A Contribution of Foreign Direct Investment, Clean Energy, Trade Openness, Carbon Emissions and Economic Growth to Energy Demand in UAE

Sbia, Rashid and Shahbaz, Muhammad and Hamdi, Helmi

Free University of Brussels, COMSATS Institute of Information Technology, Lahore, Pakistan, Central Bank of Bahrain, Bahrain

19 July 2013

A Contribution of Foreign Direct Investment, Clean Energy, Trade Openness, Carbon Emissions and Economic Growth to Energy Demand in UAE

Rashid Sbia[*]
[*]Department of Applied Economics
Free University of Brussels
Avenue F. Roosevelt, 50 C.P. 140
B- 1050 Brussels, Belgium
Rashid.Sbia@ulb.ac.be

Muhammad Shahbaz[a, b]
[a]Department of Management Sciences,
COMSATS Institute of Information Technology,
Lahore, Pakistan. Email:shahbazmohd@live.com
Cell: +92-334-3664-657, Fax: +92-42-99203100

[b]School of Social Sciences
National College of Business Administration & Economics
40/E-1, Gulberg III, Lahore-54660, Pakistan

Helmi Hamdi
Financial Stability
Central Bank of Bahrain
P.O Box 27, Manama, Bahrain
Email: helmi.hamdi@cbb.gov.bh

Abstract: This paper investigates the relationship between foreign direct investment, clean energy, trade openness, carbon emissions and economic growth in case of UAE covering the period of 1975Q1-2011Q4. We have tested the unit properties of variables in the presence of structural breaks. The ARDL bounds testing approach is applied to examine the cointegration by accommodating structural breaks stemming in the series. The VECM Granger causality approach is also applied to investigate the causal relationship between the variables. Our empirical findings confirm the existence of cointegration between the series. We find that foreign direct investment, trade openness and carbon emissions decline energy demand. Economic growth and clean energy has positive impact on energy consumption.

Keywords: Clean Energy, FDI, Emissions, Trade, Income

Introduction

The economic impacts of foreign direct investment have been analyzed thoroughly by scholars since a few decades. Earlier studies were developed by the seminal papers of Singer (1950), Prebisch (1950), Hymer, (1960) and later by Buckley and Casson, (1976). These studies have analyzed the impacts of FDI on economic growth for both target and receiving countries during the prosperous decades. Broadly, literature on FDI is divided in two axes. The first one analyses the effects of FDI on economic growth from microeconomic viewpoint (Ragazzi (1973), Stulz (1981), Doukas and Travlos (1988), Rivoli and Salorio (1996), Gorg and Greenwood (2002) among others) while the second one examines the impacts of FDI on economic growth from a macroeconomic viewpoint (Bos et al. 1974; Blomstrom and Kokko, 1996; Borensztein et al. 1998; Barrell and Pain, 1999; Carkovic and Levine, 2002). Nevertheless, the empirical studies reveal conflicting results in both levels (Hamdi et al. 2013). For example, numerous studies found that FDI can spur economic growth of the host country through capital accumulation, productivity efficiency, the diffusion of technologies and the introduction of new methods and procedures (Caves (1996), Borensztein et al. (1998), Bende-Nabende et al. (2003)). These studies showed that FDI promotes economic growth indirectly through the direct diffusion of technology which in turn augments the stock of knowledge in the host country through labor training and skill acquisition, new management practices and organizational arrangements (De Mello, 1999). In contrast, numerous microeconomic studies did not find evidence for horizontal technology transfer. Moreover most of the empirical studies using the intra-industry sector might not be suitable for capturing wider spillover effects on the host economy, such as those created by backward and forward linkages with domestic firms (Alfaro et al. 2003; Shahbaz and Leitão, 2010). The study of Hanson (2001) finds weak positive impacts of FDI for receiver countries.

Grog and Greenaway (2002) reviewed a survey of intra-industry panel work in developing, developed and transitional economies. Their investigation shows that the evidence in support of positive spillovers is rather limited (Grog and Greenaway, p. 37). However, the study of Lipsey, (2002) reviewing the micro literature shows an evidence of positive spillover effects of FDI inwards in receivers countries.

Regarding macroeconomic studies[1], results are also ambiguous (Findlay, 1978), Wang and Blomstrom (1992), Saltz (1992), Borensztein et al. (1998) Lipsey (2002), Carkovic and Levine (2002)). Findlay, (1978) showed that FDI raises the degree of technical progress in receiver countries via a contagion of the technology transfer. Borensztein et al. (1998) test the effects of foreign direct investment (FDI) on economic growth in a cross-country regression framework, utilizing data on FDI flows from industrial countries to 69 developing countries over the period 1970–89. They found that FDI affects positively economic growth through the upward of technological progress. Dolan and Tomlin, (1980) empirically examined the effect of FDI on economic growth and they found that FDI were positively linked with growth of per capita income but that the stock of FDI had a negative effect on economic growth. Dauda, (2007) argued that when a country chooses an export-promotion strategy, FDI will positively impact economic growth via trade openness. Similar results were found by Campos and Kinoshita, (2002) in which FDI, in the form of pure transferred technology, has a positive and significant impact on economic growth. In contrast, Saltz (1992) empirically examined the FDI-growth nexus for a panel of 75 developing countries during the period 1970-1980. He found a negative relationship between the level of FDI and growth. Lyroudi et al. (2004) found that foreign direct

---

[1] Grog and Greenaway (2002), Alfaro et al. (2003) and Lyroudi *el al* (2004) provide an excellent review of literature on FDI-growth nexus.

investment does not have any significant relationship with economic growth for transition countries. Lipsey, (2002) reviews the empirical studies on FDI-growth nexus and concludes that there is no reliable linkage between the volume of inward FDI stocks or flows relative to GDP and growth. The empirical investigation of Carkovic and Levine, (2002) examining the FDI inflows-growth nexus for a panel of 72 countries during the period 1960-1995 revealed that FDI inflows did impact economic growth for both developed and developing economies. Balasubramanyam et al. (1996) examined the impacts of FDI on economic growth in developing economies. Their results reveal no evidence of FDI-led-growth in receiver countries with export based strategy but they found an evidence of FDI-growth in countries with an import substitution strategy.

