The Role of Globalization on the Recent Evolution of Energy Demand in India: Implications for Sustainable Development

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Abstract: *Using annual data for the period 1971-2012, this study explores the relationship between globalization and energy consumption for India by endogenizing economic growth, financial development and urbanization. The cointegration test proposed by Bayer-Hanck (2013) is applied to estimate the long-run and short-run relationships among the variables. After confirming the existence of cointegration, the overall results from the estimation of an ARDL energy demand function reveal that in the long run, the acceleration of globalization (measured in three dimensions - economic, social and overall globalization) leads to a decline in energy demand in India. Furthermore, while financial development is negatively related to energy consumption, economic growth and urbanization are the key factors leading to increased energy demand in the long run. These results have policy implications for the sustainable development of India. In particular, globalization and financial development provide a win-win situation for India to increase its economic growth in the long run and become more environmentally sustainable.*

Keywords: Globalization, Energy demand, India, Financial development
***JEL Classifications*:** F62, Q43

1. Introduction

While India has made great strides in opening its economy to the rest of the world and participating in the process of globalization, there is a crucial research question regarding the relationship between globalization and energy demand which is confronting Indian policy makers – 'does globalization reduce energy demand in India or does globalization lead to increasing the usage of energy'? Motivated by this important research question, this paper relates energy demand with economic growth in India in the context of the significant structural transitions that have been occurring in terms of globalization, liberalization, financial development and urbanization during the last two and half decades. Between 1993 and 2013, India has experienced an average annual growth rate of 6.8%[1] in terms of real GDP, drawing significant comparisons with other countries as India has proven to be one of the fastest growing economies in the world. In the face of a macroeconomic balance of payments crisis of the early 1990s, the government of India pursued a number of liberalization policy measures designed towards reducing various trade restrictions (Agarwal and Whalley, 2013). Combined along with those initial set of policy measures, India has also been making gradual policy changes in relaxing the restrictive trade and investment regulations and opening up the economy to private and foreign businesses. The impacts of these comprehensive liberalization measures have resulted in an increase in inflows of foreign direct investment (FDI) and foreign institutional investment (FII) into the economy. Meanwhile, the Indian economy has also experienced significant structural shifts in the composition of the economy as it has transitioned from agriculture to industry. For example in the early 1990s the value added (as a % of GDP) from the agriculture sector averaged about 29%, while today it constitutes less than 18% of GDP [2]. More recently, there has been a transition to the service sector. This transition from agriculture to industry to services is facilitated by the availability of an educated and skilled labor force that are willing to participate in new jobs which are created due to the expansion of domestic economic growth and more especially due to the creation of new jobs in IT and customer services, as a result of the acceleration of out-sourcing activities initiated by the global multinational companies in the advanced countries. India's demographic transition has also been quite favorable to its economic growth. By 2030, it is projected that India will have 1.5 billion people

[1] http:// data.worldbank.org
[2] http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS/countries

with a median age of 31 to 32 years. In 2030, about 68% of India's population will be in the prime working age group of 15 – 64[3]. Based on these trends it is expected that India is going to witness huge demographic dividends in the near future as the economy will be endowed with a larger proportion of younger people who will be ready to participate in the labor force and this will have significant contributions to the overall economic growth of India. The recent global financial crisis of 2007-08 which had very severe consequence for the USA and other Western economies had a relatively lesser impact on India's economic growth prospectus. Currently there is significant interest by foreign investors to take advantage of doing business and invest in India's faster growing economy. The positive economic growth outlook for India does, however, raises questions about the current and future energy usage.

Led by the impacts of privatization, globalization and corresponding gradual changes in macroeconomic policies, there has been an emergence of greater competition among the states within India to attract private foreign investment flows and expand entrepreneurial activities by offering tax exemptions and other infrastructure initiatives like access to land, road, and electricity to both domestic and foreign investors. As a result of industrialization and service sector economic growth, there are new employment opportunities in cities which have resulted in an exodus of population from rural areas to urban areas. It is expected that by 2013 India's urbanization will increase to 40% up from today's level of 30%. The increasing concentration of population in cities has resulted in an increased demand for energy consumption as energy is a required input into various activities such as manufacturing, transportation, construction and other service sector activities. One of the major concerns regarding the use of energy in India is that India is dependent on conventional forms of energies such as coal and petroleum products and while there has been abysmal success in tapping renewable energy, it is expected that the vast majority of increased energy demand is going to be met with fossil fuels. This has (and will continue to have) significant implications not only for the emission of carbon dioxide (CO_2) and consequential environmental degradation, but also implications for generating a huge oil import bill and producing imbalances in India's balance of payments (BOPs). India's current energy mix consists of coal (69%), hydro (14%), natural gas (10%), oil (4%), nuclear (2%), and renewables (1%) and it is unlikely that this composition in the fuel mix will change significantly in the

[3] http://www.nbr.org/research/activity.aspx?id=195

coming decades[4]. India is currently experiencing an electricity deficit of around 10% at peak times and it is also the case that even in non-peak periods 400 million Indians have no access to electricity. Increased economic growth and demographic trends will keep sustained pressure on the demand for energy in India. By 2035, India's electricity demand is expected to double raising serious questions about where the additional supply is going to come from.

Globalization opens up an economy via the expansion of trade, investment activities and technological inflows which help in the acceleration of economic growth. However, this can come about with an increase in the consumption of substantial amounts of energy and if the country continues to be a net importer of energy, this can aggravate balance of payment (BOP) problems, which in turn would further affect its economic growth. Globalization can also result in new technology and knowledge transfers that have the potential for impacting the economy through reducing the demand for energy via bringing cleaner and more efficient forms of technology or means of production which would require less consumption of conventional energies. Technology and knowledge transfers are particularly important for a developing economy like India, because developing economies cannot afford to spend a large proportion of their incomes on innovative energy-saving technologies.

Globalization can have both positive and negative impacts on energy consumption. Globalization is a way of improving economic growth and welfare by removing the cross border restrictions on trade and investment with other countries. If foreign firms set up new businesses or expand their existing ones using newer and more advanced technologies that reduce energy consumption and thereby lower their overall costs, it is likely to influence the existing firms in the host country to adapt the new methods of production, reducing the overall consumption of energy. Instead if the globalization strategy of a country involves inviting more foreign firms to set up businesses and conduct investment in host countries which does not have a primary focus on reducing energy consumption, globalization may result in an increase in energy consumption in the host country. Since it is difficult to determine a priori which effect is dominant, the resulting impact of globalization on energy consumption can only be determined from a robust empirical analysis.

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[4] http://www.nbr.org/research/activity.aspx?id=181

This study contributes to the existing literature in five important ways. First, we use an augmented energy demand function to examine the relationship between globalization and energy consumption. While there are a number of studies investigating the impact of trade on energy consumption, to our knowledge there are no published research works investigating the impact of globalization and the impact of its constituent components (economic, social, and political globalization) on energy consumption. The different dimensions of globalization considered in this study constitute different channels through which globalization can impact energy consumption. For instance, the standard measure of economic globalization for a host country emphasizes globalization with respect to the expansion of trade and investment activities between the host country and the rest of the world and, as discussed in the previous paragraph, these activities will interact with energy consumption in the host country. A country's social globalization refers to personal contact, information flows, and cultural proximity. It enables individuals to share information and learn the best practices prevailing in other countries in different areas and sectors of the economy, and that in turn makes it possible to try to adapt and implement the same best practices in the home country, so as to restrain the energy usages in the process of production and consumption activities of various types. A country's political globalization includes information on number of embassies and membership in key international missions and treaties. Countries with greater political globalization are more likely to engage in international treaties and working groups directed at reducing the effects of climate change. In doing so they will try to comply with global standards to address shared concerns such as those of climate change and the emissions of carbon dioxides and other greenhouse gas emissions. Since the majority of greenhouse gas emissions come from the burning of fossil fuels, a countries commitment to climate change and reduction in carbon dioxide emissions directly affects its pattern of energy use. However, due to differences in the degree of economic interest between countries on issues such as global warming and climate change, some countries politicize the climate change issue by prioritizing other economic and social issues, which makes them not want to cooperate in signing international environmental treaties, resulting in the adoption of less pollution reduction strategies and increasing their levels of energy consumption. This study is an attempt to contribute to the literature by examining different dimensions of globalization and their relation with the levels of energy use in India. Secondly, we recognize that the Indian economy might have experienced structural breaks at different time points during the period of study, and as a result we test for structural breaks in the integrating properties of the variables. Otherwise, checking of the time series properties of the variables under investigation would tend to be biased. Thirdly, a relatively new approach to cointegration (the combined cointegration approach of Bayer and Hanck, 2013) is employed to investigate the existence of cointegration among the variables. Fourth, the robustness of the cointegration result is investigated by applying the bounds testing approach. Fifth, the causality among the variables is tested by employing the VECM Granger causality approach. Our empirical analysis shows that globalization reduces energy demand. Financial development is negatively linked with energy consumption but economic growth increases energy demand. The long run causality analysis indicates the bidirectional causality between globalization (economic, political and social globalization) and energy consumption.

The remainder of the paper is structured as follows. Section-2 discusses the related literature review. Section-3 analyzes the theoretical framework and model construction used in the analysis. Section-4 discuses the empirical results. Section-5 summarizes the findings and provides policy-oriented directions for future research.

2. Related literature review

There is a large literature examining the feedback relationship between energy consumption and economic growth across economies. While many of the early studies concentrated solely on bi-variate relationships between economic growth and energy consumption, more recent studies usually include additional variables to overcome the potential omitted variable bias or to investigate the impact of other important factors on the energy consumption – economic growth relationship. Ozturk (2010), for example, offered a comprehensive survey of recent contributions in the literature concerning the issue and ultimately observes that no consensus could be reached about the direction of causality between energy consumption and economic growth. More recently studies have extended the relationship between economic growth and energy consumption to include financial development and urbanization (Shahbaz and Lean, 2012; Islam et al. 2013; Menegaki and Ozturk, 2013). A number of other studies between economic growth and energy consumption also relate with the issue of carbon dioxide emissions through testing of the Environmental Kuznets Curve (EKC) hypothesis (Apergis and Ozturk, 2015). When it comes to relating the process of globalization (its channels or dimensions of globalization) with the levels of energy consumption along with simultaneously analyzing the issue of urbanization and economic growth, there are only a few attempts made in the literature for economies in general and developing countries in particular. Nevertheless, we attempt here to bring about several perspectives on their relationships that have been evidenced for different countries' contexts as demonstrated by different authors, along with highlighting some potential grey areas of research with reference to an emerging economy, like India, to which the present study is trying to address and thereby tries to bridge up this research gap.

To start with, Antweiler et al. (2001) in their study concluded that trade openness is beneficial to the environment when the technological effect is greater than the combination of composition and scale effects. They also showed that international trade would improve the income level of developing nations and induce them to import less pollutant technologies to enhance production. Copeland and Taylor, (2004) in their work supported that international trade is beneficial to environmental quality through environmental regulations and movement of capital-labor channels. They documented that international trade would shift the production of pollution-intensive goods from developing countries to the developed nations. Using the same theoretical framework of Antweiler et al. (2001), Cole (2006) investigated the impact of trade liberalization (an indicator of globalization) on per capita energy use for 32 developed and developing countries. He observed that trade can influence the energy consumption through the scale effect (the increased movement of goods and services on account of trade leads to economic activity and energy usage), the technique effect (trade enables technology transfer from developed to developing countries), and the composite effect (trade can affect the sector composition of an economy). He found that trade liberalization is likely to increase per capita energy use for the average country in the sample.

Narayan and Smyth (2009) investigated the causality betweem energy consumption, exports and economic growth for Iran, Israel, Kuwait, Oman, Saudi Arabia, and Syria. Their empirical results validated the feedback hypothesis implying that a 1% rise in energy consumption would increase economic growth to the extent of 0.04% and a 1% increase in exports would increase economic growth to the magnitude of 0.17%. Sadorsky (2011a) examined the trade-energy consumption nexus in a panel of 8 Middle Eastern countries. Similar to the findings of Narayan and Smyth (2009), his short run results indicated that causality runs from exports to energy consumption in addition to the bi-directional linkage between imports and energy consumption. The long-run elasticity showed that a 1% increase in per capita exports and per capita imports increased the per capita energy consumption by 0.11% and 0.04% respectively. In another study, Sadorsky (2012) investigated the relationships between energy consumption, output and trade in a sample of 7 South American countries. Short-run results showed Granger causality runs from energy consumption to imports, and there exists bidirectional causality between energy consumption and exports. In the long run, he found a causality relationship between energy consumption and trade. Ozturk and Acaravci, (2013) explored the relationship between economic growth, energy, financial development and trade for Turkish economy. They observed that economic growth and trade openness lead to increased energy consumption.

