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CAUSAL INTERACTIONS BETWEEN FDI, ELECTRICITY CONSUMPTION AND ECONOMIC GROWTH: EVIDENCE FROM DYNAMIC PANEL CO-INTEGRATION MODELS

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Abstract

In all countries, especially developing countries, foreign direct investment (FDI) plays a very important role, it is even considered as the engine of economic growth and development. Energy has always played a major role in human and economic development as well as in the well-being of society and modern societies are increasingly using more energy for industry, services, housing and transportation. This is particularly true for oil, which is now the most important traded commodity, but also for electricity, which is essential in contemporary economies characterized by the omnipresence of information technology, communication and digital. This study analyzes the relationship between foreign direct investment, electricity consumption and economic growth in 65 countries, using co-integration and Granger causality tests in panel data. The results show a disparity in terms of the relationship between the co-integration of the panel study. The results also indicate a unidirectional causality from FDI to GDP could be a good tool to prioritize the allocation of resources across sectors to promote foreign direct investment, and a bi-directional causality between the electric consumption and GDP for some panel.

Keywords: Panel co-integration, Foreign Direct Investment, Electricity consumption, Economic growth, Fmols and Dols Estimators, Panel Granger causality

JEL Classification: COO, C01, C2, C23

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1. Introduction

In the 50s and 60s, Foreign Direct Investment (FDI) was regarded with great suspicion by most developing countries. It was considered a threat to national sovereignty and multinational companies were suspected of reducing social welfare by manipulating transfer prices and the formation of enclaves.

Faced with the current globalization of markets, globalization and internalization of production and monetary policies, there has been a radical change in the attitude of developing countries that are forced today to seek sources of non-traditional and non-generating investment in debt. That is why they have turned to FDI. They are stable and less susceptible to financial crises investments. They must be able to create additional funding opportunities, without increasing the external debt of a country.

Indeed, FDI is now increasingly sought both by developed countries, by developing countries and are no longer considered as a factor of dominance, but as a major channel for technology transfer and innovation.

Thus, the global economy has been completely transformed in recent years. It operates in an environment increasingly Entangled as free trade, free movement of capital and goods become hallmarks, where FDI is increasingly qualified as a new way to finance economic growth.

In order to increase their investment capacity, to positively affect the balance of the balance of payments, make up for the shortfall in national savings, create new opportunities for better jobs with better pay and better conditions work, several countries are trying to make FDI one of the most powerful in the economic development strategy pillars.

These countries have a significant production potential, they have everything for the effective take-off of their economy. These states have focused their actions on the economic and social recovery considering FDI as a by-product of economic development, which explains the great importance attached to the attractiveness of foreign investment flows, by implementing a series of measures to make these countries more attractive.

It is easy to understand that our whole economy depends in practice on energy consumption. Considering that we transform resources into products and services, and each transformation requires the using of energy, it seems logical that economic output is related to the amount of energy added to the system.

All of us agree that there was obviously in the story, a strong link between the availability of energy resources and economic development. Thus, when man has domesticated animals like horse, camel or llama, this has made available a new energy transmission capacity and stroke, and multiplied such trade and agricultural productivity. The steam engine fueled by coal gave the signal of the industrial revolution and the emergence of our modern economy. The arrival of oil has led to the development of the automobile.

This historic link, a thesis has emerged that changes in energy production are leading to changes in economic growth. More precisely, if economic growth is strong, it would be caused by a growing and abundant energy production conversely, a decrease in energy production would cause a slowdown in economic growth. This thesis is supported in particular by Jean-Marc Jancovici, consultant and expert on energy and climate change theme.

Based on this theory, the decline in the growth of energy production is the cause of the slowdown in economic growth in Europe, particularly in France since 1980 (2% per year on average from 1980 to 2000) after the 3.5% observed during the "thirty glorious years" from 1950 to 1980.

Beyond assessing the attractiveness of regions in terms of FDI and the impact of energy consumption on economic development, the whole point of this study is to analyze the causal link between the foreign direct investment, power consumption and their actual impact on economic growth in different countries. A major problem is, is it a long-term relationship between foreign direct investment, electricity consumption and economic growth?