Recently, several studies on FDI literature have been focused on the spillover effects of FDI on the environment (energy consumption, pollution, dioxide carbon emission, clean energy usage, etc.). These studies show that FDI could threat the environment on the one hand as it could be a source of energy reduction on the other hand. In general, these studies show that foreign direct investments may have positive externalities as explained before but also lead to negative externalities. For example, according to the constant return to scale of production function, foreign direct investment has a direct impact on production of the host country and hence economic growth depending on the country absorptive capacity. This may affect energy consumption and it is known as scale effect. The scale effect keeps energy intensity constant which is considered as indirect positive impact of foreign direct investment on energy consumption. The study of Mielnik and Goldemberg, (2002) examined the foreign direct investment-energy consumption nexus while including economic growth as control variable in energy demand function. The sample incorporated 20 developing economies for short time span starting from 1987 and ends in 1998. The empirical results showed that the reduction in energy intensity is associated with a rise in foreign direct investment. They justified their results by the idea that foreign investors bring with them their own advanced technology while investing in developing economies to maximize the profits. As result, the domestic output rises with less energy consumption. However, Antweiler et al. (2001) came out with contradictory conclusions suggesting that foreign direct investment affects domestic production of host country but does not affect the energy intensity. With less extreme results and more rational, Cole, (2006) claimed that impact of foreign direct investment on energy consumption diverges across the countries as economic environment, economic structure, the stage of development, energy prices varies from country to another. Hubler, (2009) inspected the impact of foreign direct investment and trading of energy-saving technologies on energy consumption within General Equilibrium frame work. He established that foreign direct investment could be considered as incentives to implement energy-efficient technology that decrease energy consumption. Later on, Hai, (2009) validated the findings of Hubler, (2009). Chima, (2007), Xiaoli et al. (2007) and Zheng et al. (2011) found support for argument by Mielnik and Goldemberg, (2002) when investigating the relationship between foreign direct investment and energy intensity for both USA and China. Sadorsky, (2010) studied the effect of foreign direct investment on energy consumption in a panel of 22 developing economies. The empirical exercise revealed that foreign direct investment boosts energy consumption as the increase of liquidity will encourages the proliferation of new plants and factories which in turn raises energy demand. Additionally, Lee, (2013) inspected the impact of foreign direct investment and output growth on energy consumption and clean energy demand using the data of G-20 countries. The author found that the series are cointegrated and that foreign direct investment increase clean energy adoption. The existing literature also describes the causality's direction between foreign direct investment and energy consumption. For example, in case of South Africa, Dube, (2009) explored the relationship between electricity consumption and economic growth by including foreign direct investment in electricity demand function. He confirmed a cointegration relationship between the series but only when foreign direct investment and electricity consumption are considered as forcing variables. The feedback effect is found between foreign direct investment and electricity consumption. In case of Malaysia, Tang, (2009) found unidirectional causality running from foreign direct investment to electricity consumption in long run and feedback effect in short run by applying the VECM Granger causality approach. Zaman et al. (2012) stated that foreign capital inflows Granger causes electricity consumption. Lately, using panel cointegration framework, Lee, (2013) explored a complex relationship between foreign direct investment, energy consumption, clean energy, CO_2 emissions and economic growth using data of G-20 countries. The empirical analysis suggested that foreign direct investment boosts the economic growth while reducing energy intensity by the mean of energy-efficient equipment. Foreign direct investment reduces CO_2 emissions. Further, the adoption of clean energy similarly improves economic growth.

In this paper we will analyze the dynamic relationship between foreign direct investment, clean energy consumption, trade openness, carbon emissions and economic growth using energy demand in United Arab Emirates (U.A.E). The UAE is an interesting case study for several reasons. First, during the past few years the Emirates have been witnessing a buoyant economic growth thanks to high oil prices which generated massive oil revenues. Current economic dynamics of the U.A.E is also the result of the new vision and strategy adopted by the UAE government since the two decades. In fact, policymakers and the government have launched phenomenal investments to attract FDI and to encourage doing business in UAE. The goal was to diversify the UAE economy and to boost non-oil sector as natural resource are exhaustible. Consequently, the U.A.E have been witnessing huge inflows of capital and massive investment in all sector of economy including real estate, traffic airline, transport and also clean energy (especially renewable energy). The UAE has become the preferred destination for international companies and the hub of finance in Middle East and North African countries (MENA). Second, the UAE government has changed its vision toward the environment. The creation of a multi-billion dollar and multi-faceted investment company named Masdar to finance large-scale solar projects; clean-technology market and infrastructure projects in the best way revealing the determination of the UAE government to provide the renewable energy and carbon reduction targets. Moreover, the UAE government has encouraged international investors to invest in clean energy projects. Consequently, several national and international banks have quickly showed their willingness to fund renewable energy projects in the UAE. For example, well-known banks such as BNP Paribas, Société Générale and the National Bank of Abu Dhabi have recently financed the Shams 1 solar project: the largest concentrated solar power plant (CSP) in operation in the world[2]. Third, as the UAE is an OPEC member and an oil exporting country; therefore one could expect the negative impacts of FDI on energy usage and consumption. However, recent action of the UAE government may show the reverse. For all these reasons we focus our study for the UAE context. We use a long quarterly data which cover the period from 1975QI to 2011QIV. By employing the autoregressive distributed lag (ARDL) bounds testing approach to cointegration (Pesaran et al. 2001). Overall results reveal that foreign direct investment decline

---

[2] Shams 1 is located in Abu Dhabi; its capacity is 100-megawatt, and it will provide clean energy to power 20,000 homes in the UAE

energy consumption. We also find that economic growth and clean energy have positive impact on energy consumption in the UAE.