Lean and Smyth (2010a) investigated the relationship between economic growth, energy consumption and international trade for Malaysia by using multivariate Granger causality tests during the period, 1971 to 2006. They found strong evidence of the unidirectional Granger causality running from exports to energy consumption. In a similar study, Lean and Smyth (2010b) further examined the relationship among economic growth, exports and electricity generation for Malaysia over the period of 1970 to 2008 and found the causality holding true in a reverse direction (unidirectional causality running from electricity generation to exports). In a similar attempt, Erkan et al. (2010) explored the relationship between energy consumption and exports for Turkey during the period 1970-2006. Their empirical results confirmed the evidence of unidirectional causality running from energy consumption to exports. By employing annual data from 1980 to 2006 for Shandong, Li (2010) explored the relationship between energy consumption and exports. His empirical result revealed the unidirectional causality running from exports to energy consumption. Sami (2011) studied the relationship between energy consumption, exports and economic growth for Japan for the period, 1960 to 2007 and found an evidence of unidirectional causality running from exports to electricity consumption. Farhani and Ozturk, (2015) probed the relationship between economic growth and CO_2 emissions by including financial development, trade and urbanization in a carbon emissions function for Tunisian economy. They documented that trade openness improves environmental quality by reducing CO_2 emissions and causality is running from trade openness to CO_2 emissions[5]. Similarly, Al-Mulali and Ozturk, (2015) documented that trade openness leads industrialization which increases environmental degradation in the MENA region.

Hossain (2012) attempted to examine the relationship between exports and energy consumption for three South Asian economies (Bangladesh, India and Pakistan) for the period, 1976-2009. The findings supported the neutrality hypothesis. Shahbaz et al. (2013a) examined the relationship between energy consumption, economic growth and international trade for China during 1971-2011. They found evidence of a feedback Granger causal relationship between international trade and energy consumption. Shahbaz et al. (2013b) made a similar attempt for the Pakistan economy in investigating the causality between natural gas consumption, exports and economic growth. The empirical findings revealed that natural gas consumption contributed to economic growth and exports. Dedeoglu and Kaya (2013) also examined the relationship between energy consumption, exports and imports for the period, 1980-2010 for 25 OECD countries. Their empirical results confirmed bidirectional causality between 1) energy and GDP, 2) energy and exports, and 3) energy and imports. They found that a 1% increase in GDP, exports, and imports leads to a 0.32%, 0.21%, and 0.16% increase in energy use respectively. Katircioglu (2013) also proved the linkage between imports and energy consumption for the Singapore economy. The results showed that import growth was the cause of energy consumption growth. Zhang et al. (2013) investigated the effect of domestic trade on regional energy demand using Chinese data. They found that trade had positive impact on regional energy use.

Subsequently, Nasreen and Anwer (2014) examined the trade-energy-growth nexus using panel cointegration for 15 Asian countries. After finding evidence of panel cointegration, they further revealed that energy consumption was positively impacted due to economic growth and trade openness and the feedback hypothesis is only observed between trade openness and energy demand. Recently, Shahbaz et al. (2014a) also employed the heterogeneous panel cointegration and Granger causality to test the linkage between trade openness and energy consumption for 91 low, middle and high income countries. They observed a U-shaped relationship between trade-

[5] Al-mulali et al. (2015) reported that financial development causes environmental degradation in a Granger sense.

energy nexus for low and middle income countries but inverted U-shaped relationship for the high income countries. The existence of bidirectional Granger causality relationship was confirmed between both the variables using the non-homogenous causality approach. In a similar way, Aïssa et al. (2014) investigated the triangle among trade, energy (renewable) consumption and economic growth for the African nations. Their findings revealed that domestic output is stimulated by renewable energy consumption and trade but the neutral effect is observed between trade openness and renewable energy consumption.

Reviewing a wide range of literature, we observed that similar to the international context, the literatures in the Indian context mostly have examined the causality between energy consumption and economic growth (Paul and Bhattacharya, 2004; Ghosh, 2006; Mallick, 2009; Abbas and Choudhry, 2013, Mallick and Mahalik, 2014a, 2014b) and some have tested the EKC hypothesis in the context of the expanding effects of globalization and liberalisation. However, the present study differs from other studies by introducing the role of more relevant factors such as globalization (by adopting a comprehensive definition and measure of globalization) and urbanization and tries to relate those with the use of levels of energy consumption, which has been ignored in the literature. Moreover, following the works of Grossman and Krueger (1991) and Cole and Elliot (2003), although an enormous amount of literature (Anweiler et al. 2001; Copeland and Taylor, 2004; Cole, 2006; Narayan and Smith, 2009; Erkan et al. 2010; Lean and Smyth, 2010a, b; Sami, 2011; Sadorsky, 2012; Dedeoglo and Kaya, 2013) have investigated the relationship between trade liberalization, energy consumption, and environmental quality for both the developed and developing economies' context, this present study makes a significant departure from the earlier studies by analyzing the role of various dimensions in the measurement of globalization in order to examine their consequential impacts on energy consumption and economic growth, which few researchers have attempted in other countries' context and by excluding India. Further, our paper contributes to the empirical literature by using a more appropriate statistical technique.

As the main focus of our study is to examine the nexus between energy consumption and globalization for India, recognizing the fact that India has gone through enormous changes over time in its structural evolution of the economy – to a present phase characterized by increasing energy consumption, higher economic growth, intensive globalization, deeper financial development, and increased urbanization, the key variables in measuring financial development and urbanization are also included in the analysis. Financial development (broadly defined as liquidity in banking and stock markets) can affect energy consumption through a direct effect (consumers find it easier to borrow money for durable items), a business effect (greater access to financial capital which increase business activity) and a wealth effect (increased positive stock market activity increases consumer and business confidence) (Coban and Topcu, 2013; Sadorsky, 2010, 2011b). There are some studies by Sadorsky (2010) and Sadorsky (2011b) which finds evidence that financial development measured from banking development positively influences the energy consumption for a panel of emerging economies. Shahbaz and Lean (2012) find a long run relationship between energy consumption, economic growth, financial development, industrialization and urbanization for Tunisia. Islam et al. (2013) find evidence that financial development positively affects energy consumption in Malaysia. Xu (2012) finds evidence that financial development has a positive impact on energy consumption in China. Shahbaz et al. (2014b) examined the relationship between urbanization, economic growth and electricity consumption for the United Arab Emirates and found that electricity consumption contributes to economic growth and urbanization.

Ozturk and Uddin, (2012) investigated the causality between energy consumption, economic growth and CO_2 emissions in India. They found the unidirectional causality running form energy consumption to economic growth. Mallick and Mahalik (2014a) also conducted a comparative analysis to explore the relationship between energy use, economic growth and financial development for India and China. They found a positive impact of urbanization and negative effect of financial development and economic growth on energy consumption for both India and China.

There is a small but growing literature looking at the impact of urbanization on energy consumption. Urbanization, like industrialization, is a key component of modernization of an economy. Urbanization can affect energy use through the production effect (concentration of production in urban areas increases economic activity and also helps to achieve economies of scale in the production), mobility and transportation effect (workers are closer to their jobs, but raw material and finished products need to be transported into and out of dense urban areas), an infrastructure effect (increased urbanization increases the demand for infrastructure), and a private consumption effect (city dwellers tend to be wealthier and use more energy intense products) (Sadorsky, 2013). However, each of these effects has positive and negative impacts on energy use. Therefore, the empirical evidences on the impact of urbanization on energy consumption are mixed (e.g. Jones, 1989, 1991; Parikh and Shukla, 1995; Poumanyvong and Kaneko, 2010; York, 2007).

3. Theoretical Framework and Model Construction

There are several channels (e.g. income effect, globalization effect, financial development, and urbanization effect) which can drive the demand for energy in economies. As far as the Indian economy is concerned, rising economic growth (income effect) might have lead to increasing demand for energy consumption (Grossman and Krueger, 1991). This indicates that energy demand is positively linked with the prospects of higher economic growth and development of an economy. Mishkin (2009), in his recent seminal work, argues that globalization (globalization effect) is considered to be one of the potential factors inducing higher economic growth and thereby, the demand for energy is expected to rise corresponding to the economic growth. For instance, globalization is known to enable the transfer of advanced technology from the developed to the developing economies, thereby helping in the promotion of division of labor and helping to reap the increased benefits from the comparative advantage of each nation in producing and engaging in different specialized activities. Thus, the globalization process by helping countries to increase their trade improves their total factor productivity and raises the standards of living which in turn improve economic growth. Globalization increases economic activity via foreign direct investment and transfer of advanced technology from developed countries to developing nations. Globalization provides investment opportunities through promotion of foreign direct investment and thereby enhances the efficiency in the functioning of financial markets due to more business turnover and competition in the financial industries. Globalization thereby directly enhancing the trade and economic growth can influence the energy consumption demand and thus determine the quality of the environment.

Influenced by the theoretical argument of Mishkin (2009), Sadorsky (2011b) has recently analyzed the role of financial development on energy consumption through various effects which include consumer effect, business effect and wealth effect among others. As far as the consumer effect is concerned, improved financial development will allow consumers to access cheaper loans from financial institutions and use this money to purchase big ticket consumer durable goods (e.g. automobiles, houses, refrigerators, air conditioners, and washing machines). These durable consumer goods consume more energy and thereby affect the country's overall demand for energy. The business effect from improved financial development typically can help businesses more efficiently fund their investment activities. In other words, financial development basically allows firms to access less costly financial capital in order to expand existing businesses or to create new business ventures. Expanding existing business or creating new ventures may largely affect demand for higher energy. This is due to the fact that energy is demanded by business because it is utilized as one of the main inputs in the production and processing of goods and services. In the third channel, energy demand is positively linked with a wealth effect of financial development. A well-functioning stock market provides an efficient way to match savers of financial capital with those who need it for the expansion and capacity creation of industrial activities. The wealth effect is not only the product of stock market development but also an enabling factor for firms or households to access the financial resources, which can be used to expand their business activities as well as to buy consumer goods. In this way, financial development may lead to the overall expansion of the economy and at the same time leads to increasing demand for higher usage of energy.

Urbanization can have both positive and negative effects on energy consumption. Urbanization increases economic activity and leads to economies of scale in the production of goods and services. Urbanized centers also benefit from better (more energy efficient) infrastructure and transportation networks. All of these factors are likely to reduce energy consumption. Urbanization leads to increased economic wealth and wealthier people can afford more durable energy intensive goods (like refrigerators, air conditioning, and automobiles). Transporting food and raw materials into urban centers and finished products out of the urban manufacturing centers to other locations can also result in increased use of energy for consumption. Ultimately, the net impact of urbanization on energy demand can only be determined empirically.

The above theoretical discussion leads us to construct the following energy demand function:

$$EC_t = f(Y_t, FD_t, U_t, G_t) \quad (1)$$

We use a log-linear transformation of the variables to reduce the effects of changing variability in the data. The empirical estimable equation of the model can be represented as:

$$\ln EC_t = \beta_1 + \beta_2 \ln Y_t + \beta_3 \ln FD_t + \beta_4 \ln U_t + \beta_4 \ln G_t + \mu_t \quad (2)$$

where, $\ln EC_t$ is the natural log of energy consumption per capita, $\ln Y_t$ is the natural log of real GDP per capita, $\ln FD_t$ is the natural log of real domestic credit to the private sector which serves as a proxy for the financial development (FD)[6], $\ln U_t$ is the natural log of urban population per capita, $\ln G_t$ is the natural log of globalization and μ_t is residual term which is assumed to follow a normal distribution. The present study uses data for the period of 1971-2012.[7] The World Development Indicators (CD-ROM, 2013) is used to collect data on real GDP, energy consumption (kt of oil equivalent), real domestic credit to private sector and urban population. Globalization is measured by the KOF index of globalization by Dreher (2006). This index is created and maintained by ETH Zurich (http://globalization.kof.ethz.ch/). The KOF index of globalization consists of three main dimensions (economic, social and political) and an overall index of globalization[8]. The overall globalization index is a weighted average of economic globalization (36%), social globalization (38%), and political globalization (26%). The economic globalization dimension is constructed from information on actual flows (trade, FDI, portfolio investment) and restrictions (import barriers, trade tariffs, capital account restrictions). The social globalization dimension is constructed from information on personal contact

[6] We chose domestic credit to the private sector as our measure of financial development considering that it is one of the most widely used measures of financial development in the literature.

