which has some limitations as pointed by Lucas

(1976), Cooley and Prescott (1973), Terasvirta and Anderson (1992), Stock and Watson (1996), Dargay 1992 and Phillips (2001). As a result Adom (2013) examines the time-varying nature of demand elasticities in Ghana's electrical energy sector using the Rolling regression model. The author uses time series data, 1971-2008 from the World Bank Development Indicators, EnerData Global Energy and CO2 Data Research Services. The results show a positive and elastic effect of income but negative and inelastic effect from energy efficiency and economic structure. Again the rolling OLS estimates reveal that the estimated demand equation constantly shifts poles for the 29 rolling periods. This thus suggests that over the years demand elasticities for in Ghana have not been constant and is linked with policy changes.

Demand for Gasoline energy, a major contributor of greenhouse gas has also been researched by Ackah and Adu (2013) to ascertain what could be responsible for the high demand for gasoline in Ghana. The authors noted that the consumption of gasoline fuel in the country has increased particularly from 1980 to 2010 but they argued that this could not be attributed to price and income only. Hence they examined the effect of technological advances, exogenous non-economic factors, price and income on gasoline demand in Ghana. To achieve this annual data from 1971 to 2010 sourced from International Energy Agency, World Development Indicators and UNIDO. The results from Autoregressive Distribution Lag indicate that transport gasoline demand is price inelastic; productivity is found to have an inverse relationship with gasoline consumption and no significant effect of 'taste' preferences on gasoline demand in Ghana.

From the review on energy demand it is seen that micro based studies have revealed that a number of factors influence demand various type of fuel while for the macro based studies, the emphasis is on what influence demand for aggregate electricity energy. Thus the determining factors of aggregate demand for LPG, firewood and charcoal is scarcely known. This may be due to lack of data to facilitate such studies. Another observation is the lack of studies examining energy intensity in the country at both micro and macro levels. Such studies on energy intensity also present another objective way of analyzing factors that ensure efficiency of energy use (see Shi (2002) and Zhang and Chen (2009); Eskeland and Harrison (2003); Hubler (2009); Poumanyvong and Kaneko (2010).

IV. Conclusion

The study has reviewed existing studies on energy-growth nexus, and factors affecting energy consumption in Ghana. The energy-growth nexus studies have not yielded a conclusive answer and this could be due to the differences in estimation techniques, period for the study, variables used and the source of data. Also, most of the existing studies have used electricity for the energy-growth nexus. There is the need to look at the relationship between growth and the other energy fuels to enhance the available information for policy making.

Studies on demand for energy in Ghana has also been examined at the micro and aggregate level. At the micro level it is easier to analyze the determinants of a particular fuel type but the aggregate level, lack of data seems to have compelled studies to focused on electricity mainly. Such studies at the micro level have shown that socioeconomic background plays important role

in the choice of fuel while at the macro level factors like income, urbanization, policy regimes and structural change influence demand for energy. Despite the fact that electricity demand has been forecasted empirically, little empirical studies is known on the intensity of energy consumption in the country, energy conservation and willingness to pay for better energy services.

References

Abdullah, S. and Jeanty, P. W. (2011), Willingness to pay for renewable energy: Evidence from a contingent valuation survey in Kenya. *Renewable and Sustainable Energy Reviews*, 15(6): 974–2983

Ackah, I., Adu, F. and Takyi, R. O. (2014) On the Demand Dynamics of Electricity in Ghana: Do Exogenous Non-Economic Variables Count? *International Journal of Energy Economics and Policy,* 4(2):149-153

Ackah, I. and Adu, F., (2013). Modelling Gasoline Demand in Ghana: A Structural Time Series. *International Journal of Energy Economics and Policy, 4(1):76-82*

Ackah, I. and Adu, F. (2014). The Impact of Energy Consumption and Total Factor Productivity on Economic Growth Oil Producing African Countries. *Bulletin of Energy Economics,* 2(2), 28-40

Adom, P.K., (2011). Electricity Consumption-Economic Growth Nexus: The Ghanaian Case. *International Journal of Energy Economics and Policy*, 1(1), 18-31

Adom, P.K., (2013). Time-varying analysis of aggregate electricity demand in Ghana: a rolling analysis. *OPEC Energy Review 37, 1, 63-80*

Adom, P.K., Bekoe, W. and Akoena, S.K.K., (2012). Modelling aggregate domestic electricity demand in Ghana: an autoregressive distributed lag bounds cointegration approach. *Energy Policy* 42, 530–537

Adom, P.K. and Bekoe, W., (2012). Conditional dynamic forecast of electrical energy consumption requirements in Ghana by 2020: a comparison of ARDL and PAM. *Energy* 44, 367–380

Adom, P.K. and Bekoe, W. (2013). Modelling electricity demand in Ghana revisited: The role of policy regime changes. *Energy Policy* 61:42–50

Akcura, E. (2013). *Information effects on consumer willingness to pay for electricity and water service attributes*. European Bank for Reconstruction and Development, Working paper, no. 160. http://www.ebrd.com/downloads/research/economics/workingpapers/wp0160.pdf

Akinlo, A.E., (2008), Energy consumption and economic growth: evidence from 11 African countries: *Energy Economics* 30, 2391–2400.