2. Relationship between foreign direct investment and economic growth : litterature review

The correlation between the FDI inflow into host countries and economic development has been subject to rigorous research during many years. In theory, the causal relation between FDI and GDP growth can run in either direction. On the one hand, according to the “FDI-led growth hypothesis”, FDI inflows can stimulate growth for the host countries by increasing the capital stock, creating new job opportunities, and easing the transfer of technology (Borensztein et al., 1998; De Gregorio, 2003; de Mello, 1997). On the other hand, according to the “market size hypothesis”, a rapid GDP growth creating new investment opportunities in the host country can also cause larger inflows of FDI (Mah, 2010; Rodrik, 1999). Besides, although the existing studies generally suggest a positive impact of FDI on economic growth, it is also possible that FDI has negative effects on economic growth by crowding out domestic investment, increasing external vulnerability, and causing dependence (Aitken and Harrison, 1999; Lipsey, 2002). Last but not least, it is also possible that a causal relationship between FDI and economic growth does not exist, supporting the so-called “neutrality hypothesis”. The empirical studies done to identify the relationship between inward FDI and economic growth have been studied extensively. The work of Herzer (2008) found that outward FDI has positive long-run effects on domestic output in 14 industrialized countries over the period 1971 to 2005 using panel analysis. The results also pointed out that the long-run causality is bidirectional between outward FDI and domestic output.

Based on panel co-integration and causality tests, Basu and al. (2003) find that there is bidirectional causality between economic growth and FDI in 23 developing countries over the period between 1978 and 1996. Basu et al. (2003) also argued that for relatively open economies causality runs in both directions, while for relatively closed economies long-run causality mainly runs from growth to FDI. Nair-Reichert and Weinhold (2001) have found that FDI on average has a significant and positive impact on economic growth in a sample of 24 developing countries. In another largest study recently cited, Carkovic and Levine (2005) have found that FDI does not exert a significant, positive impact on economic growth in developing countries. Carkovic and Levine's (2005) study, however, was based on the unlikely assumption of the homogeneity on the coefficients of the lagged dependent variables. In a heterogeneous panel data context, Blomstrom and al. (1994) and Coe et al. (1997) find that, for FDI to have positive impacts on growth, the host country must have attained a level of development that helps it reap the benefits of higher productivity. In contrast, De Mello (1997) finds that the correlation between FDI and domestic investment is negative in developed countries.

Li and Liu (2005) find that FDI does not only affect growth directly but also indirectly through its interaction with human capital. In the same paper, Li and Liu (2005) also find a negative coefficient for FDI when it is interacted with the technology gap between the source and host economies. Using an equally large sample, Borensztein and al. (1998) find similar results—i.e., that inward FDI has positive effects on growth with the strongest impact through the interaction between FDI and human capital. De Mello (1999) finds positive effects of FDI on economic growth in both developing and developed countries but conclude that the long-term growth in host countries is determined by the spillovers of technology and knowledge from the investing countries to host countries.

Baharom Shah and Thanoon (2006) used a dynamic panel model to examine the link between FDI and growth in East Asian economies. The authors have confirmed that FDI promotes growth and that its impact is felt both in the short and long term. This study has shown that countries that have succeeded in attracting FDI may consider a more rapid increase in economic growth than those that discourage foreign direct investment. Based on a number of determinants of the linkage between FDI and economic growth (such as human capital, learning by doing, exports, macroeconomic stability, level of financial development, public investment and other determinants).

D. Gomes Neto, FJ Veiga (2013) used a panel data set covering 139 countries over the period 1970 to 2009, they studied empirically the role of foreign direct investment on growth through the diffusion of technology and innovation. The authors find that these two mechanisms have a positive effect on productivity growth and GDP growth. These results are consistent with an open economy model, in which foreign direct investment affects growth through diffusion of technology and innovation.