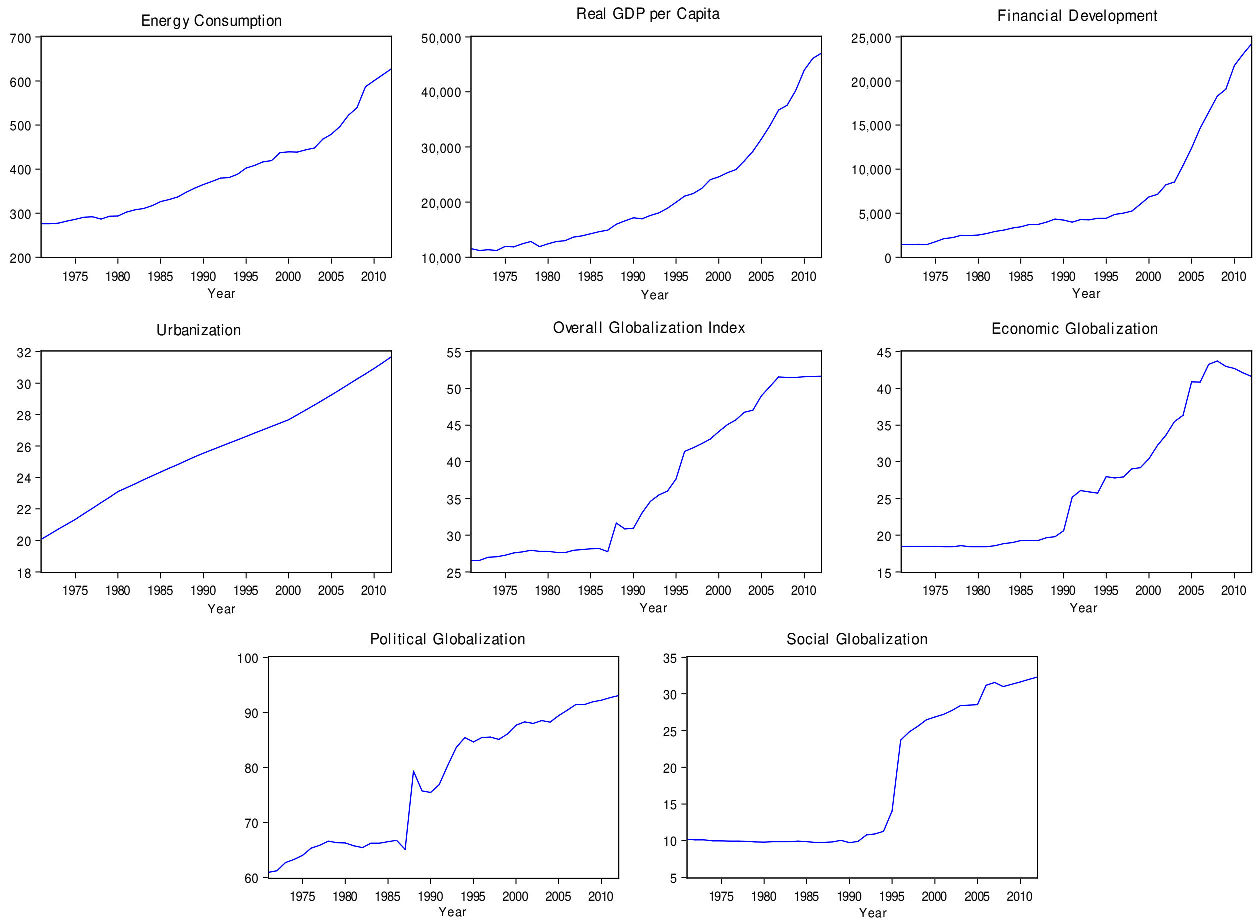
[7] The time period used in this study is dictated by the availability of data for India. The prime reason for the choice of the sample size is that the use of a long dataset not only increases the total number of observation but also enables the empirical estimation to have higher degrees of freedom. To some extent, it reduces noise coming from the individual time series cointegrated regressions and also establishes the long-run relationships between the series.

[8] As we were not able to collect the data on overall index of globalization (as well as the data on sub-indices of globalization) back to the year 1972, this restricted us to choose the mentioned time period of our analysis.

(telephone contact, tourism, foreign population), information flows (internet usage, televisions per 1000 people, trade in newspapers), and data on cultural proximity (number of McDonald's restaurants, number of IKEA stores, trade in books). The political globalization dimension is constructed from the number of embassies, membership in international organizations, participation in U.N. Security Council missions, and international treaties.[9] Population is used to convert the variables into per capita units except globalization which is basically an index. Figure-1 shows the trends of key macro variables for India. All of the variables show rising trends reflecting the impacts of increased economic growth, energy consumption, globalization, financial development (domestic credit to private sector) and urbanization which have characterized the Indian economy over the past 30 years.

Figure-1. Trends of the Variables

[9] Our review demonstrates that there exists a clear relationship between each of the individual effects of globalization (economic globalization, social globalization and political globalization) on energy consumption. Following Dreher (2006)'s measure of globalization, if one considers only the role of economic globalization (which has the weightage of 36% in the overall measure of globalization) on energy consumption in any empirical analysis, it would tend to imply that this single measure of economic globalization will not be sufficient to efficiently capture the true picture of overall globalization on energy consumption in an economy as has been done in most of the previous studies. By doing so, one will be ignoring the major influences of other two dimensions of globalization measure (social globalization and political globalization which take about 64% weightage in overall globalization).



3.1. The Bayer-Hanck Cointegration Approach

The cointegration relationship among variables is investigated by applying the combined cointegration test developed by Bayer and Hanck (2013). Engle and Granger (1987) developed the residual based cointegration test which is one of the most widely used tests of cointegration. However, this involves a two step testing procedure. The main limitation associated with the Engle-Granger cointegration test is that if there is an error done in the first step, then it carries over and feeds into the second step and ultimately provides biased empirical evidence. Further, a long-run static regression provides reliable empirical evidence but the results may be inefficient if the residuals are not normally distributed. In such a situation, we cannot make any sensible decision regarding the presence of cointegration between the variables in the long run. These issues of the Engle-Granger cointegration test were solved by Engle and Yoo (1991). The Engle and Yoo (1991) cointegration test provides more efficient empirical results due to its power and size, and this test can also be applicable if the distribution of estimators from the cointegrating vector is not normally distributed. The cointegration test proposed by Philips and Hansen (1990) was also used to eliminate the biasedness of ordinary least squares (OLS) estimates. Inder (1993), however, criticized the Philips and Hansen (1990) test and preferred to apply fully-modified OLS (FMOLS) for long run estimates compared to the estimates obtained from an unrestricted error correction model (UECM). Subsequently, Stock and Watson (1993) developed the dynamic OLS (DOLS) to test for the cointegration. DOLS is a parametric approach which uses leads and lags of variables in an OLS regression, while FMOLS provides the estimates in a non-parametric approach.

Once we have the unique order of integration in the system equation, we can then apply the Johansen and Juselius (1990) maximum likelihood cointegration approach to examine cointegration between the variables. However, this is a single-equation based cointegration technique. Further, the empirical exercise of investigating cointegration between the variables becomes invalid if any variable is integrated at I(0) in the VAR system or happens to belong to a mixed order of integration. The Johansen and Juselius (1990) maximum likelihood cointegration results are also sensitive to the incorporation of exogenous and endogenous variables in the model. This test only indicates the presence of cointegration between the variables for long run but provides no information on short run dynamics. Partially in response to these issues, Pesaran et al. (2001) suggested a bounds testing approach for cointegration using an autoregressive distributive lag model (ARDL) to scrutinize the long run cointegrating relationships between the series and also accommodating possible structural breaks in the series. This cointegration approach is applicable if series are integrated at I(1) or I(0) or I(1)/I(0). The ARDL bounds testing approach provides simultaneous empirical evidence on long run as well as short run relationships between the variables. The major problem with the ARDL bounds testing is that this approach provides efficient and reliable results if a single equation cointegration relation exists between the variables. Otherwise it may mislead the results. This approach is unable to provide any conclusive empirical results if some of the variables are integrated at I(2).

In summary, although there are numerous approaches to testing for cointegration, however, in practice it is possible that different approaches give different results. In such circumstances, it becomes difficult to obtain uniform results because one cointegration test rejects the null hypothesis, while a different test does not reject it. In the energy economics literature, a variety of cointegration tests have been used in practice (e.g. Engle-Granger's (1987) residual based test, Johansen's (1991) system based test, Boswijik (1994) and Banerjee et al. (1998) lagged error correction based approaches to cointegration). Pesavento (2004) further points out that that the power of cointegration tests may be sensitive to the presence of nuisance parameters. To overcome some of these issues, Bayer and Hanck (2013) developed a new dynamic cointegration technique by combining several popular tests for cointegration to obtain uniform and reliable cointegration results. This cointegration test provides efficient estimates by ignoring the nature of multiple testing procedures. This implies that the application of non-combining cointegration tests provide robust and efficient results compared to individual t-test or system based test.

An insight emerging from applying the Bayer and Hanck (2013) combined cointegration test is that it provides informed econometric knowledge to the researcher on the cointegrating relationship between the series by eliminating undue multiple testing procedures which is a common problem associated with other traditional cointegration techniques. Efficient and conclusive results are also guaranteed from employing the Bayer and Hanck (2013) combined cointegration technique which is not found from other traditional cointegration approaches available in the field of econometrics. Therefore, given the superiority of this applied methodology over all other existing approaches to cointegration, the conclusive results emerging from the use of the Bayer and Hanck (2013) cointegration approach is expected to provide new potential insights for policy-making authorities to use these findings for designing their energy and environmental policy.

The Bayer and Hanck (2013) cointegration test follows Fisher's (1932) critical tabulated values formula to combine the statistical significance level i.e. p-values of single cointegration test and formula is given below:

$$EG - JOH = -2[\ln(P_{EG}) + \ln(P_{JOH})] \tag{3}$$

$$EG - JOH - BO - BDM = -2[\ln(P_{EG}) + \ln(P_{JOH}) + \ln(P_{BO}) + \ln(P_{BDM})] \tag{4}$$

The probability values of different individual cointegration tests such as Engle-Granger (1987); Johansen (1991); Boswijik (1994) and Banerjee et al. (1998) are shown by P_{EG}, P_{JOH}, P_{BO} and P_{BDM} respectively. To decide whether cointegration exists or not between the variables, we follow Fisher (1932)'s critical statistic values. We may conclude in favor of cointegration by rejecting the null hypothesis of no cointegration once critical values generated by Bayer and Hanck (2013) are found to be less than the calculated Fisher (1932) statistics. Otherwise the reverse would hold true.

3.2. The VECM Granger Causality

The vector error correction model (VECM) is an econometric model that combines short-run and long-run dynamics. The VECM is useful for testing Granger causality between the variables. Suppose, there exists cointegration between the variables, the VECM can be developed as follows:

$$\begin{bmatrix} \Delta \ln EC_t \\ \Delta \ln Y_t \\ \Delta \ln FD_t \\ \Delta \ln U_t \\ \Delta \ln G_t \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix} + \begin{bmatrix} B_{11,1} & B_{12,1} & B_{13,1} & B_{14,1} & B_{12,1} \\ B_{21,1} & B_{22,1} & B_{23,1} & B_{24,1} & B_{25,1} \\ B_{31,1} & B_{32,1} & B_{33,1} & B_{34,1} & B_{35,1} \\ B_{41,1} & B_{42,1} & B_{43,1} & B_{44,1} & B_{45,1} \\ B_{51,1} & B_{52,1} & B_{53,1} & B_{54,1} & B_{55,1} \end{bmatrix} \times \begin{bmatrix} \Delta \ln EC_{t-1} \\ \Delta \ln Y_{t-1} \\ \Delta \ln FD_{t-1} \\ \Delta \ln U_t \\ \Delta \ln G_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} B_{11,m} & B_{12,m} & B_{13,m} & B_{14,m} & B_{15,m} \\ B_{21,m} & B_{22,m} & B_{23,m} & B_{24,m} & B_{25,m} \\ B_{31,m} & B_{32,m} & B_{33,m} & B_{34,m} & B_{35,m} \\ B_{41,m} & B_{42,m} & B_{43,m} & B_{44,m} & B_{45,m} \\ B_{51,m} & B_{52,m} & B_{53,m} & B_{54,m} & B_{55,m} \end{bmatrix}$$

$$\times \begin{bmatrix} \Delta \ln EC_{t-1} \\ \Delta \ln Y_{t-1} \\ \Delta \ln FD_{t-1} \\ \Delta \ln U_t \\ \Delta \ln G_{t-1} \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \\ \zeta_5 \end{bmatrix} \times (ECM_{t-1}) + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \\ \mu_{5t} \end{bmatrix} \quad (5)$$

Where Δ represents difference operator and ECM_{t-1} denotes the lagged error correction term, found from the long run cointegration equation. The long run causality can also be obtained in the VECM model by looking at the significance of the estimated coefficient on the lagged error correction term. The joint χ^2 statistic for the first differenced lagged independent variables is used to investigate the direction of short-run causality between the variables. For example,

$B_{12,i} \neq 0 \forall_i$ shows that economic growth Granger causes energy consumption and vice-versa if $B_{21,i} \neq 0 \forall_i$.