The remainder of the paper is as follows: section-II describes the methodology and data, section-III reports the estimations strategy, results and their interpretations are in section-IV and section-V presents conclusion and policy implications.

II. The Data and Model Construction

The data on real foreign direct investment (in local currency), energy consumption (kg of oil equivalent), natural gas consumption (mm cft), CO_2 emissions (metric tons) and real GDP has obtained from World Development Indicators (CD-ROM, 2012). The International Financial Statistics (CD-ROM, 2012) is used to collect data for real trade (exports + imports). We have used population series (collected from WDI) to convert all variables into per capita. The data period of our study is 1975QI-2011QIV[3]. The objective is to examine the impact of foreign direct investment, clean energy consumption, trade openness, carbon emissions and economic growth on energy consumption in case of UAE. The general form of energy demand model is constructed as following:

$$E_t = f(F_t, G_t, TR_t, C_t, Y_t) \qquad (1)$$

We have transformed all the variables into natural-log form to make the equation-1 estimable. The estimable form of equation is modeled as following:

[3] We have used quadratic match-sum method to convert annual data into quarter frequency.

$$\ln E_t = \beta_1 + \beta_2 \ln F_t + \beta_3 \ln G_t + \beta_4 \ln TR_t + \beta_5 \ln C_t + \beta_6 \ln Y_t + \mu_i \quad (2)$$

where, $\ln E_t$ is natural-log of energy consumption (kg of oil equivalent) per capita, $\ln F_t$ for natural-log of real foreign direct investment per capita, $\ln G_t$ is natural-log of green energy proxies by natural gas consumption (mm cft) per capita, $\ln TR_t$ indicates the natural-log of real trade openness (exports + imports) per capita, $\ln C_t$ is natural-log of CO_2 emissions (metric tons) per capita and $\ln Y_t$ shows the natural-log of real GDP per capita proxy for economic growth. The error term is μ_i assumed to be having normal distribution. The expected sign of $\beta_2 < 0$ if foreign direct investment adopts energy efficient technology (Lee, 2013) otherwise $\beta_2 > 0$ (Zaman et al. 2012) and $\beta_2 = 0$ if foreign direct investment has neutral effect on energy demand. $\beta_3 < 0$ shows that relationship of green energy is substitute with energy consumption otherwise green energy and energy consumption are complements if $\beta_3 > 0$. If $\beta_4 < 0$ then trade openness declines energy intensity via technique effect and trade openness boosts economic growth which in resulting increases energy demand i.e. $\beta_4 > 0$. The impact of CO_2 emissions is negative if $\beta_5 < 0$ otherwise positive. Energy is Giffen good if $\beta_6 > 0$ i.e. rise in per capita income increases energy consumption otherwise energy is inferior good if $\beta_6 < 0$.

III. Estimation Strategy

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

$$\begin{aligned}\Delta \ln E_t &= \alpha_1 + \alpha_T T + \alpha_F \ln F_{t-1} + \alpha_G \ln G_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_C \ln C_{t-1} + \alpha_Y \ln Y_{t-1} \\ &+ \sum_{h=1}^{O} \alpha_i \Delta \ln E_{t-h} + \sum_{i=0}^{p} \alpha_i \Delta \ln F_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln G_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln TR_{t-k} \\ &+ \sum_{l=0}^{s} \alpha_l \Delta \ln C_{t-l} + \sum_{m=0}^{T} \alpha_l \Delta \ln Y_{t-m} + \alpha_D D_1 + \mu_t\end{aligned} \quad (3)$$

$$\begin{aligned}\Delta \ln F_t &= \alpha_1 + \alpha_T T + \alpha_F \ln F_{t-1} + \alpha_G \ln G_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_C \ln C_{t-1} + \alpha_Y \ln Y_{t-1} \\ &+ \sum_{h=1}^{O} \alpha_i \Delta \ln F_{t-h} + \sum_{i=0}^{p} \alpha_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln G_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln TR_{t-k} \\ &+ \sum_{l=0}^{s} \alpha_l \Delta \ln C_{t-l} + \sum_{m=0}^{T} \alpha_l \Delta \ln Y_{t-m} + \alpha_D D_2 + \mu_t\end{aligned} \quad (4)$$

$$\begin{aligned}\Delta \ln G_t &= \alpha_1 + \alpha_T T + \alpha_F \ln F_{t-1} + \alpha_G \ln G_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_C \ln C_{t-1} + \alpha_Y \ln Y_{t-1} \\ &+ \sum_{h=1}^{O} \alpha_i \Delta \ln G_{t-h} + \sum_{i=0}^{p} \alpha_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln F_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln TR_{t-k} \\ &+ \sum_{l=0}^{s} \alpha_l \Delta \ln C_{t-l} + \sum_{m=0}^{T} \alpha_l \Delta \ln Y_{t-m} + \alpha_D D_3 + \mu_t\end{aligned} \quad (5)$$

$$\Delta \ln TR_t = \alpha_1 + \alpha_T T + \alpha_F \ln F_{t-1} + \alpha_G \ln G_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_C \ln C_{t-1} + \alpha_Y \ln Y_{t-1} + \sum_{h=1}^{O} \alpha_i \Delta \ln TR_{t-h} + \sum_{i=0}^{p} \alpha_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln F_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln G_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta \ln C_{t-l} + \sum_{m=0}^{T} \alpha_l \Delta \ln Y_{t-m} + \alpha_D D_4 + \mu_t \quad (6)$$

$$\Delta \ln C_t = \alpha_1 + \alpha_T T + \alpha_F \ln F_{t-1} + \alpha_G \ln G_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_C \ln C_{t-1} + \alpha_Y \ln Y_{t-1} + \sum_{h=1}^{O} \alpha_i \Delta \ln C_{t-h} + \sum_{i=0}^{p} \alpha_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln F_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln G_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta \ln TR_{t-l} + \sum_{m=0}^{T} \alpha_l \Delta \ln Y_{t-m} + \alpha_D D_5 + \mu_t \quad (7)$$

$$\Delta \ln Y_t = \alpha_1 + \alpha_T T + \alpha_F \ln F_{t-1} + \alpha_G \ln G_{t-1} + \alpha_{TR} \ln TR_{t-1} + \alpha_C \ln C_{t-1} + \alpha_Y \ln Y_{t-1} + \sum_{h=1}^{O} \alpha_i \Delta \ln Y_{t-h} + \sum_{i=0}^{p} \alpha_i \Delta \ln E_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln F_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln G_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta \ln TR_{t-l} + \sum_{m=0}^{T} \alpha_l \Delta \ln C_{t-m} + \alpha_D D_6 + \mu_t \quad (8)$$