Borensztein and al. (1998) test the effect of foreign direct investment (FDI) on economic growth in a context of panel regression, using data on FDI flows from 69 industrialized countries, their results suggest that FDI is an important vehicle for the transfer of technology, contributing relatively more to the growth of domestic investment. However, the higher productivity of FDI holds only when the host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy.

Vu and Noy (2009) used industry data for a group of six member countries of the OECD. Their work is the first to identify the sectorial impact of FDI on growth in developed countries. Their results show that FDI has a positive effect on economic growth directly and through its interaction with the work. Moreover, they find that the effects appear to be very different in different countries and economic sectors.

Azman-Saini and al. (2010), in this article, they examine the systemic link between economic freedom, foreign direct investment (FDI) and economic growth in a panel of 85 countries. Their empirical results, based on the generalized method of time-system estimator, show that FDI by itself has no direct effect (positive) impact on output growth. Instead, the effect of FDI depends on the level of economic freedom in the host country. This means clustering the countries Promote Greater freedom of economic activities significantly gain from the presence of multinational corporations (MNCs).

Basu and Guariglia (2007), this paper examines the interactions between foreign direct investment (FDI), inequality and growth, the authors used a panel of 119 developing countries, they observe that FDI promotes both inequality and growth, and tends to reduce the share of agriculture in GDP of the recipient country. They then set up a growth model of a dual economy in which the traditional (agricultural) sector uses a diminishing returns technology, while FDI is the engine of growth in the modern sector (industrial). The main predictions of the model are consistent with the stylized facts observed in the data.

Adams (2009), this study analyzes the impact of foreign direct investment (FDI) and domestic investment (FDI) on economic growth in sub-Saharan Africa for the period 1990-2003. The results show that FDI is positively and significantly correlated with economic growth in both the OLS and fixed effects estimation, but FDI is positive and significant only in the OLS estimation. The study also finds that FDI has a negative effect on the initial positive effect FDI and after subsequent periods for the group of countries studied. The sign and magnitude of the current and lagged FDI coefficients suggest a net crowding out effect. The literature review and the results of the study indicate that the continent needs a targeted approach to FDI, increasing absorptive capacity of local firms, and cooperation between the government and multinational companies to promote their mutual benefit.

Alfaro and al. (2004) in this article, the authors examine the links between foreign direct investment (FDI), financial markets and economic growth. They explore if countries improve financial systems can exploit FDI more efficiently. Using cross-country data between 1975 and 1995, the empirical analysis shows that FDI alone plays an ambiguous role in contributing to economic growth. However, countries with well-developed financial markets gain significantly from FDI. The results are robust to different measures of financial market development.

Herzer and al. (2008) this paper challenges the widespread belief that FDI generally has a positive impact on economic growth in developing countries. This paper discusses the limitations of the literature and re-examines the FDI-led growth hypothesis in 28 developing countries using co-integration techniques on a country by country basis. The authors of this paper find that the vast majority of countries, there exists neither a long-term nor a short-term effect of FDI on growth; in fact, there is not a single country where a positive effect on long-term way of FDI to GDP is found. In addition, the results indicate that there is no clear association between the impact of FDI growth and the level of per capita income, level of education, the degree of openness and level of development of financial markets in developing countries.

Bengoa and Sanchez-Robles (2003) this paper explores the interaction between economic freedom, foreign direct investment (FDI) and economic growth, the authors of this paper uses the analysis of panel data for a sample of 18 Latin American countries for 1970 - 1999. Their results show that economic freedom in the host country is a positive determinant of FDI flows. Their results also suggest that FDI is positively correlated with economic growth in host countries. The host country, however, requires the adequate human capital, economic stability and the liberalization of capital flows benefit from the long term.

3. Relationship between electricity consumption and economic growth: literature review

Electricity has become the dominant and preferred form of energy in the expansion zones of economic activity for industrialized countries. It was a major factor to improve the standard of living and played a crucial role in technological and scientific progress. Therefore, this type of energy is generally considered particularly important for economic growth.