4. Empirical results and discussion

In order to investigate the cointegration among the variables, testing of stationarity of the variables is a necessary precondition. For this purpose, we apply the Ng-Perron (2001) unit root test with the presence of intercept and trend terms in the unit root estimating equation. The results reported in Table-1 find that all of the variables under consideration such as energy consumption ($\ln EC_t$), economic growth ($\ln Y_t$), financial development ($\ln FD_t$), urbanization ($\ln U_t$), overall globalization ($\ln G_t$), economic globalization ($\ln EG_t$), political globalization ($\ln PG_t$) and social globalization ($\ln SG_t$) are found to be non-stationary at their levels but stationary in first differences. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests show that all the variables are stationary in their first differences implying the variables are integrated of I(1).[10]

Table-1: Unit Root Analysis

Variables	MZa	MZt	MSB	MPT
$\ln Y_t$	-0.9092 (1)	-0.4103	0.4512	46.0303
$\ln EC_t$	-8.8324 (2)	-1.8739	0.2121	11.1032
$\ln FD_t$	-8.0947 (1)	-1.9052	0.2353	11.5560
$\ln PG_t$	-6.8390 (1)	-1.7912	0.2619	13.3754
$\ln SG_t$	-9.8647 (2)	-2.2203	0.2250	9.2399
$\ln EG_t$	-5.5085 (1)	-1.6590	0.3011	16.5411
$\ln U_t$	-8.0536 (2)	-1.9990	0.2482	11.3364
$\ln G_t$	-6.0247 (4)	-1.7325	0.2875	15.1217
$\Delta \ln Y_t$	-23.5689 (1)**	-3.3495	0.1421	4.3593
$\Delta \ln EC_t$	-18.2981 (1)**	-3.0038	0.1641	5.1063
$\Delta \ln F_t$	-19.1248 (3)**	-3.0713	0.1605	4.8916
$\Delta \ln PG_t$	-43.6626 (2)*	-4.6720	0.1070	2.0889
$\Delta \ln SG_t$	-23.1970 (3)**	-3.3993	0.1465	3.9663

[10] These unit root results are not reported here and can be available upon request.

$\Delta \ln EG_t$	-18.9057 (2)**	-3.0362	0.1606	5.0506
$\Delta \ln G_t$	-22.3732 (3)**	-3.3272	0.1487	4.1774
$\Delta \ln U_t$	-25.5480 (2)*	-3.5272	0.1380	3.8424

Note: * and ** represents significance at 1 and 5 percent level. The lag length is shown in parentheses. For details of these notations including MZa, MZt, MSB and MPT, please see the study by Ng-Perron (2001).

In the presence of structural breaks, the Ng-Perron (2001) unit root test is known to provide biased results. This is because this unit root test does not accommodate the information about the unknown structural break dates which weakens the stationarity hypothesis. To overcome this problem, we have employed a novel unit root test developed by Zivot and Andrews, (1992) which accommodates the information about a single unknown structural break present in the series.[11] The results presented in Table-2 show that all of the variables have unit roots in their levels in the presence of structural breaks. The structural breaks i.e. 1993, 2001, 1990, 1988, 1989, 1991, 1976 and 1991 are found in the series of economic output, energy consumption, financial development, political globalization, social globalization, economic globalization, urbanization and overall globalization. It is noted that the structural breaks in variables such as political globalization and economic globalization are occurring around the period 1991. These breaks are associated with the period of liberalization reform initiatives undertaken by the government of India, following India's twin financial crises. Social globalization took time to adapt and, as a result, the break happened towards the later part of the twentieth century. Furthermore, the structural break date that occurred in the period 1998 is associated with India's higher economic growth and as an effect of this growth process in due course of the time, a similar pattern of trend shift has also been observed with regard to the energy consumption as

[11] Zivot-Andrews, (1992) single structural break test has been employed in order to check the existence of structural break in the level series. This is because the time series variables often used in the empirical testing are subject to several random shocks (e.g. economic policy related to financial sector, energy related policy, global economic financial crisis, and other external policies). Without application of this test in an empirical testing, we may unable to know the actual fluctuation of the level series over time. Therefore, the use of structural break(s) unit root test enables us to know in which period the structural break occurs. In doing this, we can control easily this break with the help of structural break unit root test. Another potential advantage of using single structural break unit root test is that the structural break test is highly associated with cointegration process between the level series. Unless we effectively capture the structural break stemming in the time level series data, we may fail to gauge the true nature of stationarity behaviour in the level series. Since the Indian economy might have experienced more than one structural break(s) over the time, we have also employed a second structural break(s) unit root test as proposed by Lumsdaine-Papell (1997) and we observed similar results, and therefore, we do not report those results here for the sake of brevity. However, those results can be available from the authors on request.

reflected in terms of higher energy demand in the Indian economy. The presence of a structural break in 1998 for the Indian economy as reflected in the movement of its key economic parameters could also be due to the short run persistence of the negative impact of the South Asian 1997 financial crisis. Rather, the South Asian crisis of 1997 might have helped the Indian economy to reap some economic benefits in the Asian region since the period 1998, which could further be due to the Indian's sustained policy efforts towards economic liberalization and globalization processes. Hence, such an economic situation might have proven to be a boon for the Indian economy by raising its relative prospects for attracting more foreign investment on the one hand and raising its prospectus for exporting more goods and services to the international market. This might have necessitated some urgency for fulfilling higher potential demand for its goods and services at home and abroad and also resultant increased capacity to produce more output and thereby leading to higher economic growth. Such an environment of higher economic growth also requires more energy consumption during the same period which is required as inputs into the production and investment activities. All the break points show some sort of consistency in the pattern of events occurring in the Indian economy. The structural break in energy consumption is linked to implementation of the Energy Conservation Act (2001) to maintain energy demand in the future for sustainable economic growth in India. However, this is to note that all the variables are found to be stationary in their first differenced forms. This indicates that all the level series are integrated of I(1).

Table-2: ZA Unit Root Test

Variable	**Level**			**1st Difference**		
	T-statistic	Time Break	Decision	T-statistic	Time Break	Decision
$\ln Y_t$	-3.184 (2)	1993	Unit Root	-7.796 (3)*	2005	Stationary
$\ln EC_t$	-3.628 (1)	2001	Unit Root	-7.127 (3)*	2007	Stationary
$\ln FD_t$	-3.4426(3)	1990	Unit Root	6.149 (2)*	1999	Stationary
$\ln PG_t$	-2.018 (2)	1988	Unit Root	-9.960 (3)*	1988	Stationary
$\ln SG_t$	-2.179 (2)	1989	Unit Root	-5.559 (4)*	1995	Stationary
$\ln EG_t$	-2.969 (3)	1991	Unit Root	-6.480 (3)*	2005	Stationary
$\ln U_t$	-3.560 (2)	1976	Unit Root	-6.644 (3)*	1981	Stationary
$\ln G_t$	-2.398 (1)	1991	Unit Root	-9.539 (1)*	1988	Stationary

Note: * represents significant at 1% level of significance. Lag order is shown in parenthesis.

As the results from the above unit root tests show that all the variables are stationary in their first differences i.e. $I(1)$, in such circumstance, the combined cointegration test developed by Bayer and Hanck (2013) is a suitable empirical method to investigate whether there exists cointegration among the variables. Table-3 presents the combined cointegration test results including the EG-JOH, and EG-JOH-BO-BDM. We find that Fisher-statistics for EG-JOH and EG-JOH-BO-BDM tests exceed the critical values at 5% level of significance when we use energy consumption, economic growth, financial development, urbanization and overall globalization as dependent variables. This rejects the null hypothesis of no cointegration among the variables. Similar results are obtained when one replaces overall globalization with its components ($\ln PG_t$, $\ln SG_t$,and $\ln EG_t$) as other measures of globalization indices. This confirms the presence of cointegration among the variables in different models, even by alternatively substituting three different measures of globalization indices. Thus, we can conclude that there is a long run relationship between energy consumption, economic growth, financial development, urbanization, and globalization (economic globalization, political globalization and social globalization) in India.

Table-3. The Results of Bayer and Hanck Cointegration Analysis

Estimated Models	EG-JOH	EG-JOH-BO-BDM	Lag Order	Cointegration
$EC_t = f(Y_t, FD_t, U_t, EG_t)$	13.483**	21.732**	2	Yes
$Y_t = f(EC_t, FD_t, U_t, EG_t)$	14.280**	21.0202**	2	Yes
$FD_t = f(Y_t, EC_t, U_t, EG_t)$	13.310**	26.790**	2	Yes
$U_t = f(EC_t, Y_t, FD_t, EG_t)$	13.383**	21.491**	2	Yes
$EG_t = f(EC_t, Y_t, FD_t, U_t)$	14.351**	28.318**	2	Yes
$EC_t = f(Y_t, FD_t, U_t, SG_t)$	15.053**	30.862*	2	Yes
$Y_t = f(EC_t, FD_t, U_t, SG_t)$	15.712*	27.075**	2	Yes
$FD_t = f(Y_t, EC_t, U_t, SG_t)$	14.205**	22.423**	2	Yes
$U_t = f(EC_t, Y_t, FD_t, SG_t)$	14.126**	21.819*	2	Yes
$SG_t = f(EC_t, Y_t, FD_t, U_t)$	14.451**	29.054**	2	Yes

$EC_t = f(Y_t, FD_t, U_t, PG_t)$	12.819**	38.811*	2	Yes
$Y_t = f(EC_t, FD_t, U_t, PG_t)$	12.886**	24.763**	2	Yes
$FD_t = f(Y_t, EC_t, U_t, PG_t)$	13.254**	43.739*	2	Yes
$U_t = f(EC_t, Y_t, FD_t, PG_t)$	13.074**	32.545*	2	Yes
$PG_t = f(EC_t, Y_t, FD_t, U_t)$	14.084**	25.577**	2	Yes
$EC_t = f(Y_t, FD_t, U_t, G_t)$	16.250*	29.638**	2	Yes
$Y_t = f(EC_t, FD_t, U_t, G_t)$	19.328*	22.224**	2	Yes
$FD_t = f(Y_t, EC_t, U_t, G_t)$	16.006*	24.051**	2	Yes
$U_t = f(EC_t, Y_t, FD_t, G_t)$	15.702*	21.663 **	2	Yes
$G_t = f(EC_t, Y_t, FD_t, U_t)$	15.701*	24.616**	2	Yes

Note: * and ** represents significant at 1and 5 per cent levels. Critical values at 1% level are 15.701 (EG-JOH) and 29.85 (EG-JOH-BO-BDM) and critical values at 5% level are 10.576 (EG-JOH) and 20.143 (EG-JOH-BO-BDM), respectively. Lag length is based on minimum value of AIC.