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

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

$$\begin{bmatrix} \Delta \ln E_t \\ \Delta \ln F_t \\ \Delta \ln G_t \\ \Delta \ln TR_t \\ \Delta \ln C_t \\ \Delta \ln Y_t \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \\ b_5 \\ b_6 \end{bmatrix} + \begin{bmatrix} B_{11,1} & B_{12,1} & B_{13,1} & B_{14,1} & B_{15,1} & B_{16,1} \\ B_{21,1} & B_{22,1} & B_{23,1} & B_{23,1} & B_{25,1} & B_{26,1} \\ B_{31,1} & B_{32,1} & B_{33,1} & B_{34,1} & B_{35,1} & B_{36,1} \\ B_{41,1} & B_{42,1} & B_{43,1} & B_{44,1} & B_{45,1} & B_{46,1} \\ B_{51,1} & B_{52,1} & B_{53,1} & B_{54,1} & B_{55,1} & B_{56,1} \\ B_{61,1} & B_{62,1} & B_{63,1} & B_{64,1} & B_{65,1} & B_{66,1} \end{bmatrix} \times \begin{bmatrix} \Delta \ln E_{t-1} \\ \Delta \ln F_{t-1} \\ \Delta \ln G_{t-1} \\ \Delta \ln TR_{t-1} \\ \Delta \ln C_{t-1} \\ \Delta \ln Y_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} B_{11,m} & B_{12,m} & B_{13,m} & B_{14,m} & B_{15,m} & B_{16,m} \\ B_{21,m} & B_{22,m} & B_{23,m} & B_{24,m} & B_{25,m} & B_{26,m} \\ B_{31,m} & B_{32,m} & B_{33,m} & B_{34,m} & B_{35,m} & B_{36,m} \\ B_{41,m} & B_{42,m} & B_{43,m} & B_{44,m} & B_{45,m} & B_{46,m} \\ B_{51,m} & B_{52,m} & B_{53,m} & B_{54,m} & B_{55,m} & B_{56,m} \\ B_{61,m} & B_{62,m} & B_{63,m} & B_{64,m} & B_{65,m} & B_{66,m} \end{bmatrix} \times \begin{bmatrix} \Delta \ln E_{t-1} \\ \Delta \ln F_{t-1} \\ \Delta \ln G_{t-1} \\ \Delta \ln TR_{t-1} \\ \Delta \ln C_{t-1} \\ \Delta \ln Y_{t-1} \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_3 \\ \zeta_3 \\ \zeta_4 \\ \zeta_5 \\ \zeta_6 \end{bmatrix} \times (ECM_{t-1}) + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \\ \mu_{5t} \\ \mu_{6t} \end{bmatrix} \quad (9)$$

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

IV. Results and their Discussions

Table-1 reports the results of descriptive statistics and pair-wise correlations. The results reveal that all the series such as energy consumption, foreign direct investment, clean energy consumption, trade openness, carbon emissions and economic growth have normal distributions. This is confirmed by the statistics of Jarque-Bera test. The pair-wise correlation analysis exposed that a positive correlation exists between foreign direct investment and energy consumption and same is true for clean energy and energy consumption. Trade openness is positively linked with energy consumption but carbon emissions and economic growth are inversely correlated with energy consumption. The correlation of clean energy and trade openness with foreign direct investment is positive but carbon emissions and economic growth are negatively linked with it. The correlation between trade openness and clean energy is positive and, negative correlation is found of carbon emissions and economic growth with clean energy. Carbon emissions and economic growth are inversely linked with trade openness but carbon emissions and economic growth are positively correlated.

Table-1: Descriptive Statistics and Correlation Matrix

Variable	$\ln E_t$	$\ln F_t$	$\ln G_t$	$\ln TR_t$	$\ln C_t$	$\ln Y_t$
Mean	9.1446	11.5618	9.1160	8.8522	3.4406	12.3273
Median	9.2939	11.3913	9.1960	8.7802	3.4293	12.2620
Maximum	9.4420	14.2036	9.5884	9.7485	4.1511	12.8449
Minimum	8.1972	9.29192	7.8499	8.1847	2.7692	11.5962
Std. Dev.	0.3096	1.27881	0.4373	0.4325	0.2863	0.2919
Skewness	-1.5743	0.4142	-1.2490	0.5035	0.3600	-0.0706
Kurtosis	4.9153	2.6602	4.0436	2.2424	4.1451	2.9880
Jarque-Bera	0.2939	1.2362	1.1300	2.4480	2.8212	0.0309
Probability	0.2800	0.5389	0.3516	0.2940	0.2439	0.9846
$\ln E_t$	1.0000					
$\ln F_t$	0.0808	1.0000				
$\ln G_t$	0.8229	0.4513	1.0000			
$\ln TR_t$	0.1212	0.3558	0.0601	1.0000		
$\ln C_t$	-0.6977	-0.1696	-0.0773	-0.4692	1.0000	
$\ln Y_t$	-0.5382	-0.3323	-0.0778	-0.5450	0.06726	1.0000

The assumption of the ARDL bounds testing is that the series should be integrated at I(0) or I(1) or I(0) / I(1). This implies that the none of variables is integrated at I(2). To resolve this issue, we have applied traditional unit root tests such as ADF, PP and DF-GLS[4]. We find that energy

[4] Results are available upon request from authors

consumption ($\ln E_t$), foreign direct investment ($\ln F_t$), clean energy consumption ($\ln G_t$), trade openness ($\ln TR_t$) and carbon emissions ($\ln C_t$) and economic growth ($\ln Y_t$) are not found to be stationary at level with constant and time trend. All the variables are stationary at 1st difference. This shows that the variables are integrated at I(1).