Amoako-Tuffour, J. (2007) *The Energy Crisis: Public Distress and problem solving*. http://www.ghanaweb.com/GhanaHomePage/features/index.php?year=2007

Amusa, H., Amusa, K., Mabugu, R., (2009). Aggregate demand for electricity in South Africa. *Energy policy* 37, 4167–4175

Ang, J.B., (2009). CO2 emissions, research and technology transfer in China, *Ecological Economics* 68, 2658-2665.

Apergis, N., Payne, J.E., (2009). CO2 emissions, energy usage, and output in Central America, *Energy Policy* 37, 3282-3286.

Apergis, N., Payne, J.E., (2010). The emissions, energy consumption, and growth nexus: Evidence from the commonwealth of independent states, *Energy Policy* 38, 650-655.

Arouri, M.H., Ben Youssef, A., M'Henni, H., Rault, C., (2012). Energy consumption, economic growth and CO2 emissions in Middle East and North African countries, *Energy Policy* 45, 342-349.

Banfi, S., Farsi, M., Filippini, M. and Jakob, M. (2008) Willingness to pay for energy saving measures in residential buildings. *Energy Economics* 30: 503–516

Bildirici, Melike E. (2013) The Analysis of Relationship Between Economic Growh and Electricity Consumption in Africa by ARDL Method. *Energy Economics Letters,* 2013, Vol. 1, No.1, pp.1-14

Cooley, T.F. and Prescott, E.C., (1973). An adaptive regression model. *International Economic Review* 14, 364–371.

Dargay, J.M., (1992). *Are price and income elasticities of demand constant?* Working Paper 16. Oxford: Oxford Institute for Energy Studies.

Dramani, J. B., F. Tandoh and D. D.Tewari (2012) Structural breaks, electricity consumption and economic growth: Evidence from Ghana. *African Journal of Business Management,* . 6(22), pp. 6709-6720

Devicienti, F., Klytchnikova, I., and Paternostro, S. (2004), Willingness to Pay for Water and

Energy: An Introductory Guide to Contingent Valuation and Coping Cost Techniques, *Energy Working Notes*, Energy and Mining Sector Board, 3.

Gunatilake, H., Maddipati, N. and Patail,S. (2012). *Willingness to Pay for Good Quality, Uninterrupted Power Supply in Madhya Pradesh, India*. South Asia Working Paper Series, No. 13, Asian Development Bank.

Ek, K. & Soderholm, P. (2010). The devil is in the details: Household electricity saving behavior and the role of information. *Energy Policy* 38 : 1578–1587

Eskeland, G., Harrison, A., (2003). Moving to greener pastures? Multinational and the pollution haven hypothesis. *J. Dev. Econ*. 70, 1–23

Esso, L. J. (2010). Threshold Cointegration and Causality Relationship between Energy Use and Growth in Seven African Countries. *Energy Economics,* 32: 1383-1391.

Garg, A. and Halsnæs, K., (2008). *Assessing the Role of Energy in Development and Climate Policies in Large Developing Countries*. UNEP Risø Centre, Denmark

Ghana Statistical Service, 2006. *Ghana Living Standards Survey (2006)*, Accra

Gunatilake, H., J. Yang, S. Pattanayak, and K. Choe. (2007). Good Practices for Estimating Reliable Willingness to Pay Values in the Water Supply and Sanitation Sector. *ERD Technical Note 24*. Manila: Asian Development Bank.

Hondroyiannis, G., 2004. Estimating residential demand for electricity in Greece. *Energy policy* 26, 319–334.

Houthakker, H.S., Taylor, L.D., (1970). *Consumer Demand in the US*, 2nd edn. Harvard University Press, Cambridge, MA.

Hubler, M., (2009). *Energy saving technology diffusion via FDI and Trade: a CGE model of China.* Kiel Working Paper, available online: /http://ideas.repec.org/p/kie/kieliw/1479.htmlS

Inglesi-Lotz, R. and Pouris, A. (2013). *On the Causality and Determinants of Energy and Electricity Demand in South Africa: A Review.* University of Pretoria, Working Paper: 2013-14

ISSER, (2009) *The State of the Ghanaian Economy*. Publication by Institute of Statistical, Social and Economic Research, University of Ghana, Legon

Karimu, A. (2013).*Cooking fuel preferences among Ghanaian Households: an empirical analysis*. Department of Economics, Umeå School of Business and Economics, Umeå University Doctorial thesis

Kraft, J., Kraft, A., 1978. On the relationship between energy and GNP. *Journal of Energy and Development* 3, 401–403.