The Bayer and Hanck (2013) combined cointegration approach is known to provide efficient parameter estimates but fails to accommodate for the structural breaks in the series. This issue is overcome by applying the ARDL bounds testing approach to cointegration advanced by Pesaran et al. (2001)[12] in the presence of structural breaks. This is followed along the lines of Shahbaz et al. (2013a,b) and Shahbaz et al. (2014). Since the ARDL bounds test procedure is known to be sensitive to lag length selection in the model, we have used the AIC criteria to select the appropriate lag order. It is reported by Lütkepohl (2006) that the dynamic link between the series can be well captured with an appropriate selection of lag length. The optimal lag length results are reported in column-2 of Table-4. We have used the critical bounds statistics from Narayan,

[12] The justification for using the ARDL model developed by Pesaran et al. (2001) is that there are several advantages behind the ARDL bounds testing approach over alternative traditional models suggested by Engle and Granger (1987) and Johansen and Juselius (1990). (i) The ARDL model does not require one to examine the non-stationarity property and the order of integration of the variables used in the analysis; (ii) the bounds test produces robust results for small sample sizes. Further, Narayan (2005) created tables with critical F-values for small sample sizes ranging from 30 to 80. As our sample size falls in this range, we use the critical bounds values provided by Narayan (2005); (iii) empirical studies have established that energy market-related variables are either integrated of order I[(1)] or I(0) in their nature and one can rarely be confronted with I(2) series (Narayan and Smyth, 2007; 2008), justifying the application of ARDL for our analysis; (iv) the ARDL technique solves the issue of endogeneity in the model estimation due to the incorporation of lagged values of the dependent variable in the model.

(2005) to determine the existence of cointegration in different models. The results show that the calculated F-statistic is found to be greater than the upper bounds critical values when energy consumption (EC_t), economic growth (Y_t), financial development (FD_t), urbanization (U_t), and overall globalization (G_t) were used as dependent variables. Similar results are also obtained when we used other measures of globalization (economic globalization i.e. EG_t, political globalization i.e. PG_t and social globalization i.e. SG_t) for the same models. This shows that the ARDL bounds test confirms the long run relationship among the variables. This entails a long run relationship between energy consumption, economic growth, financial development, urbanization and globalization in case of India over the period, 1971-2012.

Table-4: The Results of ARDL Cointegration Test

Bounds Testing Approach to Cointegration				Diagnostic tests			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimated Models	Optimal lag length	Structural Break	F-statistics	χ^2_{NORMAL}	χ^2_{ARCH}	χ^2_{RESET}	χ^2_{SERIAL}
$EC_t = f(Y_t, FD_t, U_t, EG_t)$	2, 2, 2, 2, 2	2001	8.578*	0.0201	[1]: 0.8434	[1]: 2.3113	[1]: 5.4079
$Y_t = f(EC_t, FD_t, U_t, EG_t)$	2, 2, 2, 2, 2	1993	8.442*	0.6793	[2]: 0.1165	[1]: 0.4242	[2]: 1.2222
$FD_t = f(Y_t, EC_t, U_t, EG_t)$	2, 2, 2, 1, 1	1990	6.899**	0.5921	[1]: 0.1601	[3]: 2.4678	[1]: 1.3825
$U_t = f(EC_t, Y_t, FD_t, EG_t)$	2, 2, 2, 2, 1	1976	10.441*	1.0752	[1]: 0.4144	[2]: 0.8762	[1]: 1.4578
$EG_t = f(EC_t, Y_t, FD_t, U_t)$	2, 1, 2, 2, 2	1991	11.6340*	1.4214	[1]: 2.2257	[1]: 0.0888	[1]: 1.0989
$EC_t = f(Y_t, FD_t, U_t, SG_t)$	2, 2, 2, 1, 1	2001	8.560*	0.4597	[1]: 2.1488	[1]: 2.6134	[1]: 2.4444
$Y_t = f(EC_t, FD_t, U_t, SG_t)$	2, 2, 2, 2, 2	1993	7.741**	1.0423	[1]: 0.4457	[1]: 2.4444	[1]: 1.7777
$FD_t = f(Y_t, EC_t, U_t, SG_t)$	2, 2, 2, 1, 2	1990	7.594*	0.3601	[1]: 0.3329	[1]: 2.4334	[3]: 0.2222
$U_t = f(EC_t, Y_t, FD_t, SG_t)$	2, 2, 1, 2, 2	1976	6.972**	2.2711	[2]: 2.5678	[3]: 0.2234	[3]: 1.8867
$SG_t = f(EC_t, Y_t, FD_t, U_t)$	2, 2, 2, 2, 2	1989	8.153*	0.6591	[1]: 2.6768	1]: 1.2211	[1]: 1.3322
$EC_t = f(Y_t, FD_t, U_t, PG_t)$	2, 2, 1, 1, 2	2001	6.590**	2.2222	[1]: 1.1191	[1]: 1.3409	[3]: 1.2233
$Y_t = f(EC_t, FD_t, U_t, PG_t)$	2, 2, 2, 2, 2	1993	7.123**	1.5674	[1]: 0.8890	[1]: 1.2244	[2]: 2.4423
$FD_t = f(Y_t, EC_t, U_t, PG_t)$	2, 2, 2, 2, 1	1990	9.092*	0.6531	[1]: 0.8778	[2]: 2.4141	[1]: 2.3232
$U_t = f(EC_t, Y_t, FD_t, PG_t)$	2, 1, 2, 1, 1	1976	6.789**	1.4073	[1]: 1.4180	[4]: 0.4010	[1]: 0.4656
$PG_t = f(EC_t, Y_t, FD_t, U_t)$	2, 2, 2, 2, 1	1988	10.502*	2.4510	[2]: 2.4976	[4]: 1.4334	[1]: 0.9803
$EC_t = f(Y_t, FD_t, U_t, G_t)$	2, 2, 2, 2, 2	2001	8.626**	2.5587	[1] 1.3629	[2]: 0.1870	[1]: 0.7640
$Y_t = f(EC_t, FD_t, U_t, G_t)$	2, 1, 2, 2, 1	1993	7.894*	1.0953	[2]: 0.1278	[2]: 0.2467	[1]: 2.3421
$FD_t = f(Y_t, EC_t, U_t, G_t)$	2, 2, 1, 1, 2	1990	8.014*	0.2513	[1]: 0.2890	[4]: 2.8090	[1]: 1.0090
$U_t = f(EC_t, Y_t, FD_t, G_t)$	2, 1, 1, 1, 1	1976	7.634*	2.9034	[2]: 2.8890	[1]: 0.2340	[1]: 2.8070
$G_t = f(EC_t, Y_t, FD_t, U_t)$	2, 2, 2, 2, 2	1991	9.904*	0.1454	[2]: 2.1166	[1]: 1.4563	[2]: 1.3020

	Critical values (T= 42)#						
	Lower bounds $I(0)$	Upper bounds $I(1)$					
	6.053	7.458					
	4.450	5.560					
	3.740	4.780					

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. # Critical lower and upper bounds values are collected from Narayan (2005) including unrestricted intercept and unrestricted time trend. T is the total number of observations used in the empirical analysis.

The existence of cointegration relationships between the variables leads us to examine the long run impact of economic growth, financial development, urbanization and globalization on energy consumption. The long run results reported in Table-5 show that there is a positive and statistically significant relationship between economic growth (i.e. income) and energy consumption in all of the models estimated and reported here in general. It is further noted that a 1 per cent rise in economic growth leads to a 0.5476-0.7621 per cent rise in energy demand in India, keeping other things constant. This implies that energy demand has been increasing due to the increase in economic growth. For instance, firms require greater amounts of energy for producing higher levels of agricultural, industrial and service sector output in the rapidly developing Indian economy. Households also need greater amounts of energy in order to satisfy their increasing energy consumption needs in their daily life due to a rise in per capita income. Finally, the government or public sector also needs more energy on account of higher economic growth and development in the economy. This finding is consistent with the findings of Shahbaz and Lean (2012) for Tunisia, Islam et al. (2013) for Malaysia, Shahbaz et al. (2014a) for Bangladesh and Mahalik and Mallick (2014a) for India. As far as the positive and significant relationship between economic growth and energy consumption is concerned, our study in terms of policy suggests that the government of India needs to adopt a very cautious energy policy for targeting a reduction in the usage of various energy inputs for the sake of improving environmental quality. Otherwise, there will be a trade off between achieving sustainable economic growth and development for the Indian economy by retarding the long term economic growth rate of the economy.

In terms of looking at the impact of financial development on energy demand in India, the results of our study reveal that financial development impacts energy demand significantly and negatively. If all else is the same, a 1 per cent increase in financial development reduces energy demand by 0.0876-0.1537 per cent. This highlights the adverse implication of financial development on energy usage for India. Intuitively, it suggests that in the case of India, increasing financial development (in the form of domestic credit to the private sector) increases economic activity in an efficient way that lowers energy consumption. This result supports the findings of Mahalik and Mallick (2014a,b) who found that financial development is negatively linked with energy demand in India. This is contradicting many previous studies of Shahbaz and Lean, (2012), Islam et al. (2013), Sadorsky (2010, 2011b), Coban and Topcu (2013), Aslan et al. (2014) and Komal and Abbas (2015) as the latter studies reported that financial development by leading to industrialization raises the demand for energy[13].

In examining the impact of urbanization on energy demand, it is found that a rise in urban population is significantly and positively linked with energy consumption in India. A 1 per cent increase in urban population leads to a 0.5649-0.7999 per cent increase in energy use in India. This result supports the findings of Mahalik and Mallick (2014a,b) for India and Shahbaz and Lean (2012) for Tunisia in which they reported that urbanization increases energy demand for Tunisia. This indicates there is a role for urbanization in the dynamics of energy consumption demand as urbanization is found to be one of the leading factors contributing to more energy consumption in India. This could have happened in the face of a changing Indian economic landscape (i.e. shifting the production base from an agricultural sector to an industrial sector). As the scale of industrialization has started to grow in various cities of India, this has further accelerated the pace of urbanization, by transforming various urban centers as the sources of employment opportunities making more migration possible from rural areas to urban regions of India. An increasing urban population needs more energy to meet their day-to-day consumption requirement and this effect outweighs any energy savings that may come from increased economies of scale associated with urbanization.

[13]This difference in empirical results may be due to the use of different data sets, time periods of study as well as different econometric approaches.

Rising urbanization could also imply loss of environmental quality due to heavy pressure from urban growth. This will make it more difficult for India to achieve sustainable economic growth. Keeping such perspectives in mind, an emerging economic and energy policy implication is for the government of India (along with the state government and local governments) to think of an alternative mechanism for checking the growth of urban population which will help to reduce the adverse environmental effects (i.e. climate change and global warming) of more energy use.

Our empirical results show that globalization (i.e. economic globalization, social globalization and overall globalization) has a negative impact on energy demand. It is also statistically evident that an increase in economic globalization, social globalization and overall globalization by 1 per cent each brings about 0.1143 per cent, 0.0693 per cent, and 0.2751 per cent decline in energy use respectively. Moreover, it is promising from a policy perspective to see that economic globalization, social globalization and overall globalization contribute to less energy demand for an emerging economy like India.

We believe that there are different channels of globalization such as (economic globalization which mainly operates through trade and capital inflows, and social globalization which operates through the ways of information and cultural flows, and regional economic integration) that might be driving the reduced usage of energy demand in India. For instance, economic globalization by increasing financial openness and trade openness might have attracted inflows of foreign direct investment (FDI) into the Indian economy backed up by higher profit opportunities and higher economic growth in the host economy. Sometimes when foreign investors come into developing economies to set up their business and investment, they come with their own advanced methods of production that require less intensive use of energy. In the process, it creates a demonstration effect for the existing firms at home to switch to newer production methods which can greatly reduce energy consumption. Secondly, social globalization (mostly along with economic globalization) allows for the sharing of information regarding best practices. This enables individuals to learn the best practices prevailing in other countries in different areas and sectors of the economy, and that in turn makes it possible to try to adapt and implement the same best practices in their home country so as to reduce energy usage in the production and consumption activities of various types. In the same way, national governments by signing various international treaties also try to comply with global standards to address shared concerns such as climate change and the emission of carbon dioxide. However, we did not find a significant effect of political globalization on energy consumption either in the long run or short run. Overall, our study indicates that globalization measured in terms of an index of its three dimensions reduces energy consumption in India. This also suggests that globalization by enhancing the mobility of population and capital, trade and investment and technology transfers across countries' borders and sharing of information helps the economy to reduce energy consumption and effectively manage the energy usages in various sectors through better utilization in consumption, production and business activities. This finding is contradictory with Cole (2006) who documented a positive impact of trade liberalization (proxy for globalization) on energy consumption.

Lastly, we have incorporated a dummy variable to account for the impact of the Energy Conversation Act (2001) on energy demand in India. The main purpose of this Act is to reduce energy intensity by developing programs and strategies to increase energy conservation and improve efficiency in use. We find that implementation of Energy Conversation Act reduces energy demand in the long run by 0.0319-0.0547 per cent at 1% level of significance.