Table-2: Clemente-Montanes-Reyes Detrended Structural Break Unit Root Test

Model: Trend Break Model								
	Level data				First difference data			
Series	T_{B1}	T_{B2}	Test statistics	K	T_{B1}	T_{B2}	Test statistics	K
$\ln E_t$	1984Q1	---	-3.736	6	1985Q2	----	-5.082**	4
	1984Q1	2004Q4	-4.738	3	1984Q1	1988Q1	-10.692*	4
$\ln F_t$	2002Q4	---	-4.163	6	2003Q1	----	-13.300*	3
	2002Q4	2008Q4	-3.799	3	2002Q1	2004Q2	-5.976**	6
$\ln G_t$	1987Q1	---	-4.066	2	1982Q1	----	-6.499*	5
	1992Q1	1997Q2	-4.099	5	1982Q1	1998Q1	-7.200*	3
$\ln TR_t$	1992Q1	---	-2.720	2	1980	---	-4.850**	3
	1998Q2	2007Q2	-1.375	4	1980Q1	1997Q2	-6.062*	5
$\ln C_t$	1997Q1	---	-2.265	2	1994	---	-6.524*	4
	1996Q4	1999Q4	-3.777	4	1996Q1	1999Q1	-6.509*	6
$\ln Y_t$	1984Q1	---	0.668	5	1987Q1	---	-6.199*	3
	1985Q2	2007Q2	-2.239	8	1987Q1	2006Q1	-6.395*	7
Note: T_{B1} and T_{B2} are the dates of the structural breaks; k is the lag length; * and ** show								

significant at 1% and 5% levels respectively.

To avoid the biasness of AFD, PP and DF-GLS unit root tests because these tests do not have information about structural breaks occurring in the series. The appropriate information about structural breaks would help policy makers in designing inclusive trade, energy and environmental policy to boost economic growth for long run. The issue of structural break is resolved by applying Clemente et al. (1998) with single and two unknown structural breaks arising in the macroeconomic variables. The results are detailed in Table-2. We find, while applying Clemente et al. (1998) test with single unknown break, that energy consumption, foreign direct investment, clean energy consumption, trade openness, carbon emissions and economic growth have unit root at level with intercept and trend. The structural breaks are found in energy consumption, foreign direct investment, clean energy consumption, trade openness, carbon emissions and economic growth in 1984Q1, 2002Q4, 1987Q1, 1992Q1, 1997Q1 and 1984Q1 respectively. The variables are found to be stationary at 1st difference. This implies that series have same level of integration. The robustness of results is validated by applying Clemente et al. (1998) with two unknown structural breaks. Our findings indicate that variables are integrated at I(1).

The unique integrating order of the variables lends a support to test the existence of cointegration between the variables. In doing so, we apply the ARDL bounds testing approach in the presence of structural breaks to examine cointegration between the variables. The results are reported in Table-3. The lag order of the variables is chosen following Akaike information criterion (AIC) due to its superiority over Schwartz Bayesian criterion (SBC). AIC performs relatively well in small samples but is inconsistent and does not improve performance in large samples whilst SBC in contrast appears to perform relatively poorly in small samples but is consistent and improves in performance with sample size (Acquah, 2010).

The appropriate lag section is required because F-statistic variables with lag order of the variables. The lag order of the variables is given in second column of Table-3. The results reported in Table-3 reveal that our computed F-statistics are greater than upper critical bounds generated by Pesaran et al. (2001) which are suitable for large data set. We find four cointegrating vectors once energy consumption, foreign direct investment, clean energy consumption, carbon emissions and economic growth are treated as predicted variables. This shows that we have five cointegrating vectors in our model. We may confirm that there is a long run relationship between energy consumption, foreign direct investment, clean energy consumption, trade openness, carbon emissions and economic growth in case of UAE over the period of 1975QI-2011QIV.

Table-3: The Results of ARDL Cointegration Test

Bounds Testing to Cointegration				**Diagnostic tests**		
Estimated Models	Optimal lag length	F-statistics	Break Year	R^2	$Adj-R^2$	D. W test
$E_t = f(F_t, G_t, TR_t, C_t, Y_t)$	5, 4, 3, 5, 5, 5	6.109*	1984Q1	0.7677	0.6448	1.9955
$F_t = f(E_t, G_t, TR_t, C_t, Y_t)$	5, 4, 4, 5, 5, 5	5.375*	2002Q4	0.8296	0.7541	2.1026
$G_t = f(E_t, F_t, TR_t, C_t, Y_t)$	5, 3, 3, 5, 5, 3	3.680***	1987Q1	0.7983	0.7079	2.0213
$TR_t = f(E_t, F_t, G_t, C_t, Y_t)$	5, 5, 5, 5, 5, 5	1.351	1992Q2	0.8037	0.7166	2.0674

$C_t = f(E_t, F_t, G_t, TR_t, Y_t)$	5, 4, 5, 4, 4, 5	3.971***	1997Q1	0.6441	0.4863	2.0557
$Y_t = f(E_t, F_t, G_t, TR_t, C_t)$	5, 5, 5, 5, 5, 5	4.377**	1984Q1	0.8249	0.7473	2.1672
Significant level	Critical values					
	Lower bounds $I(0)$	Upper bounds $I(1)$				
1 per cent level	3.60	4.90				
5 per cent level	2.87	4.00				
10 per cent level	2.53	3.59				
Note: *, **, *** represent significance at 1, 5 and 10 per cent level respectively.						