There are many jobs that have been conducted on the relationship between electricity consumption and economic growth. As Ferguson and al, Wolde-Rufael, Narayan and al and Ciarreta and Zarraga. Ferguson and al. studied the relationship between electricity consumption and economic development in more than 100 countries. Correlations between electricity consumption / inhabitant and GDP / inhabitant were analyzed and compared with those between total supply / inhabitant and GDP / inhabitant primary energy. An analysis linked the proportion of energy used in the form of electricity, "e / E ratio", with a GDP / inhabitant. The general conclusions of this study are that rich countries have a strong correlation between electricity consumption and wealth creation than do poor countries and for the global economy as a whole, there is a strong correlation between electricity consumption and wealth creation than there are between total energy consumption and wealth. The study also shows that in rich countries, the increase in wealth over time is correlated with an increase / e ratio E. Wolde-Rufael tested the long-term relationship and causality between electricity consumption per inhabitant and real gross domestic product

(GDP) per inhabitant for 17 African countries for the period 1971-2001 using a test newly developed proposed by Pesaran et al Co-integration. (2001) using a modified version of Granger causality test of Toda and Yamamoto (1995). Empirical studies show that there is a long-term relationship between electricity consumption per inhabitant and real GDP per inhabitant of only nine countries and Granger causality to only 12 countries. In 6 countries, there were a positive unidirectional causality from real GDP per inhabitant to per inhabitant electricity consumption for reverse causality three countries and bidirectional causality for the remaining three countries. Narayan and al. apply recent developments in unit root and panel co-integration techniques to estimate the long-term income and short-term and price elasticity's of residential electricity demand in the G7. They use annual time series data from 1978 to 2003 for the group of G7 countries. The panel results indicate that residential long-term demand for electricity is price elastic and inelastic income. The study concludes that, from an environmental point of view it is possible to use pricing strategies in the G7 countries to reduce residential electricity demand, and reduce carbon emissions in the long term.

Ciarreta and Zarraga apply recent panel methodology to investigate the long-run and causal relationship between electricity consumption and real GDP for a set of 12 European countries using annual data for the period 1970–2007. The results show the evidence of a long-run equilibrium relationship between the three series and a negative short-run and strong causality from electricity consumption to GDP.As expected, there is bidirectional causality between energy prices and GDP and weaker evidence between electricity consumption and energy prices. These results support the policies implemented towards the creation of a common European electricity market.

4. Data and Methodology

4.1. Data analysis

The data set consists cross-country observations for 65 countries over the 1980–2010 period obtained from the data base of United Nations Conference on Trade and Development CNUCED (UNCTAD stat)2013. Data on FDI into Dollars (United States) at current prices and current exchange rates in millions, the electrical energy consumption (ELC) defined in kilowatt hours per inhabitant is extracted from the World Bank Development Indicators (WDI). The GDP data into dollars (United States) at constant prices (2005) and exchange rates (2005) in millions.

Our database includes 65 countries. We classified the countries into seven panels depending on the region and continents to examine whether there are structural differences. Groups of countries are listed as follows Asia and oceanic countries (Australia, China, India, Japan ,Malaysia , New Zealand, Thailand, Vietnam, Philippines, Singapore),Middle Eastern countries(Iran, Emirates, Bahrain, Jordan, Lebanon, Oman, Qatar, Saudi Arabia),North America countries(United States Canada, Mexico),Latin America countries(Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Jamaica, Chile),Europe countries (Austria ,Albania, Belgium, Denmark, Finland ,France, Germany Greece, Iceland, Ireland, Italy, Netherlands, Norway, Poland Portugal, Romania, Spain, Sweden, Switzerland, Turkey, United Kingdom),North Africa countries (Algeria, Egypt, Libya, Morocco, Tunisia),and central Africa countries (Angola, Cameroon, Côte d'Ivoire, Nigeria, Senegal, Ghana ,South Africa).

4.2. Methodology

In the analysis of the relationship in long-term of the panel data, the choice of the appropriate technique is an important theoretical and empirical question. Co-integration is the most appropriate technique to study the long-term relationship between our FDI and GDP variables. The empirical strategy used in this paper can be divided into four main stages. First, unit root tests in panel series are undertaken. Second, if they are integrated of the same order, the Co-integration tests are used. Third, if the series are co-integrated, the vector of Co-integration in the long-term is estimated using the methods (FMOLS) and (DOLS). Finally, the Granger causality test in panel will be undertaken.