Table-5: Long and Short Runs Results

Dependent variable = $\ln EC_t$								
Long Run Analysis								
Variables	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics	Coefficient	T-Statistics
Constant	-1.0783*	-2.7582	-1.4108*	-4.4263	-0.5674	-1.6083	-1.8850*	-4.6968
$\ln Y_t$	0.6350*	9.9559	0.6768*	13.9428	0.5473*	9.4462	0.7621*	11.8850
$\ln FD_t$	-0.0895*	-3.3826	-0.1141*	-4.8625	-0.0876**	-2.2851	-0.1537*	-5.3338
$\ln U_t$	0.5806*	5.9100	0.5649*	6.7198	0.6935*	3.7730	0.7999*	8.0322
$\ln EG_t$	-0.1143**	-2.4232			…	…	…	…
$\ln SG_t$	…	…	-0.0693*	-4.5908	…	…	…	…
$\ln PG_t$	…	…	…	…	-0.0916	-0.8900	…	…
$\ln G_t$							-0.2751*	-4.5509
D_t	-0.0547*	-2.9080	-0.0359*	-3.8109	-0.0510*	-3.8043	-0.0319*	-2.3711
R^2	0.9845		0.9859		0.9837		0.9858	
Short Run Analysis								

Variables	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Constant	0.0266**	2.2115	0.0248**	2.1445	0.0294**	2.2837	0.0217***	1.8006
$\Delta \ln Y_t$	0.2512**	2.4381	0.3172*	3.2872	0.2873**	2.7014	0.3766*	3.4690
$\Delta \ln FD_t$	-0.0595	-1.1833	-0.0545	-1.2477	-0.0632	-1.2580	-0.0782	-1.6350
$\Delta \ln U_t$	-1.0033	-1.0195	-0.9868	-1.0487	-1.1863	-1.1630	-0.6229	-0.6414
$\Delta \ln PG_t$	-0.0121	-0.1664	…	…	…	…	…	…
$\Delta \ln SG_t$	…	…	-0.0377	-1.4052	…	…	…	…
$\Delta \ln EG_t$	…	…	…	…	-0.0889	-1.3555	…	…
$\Delta \ln G_t$	…	…	…	…	…	…	-0.1400	-1.5849
D_t	0.0090	1.4800	0.0051	0.8942	0.0074	1.1743	0.0059	1.0183
ECM_{t-1}	-0.3934*	-2.7835	-0.6222*	-3.9905	-0.4452*	-2.8609	-0.6133*	-3.5778
R^2	0.3059		0.4211		0.3153		0.3871	
F-statistic	3.0853**		5.0920*		3.2245**		4.4223*	
D. W	1.7406		1.7374		1.6945		1.7588	
Short Run Diagnostic Tests								
Test	F-statistic	Prob. value	F-statistic	Prob. Value	F-statistic	Prob. value	F-statistic	Prob. Value
$\chi^2 SERIAL$	1.1526	0.2272	1.2218	0.3078	2.1832	0.1287	1.1141	0.3402
$\chi^2 ARCH$	0.0667	0.8975	0.0309	0.8614	0.0676	0.7962	0.0105	0.9187
$\chi^2 WHITE$	1.7338	0.1526	1.6840	0.1643	0.7946	0.5609	1.2739	0.2971
$\chi^2 REMSAY$	2.0078	0.1233	0.5141	0.4782	2.8258	0.1222	2.5901	0.1011

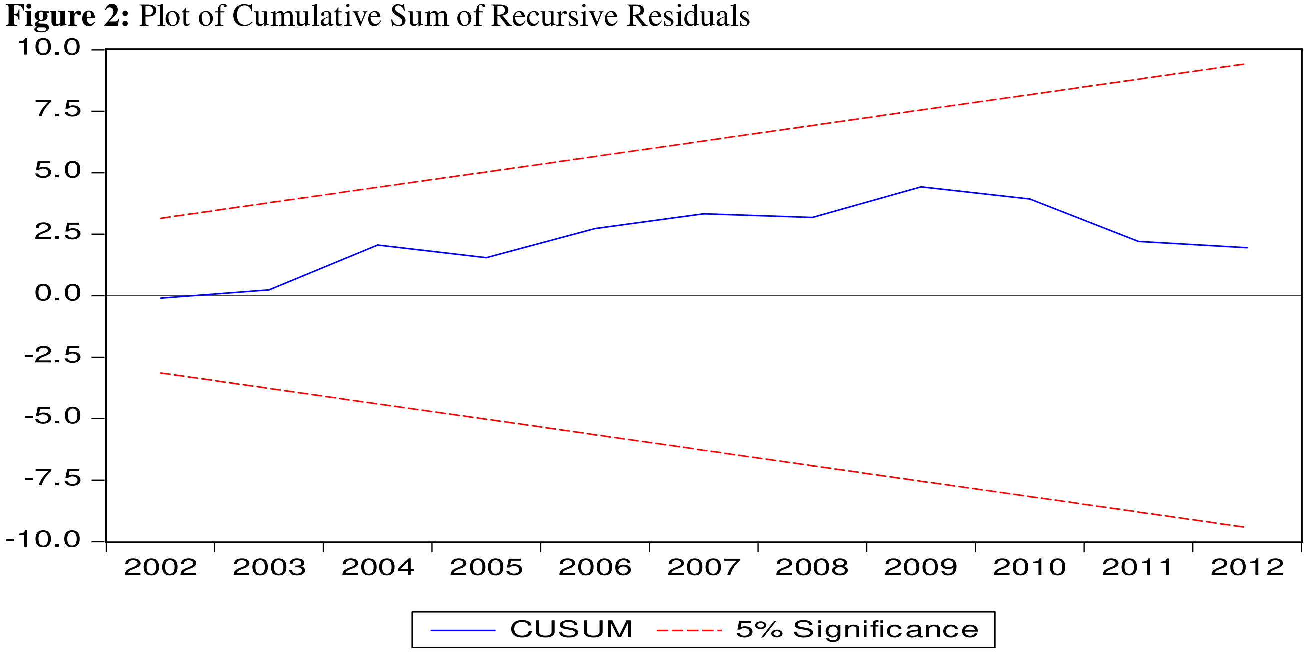
Note: * and ** show significant at 1% and 5% levels of significance, respectively.

Although the study emphasizes the importance of the long run estimates for the policy implications, nevertheless, the short run results reported in the lower segment of Table-5 show that economic growth is significantly and positively related with energy consumption. Financial development and urbanization both lower energy consumption but are statistically insignificant. Urbanization is also inversely linked with energy demand but insignificant. The overall measure of globalization (including its three components such as economic globalization, political globalization and social globalization) decreases energy demand insignificantly. The short run deviations from the long run equilibrium are corrected by 39 to 62 percentages each year. Moreover, the dummy variable (Energy Conservation Act, 2001) has a positive but insignificant impact on energy demand in the short run. The diagnostic tests in our analysis suggest that error terms of short run models are normally distributed; free from serial correlation, heteroskedasticity, and ARCH problems across all the four models. The Ramsey reset test further provides that the functional forms are well specified.

In addition, the stability of the ARDL energy demand model is investigated by employing cumulative sum of recursive residuals (CUSUM) and the CUSUM of square ($CUSUM_{SQ}$) suggested by Brown et al. (1975). Model misspecification can also lead to biased coefficient estimates that might influence the explanatory power of the results. Both the CUSUM and CUSUMsq tests are widely used to test the constancy of parameters. Furthermore, Brown et al. (1975) pointed out that these tests help in testing the dynamics of parameters. Hence, the expected value of the recursive residuals is zero leading to a non-rejection of the null hypothesis of parameters constancy. The plots for both CUSUM and CUSUMsq are shown in Figures 2-9 at 5 per cent level of significance and the results indicate that plots for both the tests are falling within the critical bounds of 5 per cent levels of significance. This suggests that our estimated ARDL energy demand models are stable.

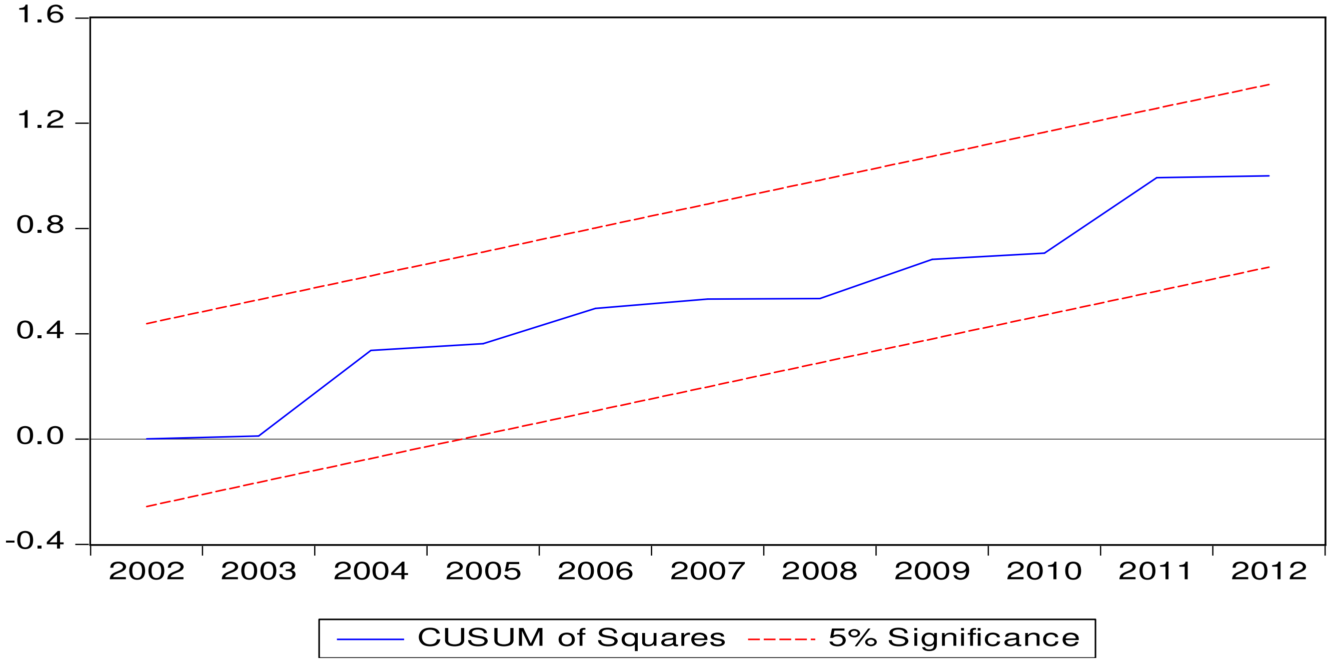
Economic Globalization

Figure 2: Plot of Cumulative Sum of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

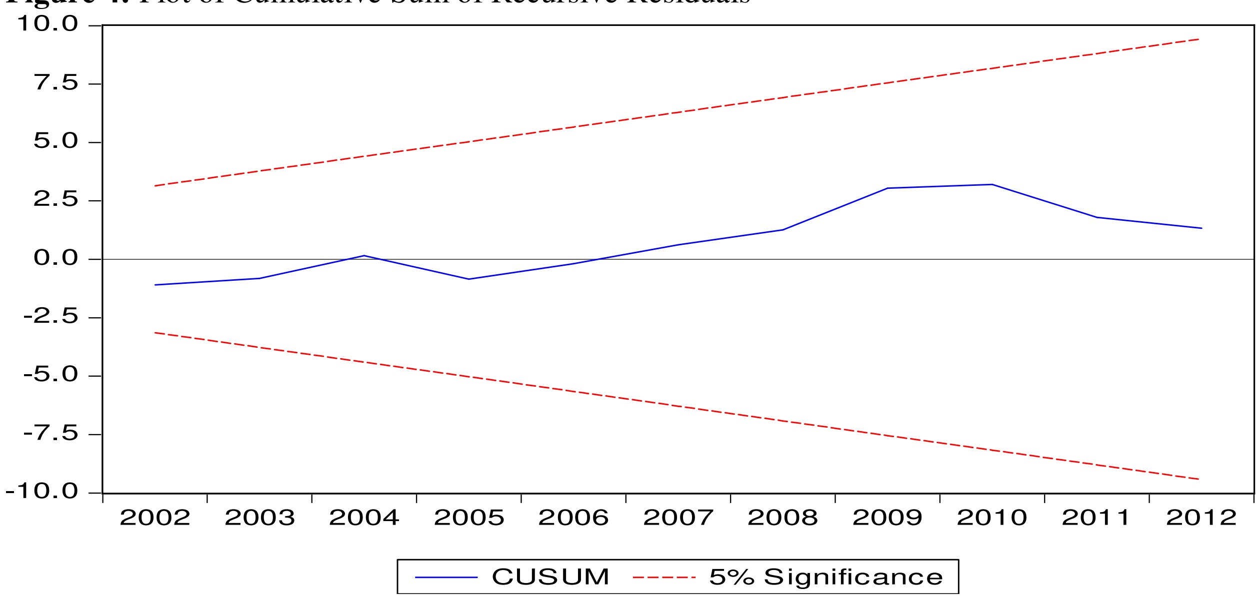
Figure 3: Plot of Cumulative Sum of Squares of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