Kuunibe, N. H. Issahaku and P. K. Nkegbe (2013). *Journal of Sustainable Development Studies* 3(2): 181-198

Kwakwa, P.A., 2011. Disaggregated energy consumption and economic growth in Ghana *International Journal of Energy Economics and Policy* 2, 1, 34-40.

Kwakwa, P. A., Wiafe, E.D. and Alhassan, H., 2013. Households Energy Choice in Ghana. *Journal of Empirical Economics* 1(3): 96-103

Lean, H.H., Smyth, R., (2010). CO2 emissions, electricity consumption and output in ASEAN, *Applied Energy* 87, 1858-1864.

Lin Bo Q., (2003). *Electricity demand in the people's Republic of China: investment requirement and environmental impact*. Infrastructure Division, East and Central Asia Department of the Asian Development Bank

Lucas, R.R., (1976). Econometric policy evaluation: a critique. *Carnegie-Rochester Conference Series on Public Policy* 1, 19–46.

Ma, G. Andrews-Speed, P. & Zhang, J. (2013). Chinese consumer attitudes towards energy saving: The case of household electrical appliances in Chongqing, *Energy Policy* 56: 591-602

Manyo-Plange, N.C. (2011). The Changing Climate of Household Energy. Determinants of Cooking Fuel Choice in Domestic Settings in Axim, Ghana. Retrieved from http://www.cleancookstoves.org/resources_files/the-changing-climate-of.pdf

Mensah, J. T. and Adu, G., (2013). *An empirical analysis of household energy choice in Ghana.* Swedish University of Agricultural Sciences, Department of Economics, Working Paper Series 2013: Uppsala 2013

Mills, B., Schleich, J., (2012). Residential Energy-Efficient Technology Adoption, Energy Conservation, Knowledge, and Attitudes: An Analysis of European Countries. *Energy Policy* 49, 616–628

Paul, S. and Bhattacharya, R.B. (2004). Causality between energy consumption and

economic growth in India: a note on conflicting results. *Energy economics,* 26: 977-983.

Phillips, P.C.B., 2001. Trending time series and macroeconomic activity: some present and future challenges. *Journal of Econometrics* 100, 21–27.

Pokharel, B. (2010). *Power Shortage, its impacts and the Hydropower Sustainability Assessment Protocol: In the context of South Asia*. Masters Thesis submitted to the Depart of Natural Resource Sciences, McGill University, MacDonald Campus, Montreal, QC, Canada

Poumanyvong, P., Kaneko, S., (2010). Does urbanization lead to less energy use and lower CO2 emissions? A cross-country analysis. *Ecological Economics,* 70, 434–444

Shi, D., (2002). The Improvement of Energy Consumption Efficiency in China's Economic Growth. *Economic Research Journal* 9, 49–56.

Stock, J.H. andWatson, M.W., 1996. Evidence on structural instability in macroeconomic time series relations. *Journal of Business and Economic Statistics* 14, 11–30.

Terasvirta, T. and Anderson, H.M., 1992. Characterising nonlinearities in business cycles using smooth transition autoregressive models. *Journal of Applied Econometrics* 7, S119–S136.

Tsehaye, E., S. Tamiru and E. Engida (2010), *Economy wide impact of electricity shortage: A CGE analysis,* Newsletter: Ethiopia Strategy Support Program II (ESSP II), available at www.edri.org.et/Documents/IFPRI- ESSP%20II%20newsletter%20July-August2010.pdf. Accessed on January 2014

Twerefo D.K., Akoena S.K.K., Egyir-Tettey F.K. and Mawutor G., (2008), *Energy consumption and economic growth: evidence from Ghana.* Department of Economics, University of Ghana,

United Nations , 2005. *The Energy Challenge for Achieving the Millennium Development Goals*. UN Energy Paper June 22

Wang, Z., Zhang, B., Yin, J. and Zhang, Y. (2011). Determinants and Policy implications for household electricity behavior: Evidence from Beijing, China. *Energy Policy*. 20:2550-2557

Wolde-Rufael, Y., 2006. Electricity consumption and economic growth: a time series experience for 17 African countries. *Energy Policy* 34, 1106 –1114.

Zhang, S., Chen, L., (2009). The Empirical Research of the Impact of Economic Globalization to China's Energy Utilization Efficiency-Based on China's Industry Panel Data. *Economic Science* 1, 102–111

Zuresh, A., Peter, H., 2007. Electricity demand in Kazakhstan. *Energy policy* 35, 3729–3743.