5. No-stationarity of the series: detection tests

5.1. Definition of non-stationarity

Most of the time series are non-stationary, i.e. the process that describes does not verify at least one of the definition conditions of a stationary process given by:

$(Y_t) = \mu \forall t$ (Constant, not dependent on t). (1)

$VAR(Y_t) = \sigma_y^2 < \infty \forall t$ (Constant, not dependent on t). (2)

$COV(Y_t, Y_{t+k}) = E\{(Y_t - \mu)(Y_{t+k} - \mu)\} = \gamma_k$ (Not depend on t). (3)

$\{\varepsilon_t\}$ Series which $(\varepsilon_t) = 0, VAR(\varepsilon_t) = \sigma_\varepsilon^2, COV(\varepsilon_t, \varepsilon_{t+k}) = 0$. Is a stationary series. It is also called white noise.

6. Why test the panel unit root?

The unit root tests administered to the panel data have several advantages over those time-series. First, the number of data used is more important because of the meeting of the individual dimension and the temporal dimension.

The Extending of the database has real interest, as it strengthens the power of unit root tests to distinguish whether a series is stationary or non-stationary. Several studies show that the unit root tests on panel data are more powerful than those carried out on time series.

Technical panel data may also be preferred because of their low restrictions; in fact, they capture specific effects to each patient, heterogeneity of the direction and magnitude of the parameters through the panel. In addition, these techniques allow the model to be selected with a high degree of flexibility by providing a relatively wide range of different specifications, from models with constant and deterministic trend up to models with no constant and no trend; within each model, there is the possibility of testing for common time effects.

Panel unit root tests are used to examine the degree of integration between FDI and our GDP. To assess the stationary properties of the used variables, this study use five different panel unit root tests including Levin, Lin and Chu (herein referred to as LLC); Im, Pesaran, and Shin (herein referred to as IPS); Maddala and Wu, Breitung (herein referred to as BRT) and Hadri. For each technique, we test for unit roots in the panel using two types of models. The first model has a constant and a deterministic trend and the second model has only a constant and no trend.

7. Co-integration approach

The concept of Co-integration can be defined as a systematic co-movement between two or more variables in the long-term. According to Engle and Granger, if $X$and Y are both non-stationary, it would expect that a linear combination of X and Y would be a random step. However, the two variables may have the property that a particular combination of them $\mathrm{Z} = \mathrm{X} - \mathrm{bY}$ (4) is stationary. If such a property holds true, we say that $\mathrm{X}$and Y are Co-integrated.

7.1. Panel Co-integration

It is now recognized in the scientific literature that the best methods for testing unit roots and Co-integration is to use methods based on a panel. These methods greatly increase the power of the tests and often involve a two-steps procedure. The first step is to test the panel unit root; the second is the panel Co-integration tests.

For the 65 countries in our empirical study, heterogeneity may arise due to differences in region, the specifics of the economy of countries and many other things. To ensure wide applicability of any panel Co-integration Test, it is important to take into account as much as possible heterogeneity between the different group members.

Pedroni [31, 32, 33] developed a method based on panel Co-integration residues that can take into account the heterogeneity in individual effects, the slope coefficients and individual linear trends between patients. Pedroni [44], considers the following type of regression:

$$y_{it} = a_i + \delta_i t + \beta_i Z_{it} + e_{it} \qquad (5)$$

For a time series panel of observables y_{it} and Z_{it} for members $i = 1, \ldots, N$ over time periods $t = 1, \ldots T$. the variables y_{it} and X_{it} are assumed to be integrated of order one, denoted $I(1)$. The parameters a_i and δ_i allow for the possibility of individual effects and individual linear trends, respectively. The slope coefficients β_i are also permitted to vary by individual, so in general the Co-integrating vectors may be heterogeneous across members of the panel.