Now we move to long run results after finding long run relationship among the series. The results are reported in Table-4. We find that foreign direct investment is negatively linked with energy consumption and it is statistically significant at 1 percent level of significance. This implies that foreign direct investment in UAE is energy efficient. The UAE becomes one of the most attractive countries for foreign direct investments, especially because the easiness and free of cost of capital and income. The UAE was ranked 11th on the global level according to the 2010 FDI confidence index (Kearney, 2010) revealing the country attractiveness. However, the UAE has implemented an obligatory new energy rating system on all domestic appliances as part of the initiative by the Emirates Standardisation and Metrology Authority (ESMA). Keeping other things constant, 1 percent increase in foreign direct investment saves energy by 0.0215 percent. The impact of clean energy is positively linked with energy consumption at 1 percent significance level. A 1 percent supply in green energy impacts energy consumption by 0.8523 percent, all else is same. Trade openness affects energy consumption negatively and it is statistically at 1 percent level of significance. The common believe about trade openness is that it leads to an increase of economic output and therefore an increase of energy uses. However, a different point of view may be true. Free trade may leads to energy use efficiency as the energy market is bigger and the access to reduced energy-intensity products is easier. Further, trying to be one of the leaders in the field of energy use and environmental friendly, UAE implements the states of art technologies, even expensive, to reduce its foreign gas dependence for electricity generation. Further, the oil windfalls and trade positive impacts on households' income led to a general recognition of the massive environment destruction due to intensive energy use and structural change of the waste behavior in oil rich country. The promotion of clean energy in UAE has increased the demand for environmental-friendly products and better willing to protect the environment and to combat the climate change. It reveals that a 0.3631 percent energy demand is declined by 1 percent increase in trade openness keeping other things constant. The relationship of carbon emissions with energy consumption is negative at 1 percent level of significance. It is noted that a 1 percent increase in carbon emissions deteriorates energy demand by 0.1604 percent, all else remains same. The impact of economic growth on energy demand is positive and statistically, it is significant at 1 percent level of significance. Keeping all else is same, a 1 percent increase in economic growth enhances energy demand by 0.2087 percent.

Table-4: Long and Short Run Analysis

Dependent Variable = $\ln E_t$			
Panel- A: Long Run Results			
Variables	Coefficient	Std. Error	Prob. Values
Constant	0.7074*	0.1953	0.0004
$\ln F_t$	-0.0215*	0.0081	0.0089

$\ln G_t$	0.8523*	0.0348	0.0000
$\ln TR_t$	-0.3631*	0.0260	0.0000
$\ln C_t$	-0.1640*	0.0431	0.0002
$\ln Y_t$	0.2087*	0.0410	0.0000
R^2	0.9204		
$Ajd-R^2$	0.9176		
Panel-B: Short Run Results			
Constant	0.0007	0.0007	0.3413
$\ln F_t$	-0.0162*	0.0046	0.0006
$\ln G_t$	0.5861*	0.1226	0.0000
$\ln TR_t$	-0.1066***	0.0638	0.0967
$\ln C_t$	-0.0381	0.0354	0.2833
$\ln Y_t$	0.4448*	0.1172	0.0002
ECM_{t-1}	-0.0662**	0.0259	0.0116
R^2	0.2970		
$Ajd-R^2$	0.2669		
F-statistic	9.8609		
Diagnostic Test			
Test	F-statistic	Probability	
$\chi^2 SERIAL$	0.2011	0.8110	
$\chi^2 ARCH$	0.2943	0.5510	

$\chi^2 WHITE$	0.6041	0.7612	
$\chi^2 REMSAY$	0.2351	0.5567	
Note: *, ** and *** represent significance at 1%, 5% and 10%level respectively. $\chi^2 SERIAL$ is for serial correlation, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.			

The short run results are also reported in Table-4 (see Panel-B). Our results expose that foreign direct investment has negative impact on energy consumption at 1 percent level of significance. The relationship between clean energy and energy consumption and is positive and statistically, it is significant at 1 percent. Trade openness is positively linked with energy consumption at 10 percent significance level. The effect of CO_2 emissions is negative but statistically, it is insignificant. The relationship of economic growth with energy consumption is positive and statistically significant at 1 percent level of significance. The short run model seems to fulfill diagnostic tests. We find that there is no problem of normal distribution of error term in short run model and same inference is drawn for serial correlation. The auto-conditional Heteroskedisticity is not present in the short run model as well as no problem of white Heteroskedisticity is found. The functional form of short run model is well formulated confirmed by Ramsey Reset test.

The VECM Granger Causality Analysis

If cointegration is confirmed, there must be uni-or bidirectional causality between/ among the series. We examine this relation within the VECM framework. Such knowledge is helpful in crafting appropriate energy, trade, environment and growth policies for sustainable economic growth in case of UAE. Table-5 reports results on the direction of long and short runs causal relationship. In long run, our results find that bidirectional causality exists between energy consumption and foreign direct investment and same is true between foreign direct investment and economic growth. The feedback effect is found between energy consumption and clean energy. The relationship between foreign direct investment and clean energy is bidirectional. Trade openness Granger causes foreign direct investment, energy consumption, clean energy, CO_2 emissions and economic growth. The relationship between carbon emissions and economic growth is bidirectional. There is also bidirectional causal relationship exists between energy consumption and CO_2 emissions and same is true for foreign direct investment and carbon emissions.