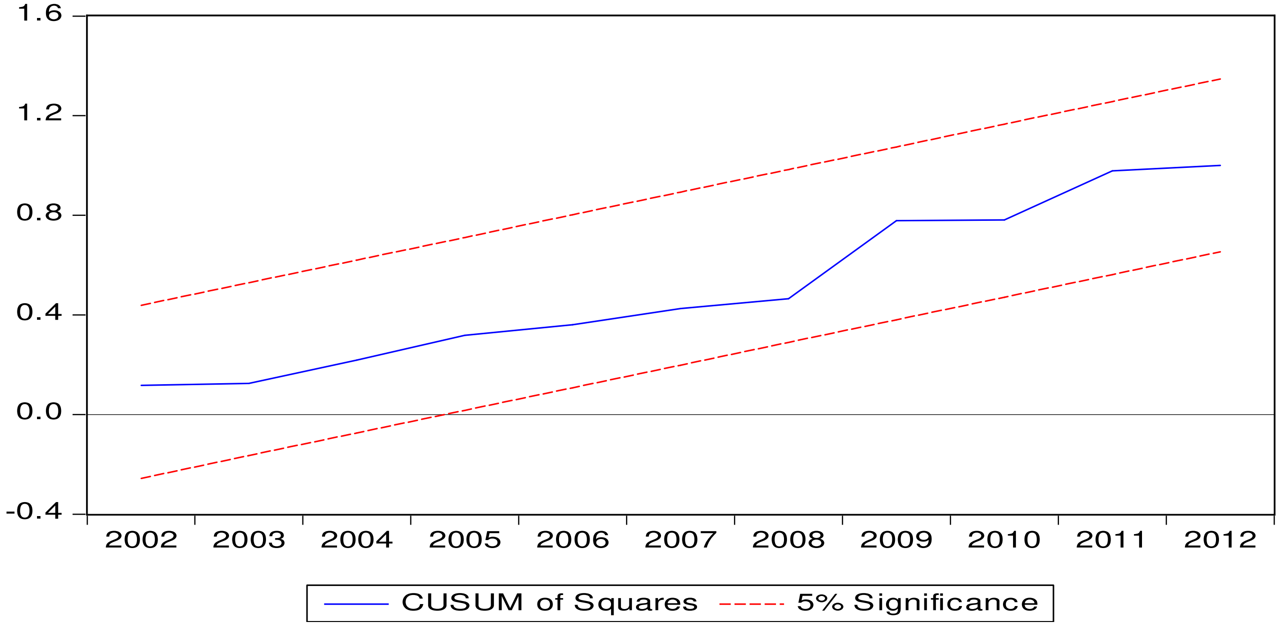
Social Globalization

Figure 4: Plot of Cumulative Sum of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

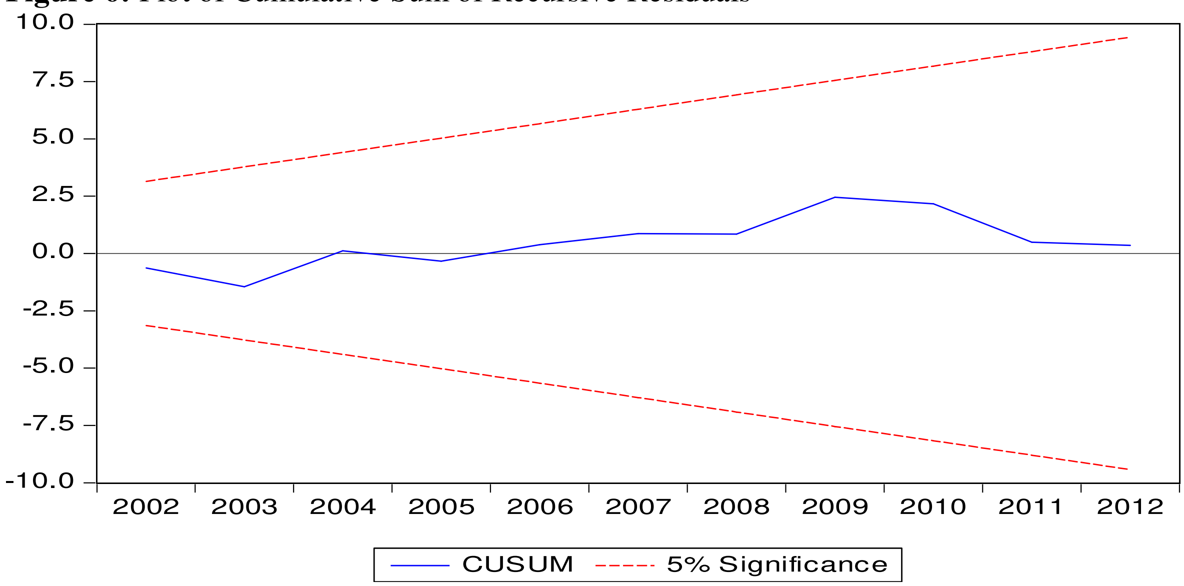
Figure 5: Plot of Cumulative Sum of Squares of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

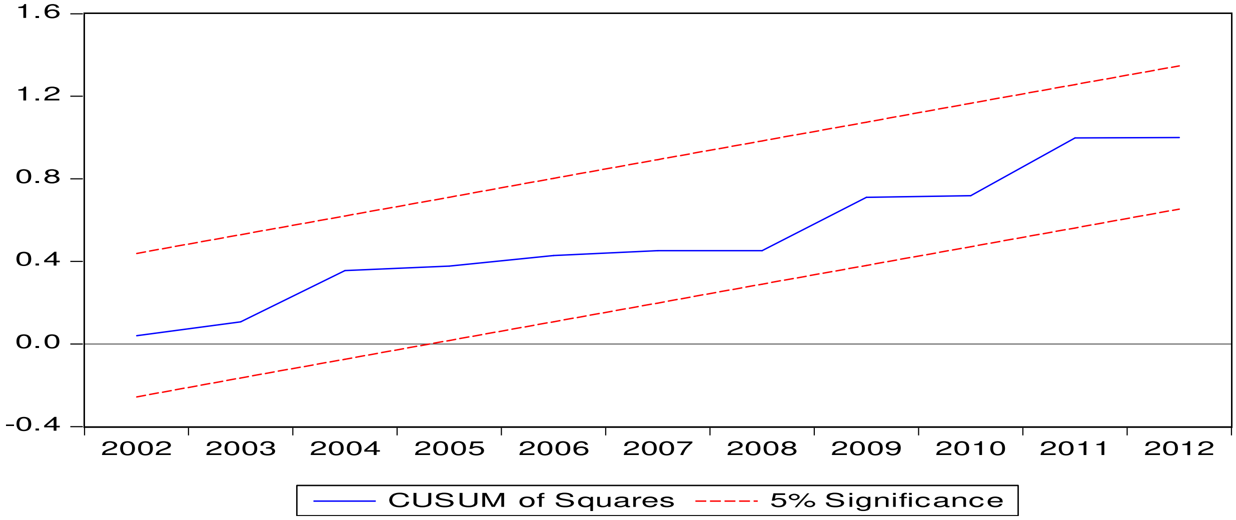
Political Globalization

Figure 6: Plot of Cumulative Sum of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

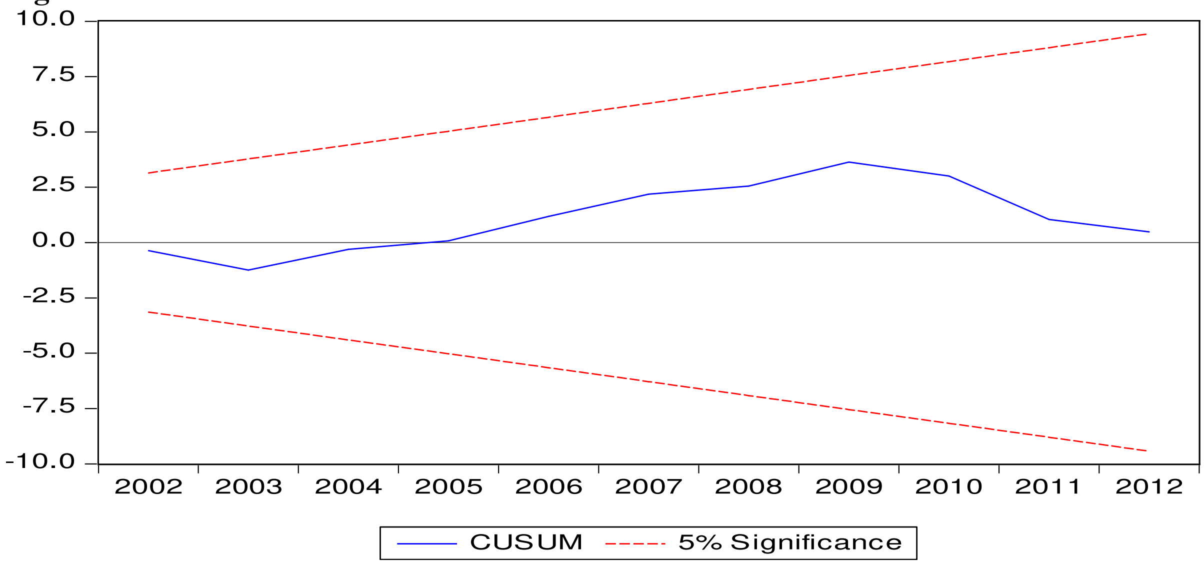
Figure 7: Plot of Cumulative Sum of Squares of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

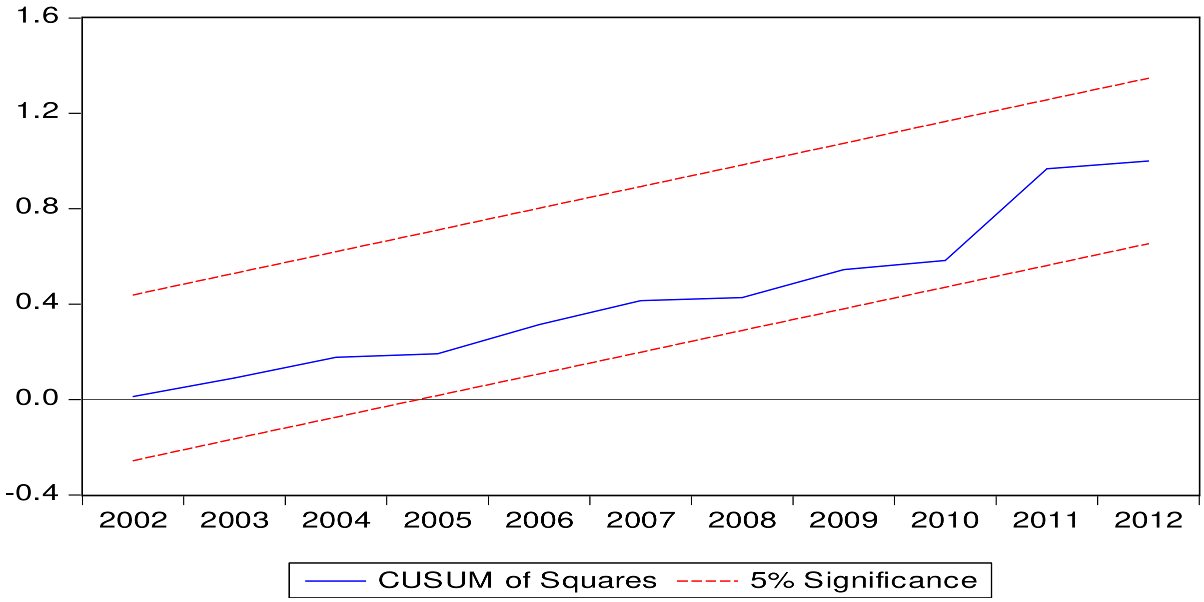
Overall Globalization

Figure 8: Plot of Cumulative Sum of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

Figure 9: Plot of Cumulative Sum of Squares of Recursive Residuals



Note: Straight lines represent critical bounds at 5% significance level

The VECM Granger Causality Analysis

When cointegration is confirmed, there must be unidirectional or bidirectional causality among the variables. We examine this relationship within the VECM framework with the inclusion of three different measures of globalization in a similar fashion as is done in the preceding section along with the incorporation of a dummy variable to capture the structural breaks in the series[14]. Such knowledge is essential for formulating appropriate energy policies for achieving a sustainable economic growth for any emerging economy. Table-6 reports the results for the direction of causality in the long run as well as in the short run. It is noted that there exists a feedback relationship between economic growth and energy consumption in the long run. In the long run, economic growth Granger causes energy consumption, while energy consumption also Granger causes economic growth. One of the implications of this result is that any policy which discourages energy use will negatively impact economic growth for India. Such a finding is consistent with Paul and Bhattacharya (2004), but only partly agrees with Cheng (1999) and Pradhan (2010) as the latter studies only report that energy consumption is a cause of economic growth. A long run feedback effect is found between financial development and energy consumption. This result is consistent with Shahbaz and Lean (2012), who reported a feedback

[14] These break years are based on ZA unit root test with single unknown structural break in the series.

effect between the energy demand and financial development for Tunisia and consistent with Islam et al. (2013) who reported a feedback relation for Malaysian. The relationship between urbanization and energy consumption is bidirectional. On contrary, Shahbaz and Lean (2012) reported the unidirectional causality running from urbanization to energy consumption in Tunisia. Globalization (economic, social and political) show bidirectional Granger causality with energy consumption.