Table-5: The VECM Granger Causality Analysis

Dependent Variable	Direction of Causality						
	Short Run						Long Run
	$\Delta\ln E_{t-1}$	$\Delta\ln F_{t-1}$	$\Delta\ln G_{t-1}$	$\Delta\ln TR_{t-1}$	$\Delta\ln C_{t-1}$	$\Delta\ln Y_{t-1}$	ECT_{t-1}
$\Delta\ln E_t$	....	6.0700* [0.0017]	6.2159* [0.0026]	0.2790 [0.7570]	0.0578 [0.9438]	5.1810* [0.0068]	-0.0810* [-3.5684]
$\Delta\ln F_{t-1}$	4.5229** [0.0126]	....	7.7284* [0.0007]	0.5515 [0.5774]	0.3437 [0.7098]	0.2128 [0.8086]	-0.2032* [-5.0333]
$\Delta\ln G_{t-1}$	5.7470* [0.0040]	11.6139* [0.0000]	....	1.0693 [0.3462]	0.3474 [0.7071]	0.1084 [0.8973]	-0.0230* [-3.8383]
$\Delta\ln TR_{t-1}$	0.2569	0.1630	1.7286	....	4.1012*	3.6601**	

	[0.7338]	[0.8497]	[0.1973]		[0.0123]	[0.0223]	....
$\Delta \ln C_{t-1}$	0.1149 [0.8915]	0.8530 [.8542]	0.2597 [0.9717]	3.7347** [0.0264]	....	0.6516 [0.5228]	-0.1155* [-4.2398]
$\Delta \ln Y_{t-1}$	4.2566** [0.0161]	0.6469 [0.5253]	0.2493 [0.7793]	3.6166** [0.224]	0.6556 [0.5208]	....	....
Note: *, ** and *** show significance at 1, 5 and 10 per cent levels respectively.							

In short run, the feedback effect is found between foreign direct investment and energy consumption and energy consumption. The relationship between foreign direct investment and clean energy is bidirectional. Economic growth and energy consumption Granger cause each other. Trade openness Granger causes CO_2 emissions and same is true from opposite side. Economic growth and trade openness are complementary as bidirectional causal relationship exists between.

V. Conclusion and Policy Implications

Energy is an important issue and source of economic growth. Energy consumption plays a vital role in promoting economic growth. United Arab Emirates is an emerging economy and attractive for foreign direct investment due to her liberalized economic policies. Realizing the risks of being largely exposed to fluctuations of hydrocarbon prices and the exhaustible natural resources, the government has undergone several policy measures to promote economic diversification including the energy mix to be away from gas and toward clean energy such as renewable and nuclear. To respect the global carbon agenda which was planned to reduce CO_2 emissions by 30% by 2030, the U.A.E. government gave attractive advantages for investors in clean energy. Consequently, investments in renewable energy and clean energy have increased significantly in recent period. In this sense, foreign direct investment may affect energy demand via income effect, technique effect and composite effect. Therefore, this paper attempted to investigate the impact of foreign direct investment on energy consumption by incorporating green energy, trade openness, CO_2 emissions and economic growth in energy demand function. The study covers the data period of 1975QI-2011QIV in case of UAE. We have applied structural break unit test to test the stationary properties of the variables. The cointegration for long run is investigated by applying the ARDL bounds testing accommodating structural breaks stemming in the series.

Our results revealed that the cointegration exists among the variables. Furthermore, foreign direct investment saves energy i.e. negative impact of foreign direct investment on energy consumption. These encouraging results could increase UAE's motivations to increase FDI flows without affecting energy consumption. Green energy stimulates energy demand, however at lower rate as compared to the use of traditional products and technologies. The relationship between trade openness and energy consumption is negative i.e. trade openness lowers energy consumption due to adoption of energy efficient technology. Large-scale trade in UAE allowed the implantation of innovative technologies to reduce the energy consumption. Carbon emissions also decline energy demand. Income growth is positively linked with energy consumption.

The causality analysis exposed the feedback effect between foreign direct investment and energy consumption. Foreign direct investment Granger causes green energy and same is true from opposite side. Energy consumption, foreign direct investment, green energy, carbon emissions and economic growth are Granger cause of trade openness. Carbon emissions and energy consumption are Granger caused bidirectional and same inference is drawn between CO_2 emissions and foreign direct investment. The feedback effect is found between economic growth and energy consumption and same is true for CO_2 emissions and economic growth. The relationship between energy consumption and carbon emission is bidirectional. Green energy Granger causes energy consumption and same is true from opposite side. The bidirectional causal relationship exists between green energy and economic growth.

Many policy implications could be drawn from this paper. First, trade policies in UAE have improved the energy use efficiency and the availability of green energy products to reduce CO_2 emissions in the UAE. Second, the UAE dependence on foreign-gas for electricity generation has forced the UAE to invest heavily in green energy like solar and nuclear plants. Third, Government willing to reduce energy consumption has been clear with different implemented legal constraints to use best products in term of energy use. Last but not least, UAE policies has oriented the FDI flows to green energy after huge energy intensive projects in early 2000s i.e. massive real estate projects like artificial islands. This shows that UAE government is already on right way in improving the living standard of nation by implementing environmental friendly projects in the country.

Reference

1. Acquah, H-d., (2010). Comparison of Akaike information criterion (AIC) and Bayesian information criterion (BIC) in selection of an asymmetric price relationship. Journal of Development and Agricultural Economics, 2(1), 1-6.

2. Alfaro, L. A., Chanda, S., Kalemli-Ozcan, A. S., Sayek, S. (2004). FDI and economic growth: the role of local financial markets. Journal of International Economics. 64, 113-134.
3. Antweiler, W., Copeland, B. R., Taylor, M. S., (2001). Is free trade good for the environment? The American Economic Review, 91, 877-908.
4. Balasubramanyam, V., Salisu, M and Sapsford, D., (1996). Foreign direct investment and growth in EP and IS countries. Economic Journal, 106, 92-105.
5. Barrell, R., Pain, N., (1997). Foreign direct investment, technological change and economic growth within Europe. The Economic Journal. 107, 1770-1786.
6. Bende-Nabende, A., J. Ford, B. Santoso, and Sen, S., (2003). The interaction between FDI, output and the spillover variables: cointegration and VAR analyses for APEC, 1965-99. Applied Economics Letters, 10, 165-172.
7. Blomstrom, M. and Kokko, A., (1996). Multinational corporations and spillovers. Journal of Economic Surveys, 12, 247-277.
8. Borensztein, E., De Gregorio, J., Lee, J-W., (1998). How does foreign direct investment affect economic growth? Journal of International Economics. 45, 115–135.
9. Bos, H.C., Sanders, M. and Secchi C., (1974). *Private foreign investment in developing countries: A quantitative study on the macroeconomic effects*, Dardrecht: Reidel.
10. Buckley, P. J. and Casson, M., (1976). The future of the multinational enterprise. Macmillan, London.
11. Campos, N.F. and Kinoshita, Y., (2002). FDI as technology transferred: Some panel evidence from transition economies. The Manchester School, 70, pp. 398–419.
12. Carcovic M. and Levine R., (2002). Does foreign direct investment accelerate economic growth? Department of Business Finance, University of Minessota, *Working paper Series.* Paper also available at www.worldbank.org/research/conferences/financial_globalization/fdi.pdf.
13. Caves, R. E., (1982). Multinational enterprise and economic analysis. Cambridge University Press, Cambridge and New York.
14. Chima, C. M., (2007). Intensity of energy use in the U.S.A: 1949-2003. Journal of Business & Economics Research. 5, 17-30.

15. Clemente, J., Montañés, A., Reyes, M., 1998. Testing for a unit root in variables with a double change in the mean. Economics Letters 59, 175-182.
16. Cole, M. A., (2006). Does trade liberalization increase energy use? Economics Letters, 92, 108-112.
17. Dauda, R. O.S., (2007). The impact of FDI on Nigeria's economic growth: Trade policy matters. Journal of Business and Policy Research, 3, 11-26.
18. De Mello, L.R., (1999). Foreign direct investment-led growth: Evidence from time series and panel data. Oxford Economic Papers, 51, 133- 150.
19. Doukas, J., and Travlos, N.G., (1988). The effect of corporate multinationalism on shareholders wealth; evidence from international acquisitions. *Journal of Finance*, 43, 1161-1175.
20. Dube, S. (2009). Foreign Direct Investment and Electricity Consumption on Economic Growth: Evidence from South Africa. International Economics. 62, 175-200.
21. Findlay, R., (1978). Relative backwardness, direct foreign investment, and the transfer of technology: A simple dynamic model. Quarterly Journal of Economics, 92, 1-16.
22. Gorg, H. and Greenaway, D., (2002). Much do about nothing? Do domestic firms really benefit from foreign direct investment? Research Paper 2001/37, Globalisation and Labour Markets Programme, at Leverhulme Centre for Research on Globalisation and Economic Policy, Nottingham.
23. Hanson, G. H., (2001). Should countries promote foreign direct investment? G-24 Discussion Paper No. 9. New York: United Nations.
24. Helmi, H., Sbia, R., Abdelaziz, H. and Hakimi, W. K., (2013). Multivariate Granger causality between foreign direct investment and economic growth in Tunisia. Economic Bulletin, 33, 1193-1203.
25. Hubler, M., (2009). Energy saving technology diffusion via FDI and trade using CGE model of China. Working paper no.1491, Kiel Institute of World Economy.
26. Hymer, S., (1960). The international operations of national firms: a study of foreign direct investment. MIT Press, Cambridge, Mass. (published in 1976).
27. Lee, J. W., (2013). The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth. Energy Policy. http://dx.doi.org/10.1016/j.enpol.2012.12.039.

28. Lipsey, R. E., (2002). Home and host country effects of FDI. NBER Working Papers 9293, National Bureau of Economic Research, Inc.

29. Lyroudi, K., Papanastasiou, J., Vamvakidis, A., (2004). Foreign direct investment and economic growth in transition economies. South-Eastern Europe Journal of Economics, 1, 97-110.

30. Mielnik, O., Goldemberg, J., (2002). Foreign direct investment and decoupling between energy and gross domestic production in developing countries. Energy Policy, 30, 87-89.

31. Pesaran, M.H., Shin, Y., Smith, R., 2001. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16, 289-326.

32. Prebisch, R., (1950). *The economic development of Latin America and its principal problems*. New York: United Nations.

33. Ragazzi, G., (1973). Theories of the determinants of direct foreign investment. IMF Staff Papers, 20, 471-498.

34. Rivoli, P. and E. Salorio, (1996). Foreign direct investment under uncertainty. Journal of International Business Studies, 335-57.

35. Saltz, S., (1992). The negative correlation between foreign direct investment and economic growth in the Third World: Theory and evidence, *Rivista Internazionale di Scienze Economiche e Commerciali*, 39, 617-633.

36. Shahbaz, M., Leitao, N. C., (2010). Intra-industry trade: The Pakistan experience. International Journal of Applied Economics, 7, 18-27.

37. Singer, H. W., (1950). The distribution of gains between investing and borrowing countries. American Economic Review, 40, 473-485.

38. Stulz, R., (1981). On the effects of barriers to international investment. The Journal of Finance, 36, 923-934.

39. Tang, C. F. (2009). Electricity consumption, income, foreign direct investment, and population in Malaysia: new evidence from multivariate framework analysis. Journal of Economic Studies, 36(4), 371-382.

40. Wang, J.-Y., and Blomstrom, M., (1992). Foreign investment and technology transfer: A simple model. European Economic Review, 36, 137–155.

41. Xiaoli, S., Junfeng, S., Xuefei, S., (2007). Empirical of industry distribution of FDI impact on China’s energy consumption analysis. Finance & Trade Economics, 3, 117-121.

42. Zaman, K. Khan, M. M. Ahmad, M. Rustem, R. (2012). Determinants of electricity consumption function in Pakistan: old wine in new bottles. Energy Policy, 50, 623-634.

43. Zheng, Y., Qi, J., Chen, X., (2011). The effect of increasing exports on industrial energy intensity in China. Energy Policy, 39, 2688-2698.