The short run Granger causality estimates provide further evidence that economic growth causes energy consumption and energy consumption causes economic growth i.e. the feedback effect. In the short run unidirectional causality is found running from energy consumption to financial development. In short run, urbanization is caused by energy consumption. Urbanization causes economic growth and financial development causes urbanization. Globalization (economic, social and political) causes financial development. However, while examining different dimensions of globalization (economic, social and political), we do not observe any of their feedback relationship with the energy consumption in the short run.

Table-6: VECM Granger Causality Analysis

Dependent Variable		Type of causality					
	Short Run Estimates						Long Run
	$\sum \Delta \ln EC_{t-1}$	$\sum \Delta \ln Y_{t-1}$	$\sum \Delta \ln FD_{t-1}$	$\sum \Delta \ln U_{t-1}$	$\sum \Delta \ln EG_{t-1}$	Break Year	ECM_{t-1}
$\Delta \ln EC_t$	…	2.9665*** [0.0678]	1.8001 [0.1832]	0.1002 [0.9050]	1.4171 [0.2587]	2001	-0.5377** [-2.5118]
$\Delta \ln Y_t$	2.9225*** [0.1002]	…	12.1433* [0.0001]	3.2103* [0.0036]	2.1109 [0.1394]	1993	-0.6200* [-2.9107]
$\Delta \ln FD_t$	10.4479* [0.0492]	1.6883 [0.2025]	…	9.7628 [0.1498]	5.3429** [0.0106]	1990	-0.3338* [-3.6135]
$\Delta \ln U_t$	2.6353*** [0.0888]	2.1064 [0.1399]	11.5598* [0.0002]	…	0.3577 [0.7175]	1976	-0.0316* [-2.9813]
$\Delta \ln EG_t$	0.9751 [0.3892]	0.6224 [0.5489]	1.3127 [0.2846]	0.4430 [0.6463]	…	1991	-0.3394** [-2.5461]
	$\sum \Delta \ln EC_{t-1}$	$\sum \Delta \ln Y_{t-1}$	$\sum \Delta \ln FD_{t-1}$	$\sum \Delta \ln U_{t-1}$	$\sum \Delta \ln SG_{t-1}$	Break Year	
$\Delta \ln EC_t$	…	3.4055** [0.0469]	0.9772 [0.3884]	0.0779 [0.9252]	0.9182 [0.4105]	2001	-0.7200* [-1.7917]
$\Delta \ln Y_t$	4.3252** [0.0227]	…	7.1608* [0.0030]	1.0208 [0.3729]	1.4772 [0.2449]	1993	-0.5895** [-2.1249]
$\Delta \ln FD_t$	8.9958* [0.0009]	0.6646 [0.5221]	…	3.9297** [0.0309]	0.5992 [0.5559]	1990	-0.2671*** [-1.7502]

$\Delta\ln U_t$	1.9212 [0.1646]	1.5282 [0.2992]	8.7594* [0.0011]	…	1.2307 [0.3069]	1976	-0.0226* [-2.4085]
$\Delta\ln SG_t$	1.9517 [0.1602]	0.9472 [0.3995]	0.2480 [0.7819]	0.4103 [0.6672]	…	1989	-0.4157* [-3.3661]
	$\sum\Delta\ln EC_{t-1}$	$\sum\Delta\ln Y_{t-1}$	$\sum\Delta\ln FD_{t-1}$	$\sum\Delta\ln U_{t-1}$	$\sum\Delta\ln PG_{t-1}$	Break Year	
$\Delta\ln EC_t$	…	2.4135 [0.1073]	1.7302 [0.1950]	0.0882 [0.9158]	0.1841 [0.8328]	2001	-0.4968** [-2.6163]
$\Delta\ln Y_t$	3.1619*** [0.0572]	…	10.2051* [0.0004]	3.1982*** [0.0556]	1.4760 [0.2452]	1993	-0.4358** [-2.3120]
$\Delta\ln FD_t$	10.7682* [0.0003]	1.2686 [0.2964]	…	11.7640* [0.0000]	3.4506** [0.0453]	1990	-0.5226* [-4.9626]
$\Delta\ln U_t$	3.6867** [0.0337]	0.8344 [0.4441]	11.2289* [0.0002]	…	1.6205 [0.2151]	1976	-0.0413** [-2.6966]
$\Delta\ln PG_t$	1.5331 [0.2328]	0.1262 [0.8819]	0.7102 [0.4998]	0.5208 [0.5995]	…	1988	-0.5723** [-2.5075]
	$\sum\Delta\ln EC_{t-1}$	$\sum\Delta\ln Y_{t-1}$	$\sum\Delta\ln FD_{t-1}$	$\sum\Delta\ln U_{t-1}$	$\sum\Delta\ln G_{t-1}$	Break Year	
$\Delta\ln EC_t$	…	4.4979** [0.0119]	2.0283 [0.1498]	0.0624 [0.9396]	1.1422 [0.3330]	2001	-0.7625* [-3.1625]
$\Delta\ln Y_t$	3.2756** [0.0522]	…	10.6953* [0.0003]	2.7692* [0.0793]	1.8475* [0.1757]	1993	-0.4112* [-4.3538]
$\Delta\ln FD_t$	11.4392* [0.0002]	1.2794 [0.2934]	…	11.1738 [0.0003]	3.5003** [0.0453]	1990	-0.4762* [-4.8814]
$\Delta\ln U_t$	3.9060** [0.0315]	0.9500 [0.3984]	11.3664* [0.0002]	…	1.4998 [0.2400]	1976	-0.0404* [-2.8269]
$\Delta\ln G_t$	3.4608** [0.0449]	0.5618 [0.5763]	0.2889 [0.7512]	0.3891 [0.6816]	…	1991	-0.5781** [-2.7213]

Note: *, ** and *** denote the significance at the 1, 5 and 10 per cent levels, respectively. P values reported in parentheses for short run tests and t statistics reported in parentheses for long run tests.

5. Concluding remarks and policy implications

This study explored the relationships between globalization and energy consumption by incorporating economic growth, financial development and urbanization in an energy demand function for the Indian economy for the period, 1971-2012. We employed the Bayer-Hanck (2013) cointegration approach to examine the long run relationship between the variables. The integrating properties of the variables are investigated by applying the Zivot and Andrews, (1992) test that accommodates a single unknown structural break stemming from the series. Pesaran's et al. (2001) autoregressive distributed lag (ARDL) bounds testing cointegration procedure is further applied to test the robustness of our long run estimates. The long run estimates obtained from the bounds test validates the presence of cointegration between the variables. Moreover, economic growth is found to be positively linked to energy consumption.

Financial development tends to decrease energy demand. Urbanization raises energy consumption. The overall measure of globalization lowers energy demand including its two important components (economic and social). The Energy Conservation Act (2001) in India significantly reduces energy demand in the long run. The Granger causality analysis shows a feedback relationship between economic growth and energy consumption suggesting that economic growth Granger causes energy consumption and vice-versa. This implies that in the short run, any energy policy that discourages the use of energy would reduce economic growth.

The long run findings emanating from this study offer some tentative interesting policy insights. The observed adverse impact of globalization on energy demand for the Indian economy favorably suggests that it is vital for the policymakers to design appropriate policies for opening up the Indian economy for enhancing trade relationships and attract more capital inflows into the economy. Engaging India in more free trade deals with the rest of the world economies is one of the steps to realize this stated objective of reducing energy consumption for this emerging economy. It is also the case that since financial development has a negative impact on energy consumption, this has also a strong and favorable policy implication, implying that financial development should be strengthened in a desirable way, so as to achieve sustainable economic growth and reduced the reliance on energy consumption over the long run. In the case of India greater financial development could come through increased domestic credit to the private sector. In addition, better rules and regulations on property rights, corruption, accounting and financial transparency and investor protection would also be beneficial for greater financial development in the Indian economy. The results from this paper further suggest that, for India, increased globalization and increased financial development are the principal drivers behind rising economic growth and energy demand reduction. In other words, globalization and financial development provide a win-win situation for India to increase its economic growth in the long run and become more environmentally sustainable. This win-win situation as a result of the by-product of both globalization and financial development would enable the Indian economy to continue to grow in an environmentally sustainable way. As a result, the Indian economy would be able to realize multiple benefits of comparative advantages in exporting its cheap labour to other countries and receiving greater amounts of inward foreign investments for the overall development and improvement in the institutional quality. Our results also suggest that both 'open-door' policy (globalization) and financial development would go hand-in-hand for environmentally sustainable development of India. From a policy perspective, we recommend that India continue on a path of increased financial development and globalization.

Finally, the results of this paper also indicated that Energy Conservation Act (2001) implemented by the Indian government has also resulted in reduced long run demand for energy consumption. The novelty of this Act shows that India is not worse off by reducing intensity of energy consumption required for the consumption and production of goods and services as the economy is able to maintain a high growth momentum over the years. This could also indicate that apart from the central government of India in implementing this Act effectively, other economic players, such as consumers, businesses, and oil refiners might have been more responsible and responsive for the cost-effective management practices of reducing the energy consumption in their respective activities. From this perspective, we believe that strong co-operation between central government and other economic players will further create structural reform and build on the Energy Conservation Act (2001) so as to further reduce the energy usage and thereby achieve sustainable economic growth.

Although this study makes a preliminary attempt in understanding the effects of globalization on energy demand for India, by controlling for the effects of urbanization and financial development of the home country along with incorporating a newer definition of globalization in its different dimensions, this study could also serve as a basis for showing the useful directions for carrying out similar studies for other countries. For example, one can conduct studies on a panel data set of countries from both advanced as well as developing countries by grouping them on the basis of their similar economic potentials and similar level and composition in the use of different sources of energy. Further research in this area may bring deeper policy insights which will be helpful for designing effective economic and efficient energy and environmental policies, especially in the direction of achieving sustainable development of different economies.

Future empirical research may also provide directions for energy and environment policy by incorporating other banking sector development indicators (viz. total domestic credit as % of GDP and broad money supply as % of GDP) and stock market development indicators (viz.

stock market capitalization as % of GDP, turnover ratio as % of GDP, and share-traded value ratio as % of GDP) as different proxy measures for capturing the degree of financial development of economies and whether their relationships remain stable with energy demand or are sensitive to changes in its conceptual measurement when they are used in various energy demand functions. Following the seminal work of Mishkin (2009), in which he theoretically established that institutional quality is one of the potential channels through which financial development can greatly be impacted and that in turn can influence economic development, in this perspective, there is a role for future research to empirically explore the impact of institutional quality on energy consumption. This study, while analyzing different dimensions of globalization and their relationships with energy consumption, is basing its conclusions on aggregative measures of globalization indices and their relationships with the aggregated energy consumption measure. It may be quite useful for the policy makers to examine the effects of different constituents of each of these three dimensions of the globalization index within each individual measure on the levels of energy consumption and, further the impacts of each of these constituents of the globalization index on different sources of energy, as energy sources could be different for different countries and they could also vary in terms of their economic efficiencies.

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