Pedroni proposes seven statistics to test the null hypothesis of no Co-integration in heterogeneous panels. These tests comprise of two types. The first type is the panel Co-integration tests (within-dimension). The within dimension tests consist using four statistics, namely, panel $v - \text{Statistics}$, panel $\rho - \text{Statistics}$, panel $PP - \text{Statistic}$, and panel $ADF - \text{Statistic}$. These statistics pool the autoregressive coefficients across different members for the unit root tests on the estimated residuals, and the last three test statistics are based on the "between" dimension (called 'group' hereafter). These tests are group $\rho - \text{Statistics}$, group $PP - \text{Statistic}$, and group $ADF - \text{Statistic}$. These statistics are based on the averages of the individual autoregressive coefficients associated with the unit root tests of the residuals for each patient in the panel. Both kinds of tests focus on the null hypothesis of no Co-integration.

However, the distinction comes from the specification of the alternative hypothesis. For the tests based on "Within", the alternative hypothesis is $\rho_i = \rho < 1$ for all i, while concerning the last three test statistics that are based on the "Between" dimension, the alternative hypothesis is $\rho_i < 1$ for all i.

The finite sample distribution for the seven statistics has been tabulated by Pedroni through Monte Carlo simulations. The calculated statistic tests must be smaller than the tabulated critical value to reject the null hypothesis of the absence of Co-integration.

All seven tests are conducted on the estimated residuals from a model based on the regression in (5). Following, Pedroni, heterogeneous panel and heterogeneous group mean panel Co-integration statistics are calculated as follows:

Panel $v - Statistics$

$$Z_v \equiv T^2 N^{\frac{3}{2}} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \qquad (6.a)$$

Panel $\rho - Statistics$

$$Z_\rho = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right) \qquad (6.b)$$

Panel $PP - Statistic$

$$Z_t = \left(\bar{\sigma}_{N,T}^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (6.c)$$

Panel $ADF - Statistic$

$$Z_t^* \equiv \left(\bar{S}_{N,T}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{i,t}^{*} \qquad (6.d)$$

Group $\rho - Statistics$

$$\tilde{Z}_\rho \equiv TN^{-\frac{1}{2}} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (6.e)$$

Group $PP - Statistic$

$$\tilde{Z}_t \equiv N^{-\frac{1}{2}} \sum_{i=1}^{N} \left(\hat{\sigma}_i^2 \sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-\frac{1}{2}} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (6.f)$$

Group $ADF - Statistic$

$$\tilde{Z}_t^* \equiv N^{-\frac{1}{2}} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{S}_i^{*2}\, \hat{e}_{i,t-1}^{*2} \right)^{-\frac{1}{2}} \sum_{t=1}^{T} \hat{e}_{i,t-1}^{*}\, \Delta \hat{e}_{i,t}^{*} \tag{6.g}$$

Where, $\hat{e}_{it}$ is the estimated residual from (5) and $\hat{L}_{11_i^2}$ is the estimated long-run covariance matrix for $\Delta\, \hat{e}_{i,t}$.The other terms are properly defined in Pedroni with the appropriate lag length determined by the Newey–West method.

8. Estimating the long -run co-integration relationship in panel context

After confirmation of the existence of a Co-integration relationship between the series, must be followed by the estimation of the long-term relationship. There are different estimators available to estimate a vector Co-integration panel data, including with and between groups such as OLS estimates, fully modified OLS (FMOLS) estimators and estimators namely dynamic OLS (DOLS).

In the Co-integrated panels, using the technique of ordinary least squares (OLS) to estimate the long-term equation leads to biased estimated parameters unless the regressors are strictly exogenous, so that, the OLS estimators cannot generally be used for valid inference.

9. Panel granger causality

Panel Co-integration method tests whether the existence or absences of long-run relationship between FDI, ELC and GDP for the 65 countries. It doesn't indicate the direction of causality. When Co-integration exists among the variables, the causal relationship should be modeled within a dynamic error correction model Engle and Granger. The main purpose of our study is to establish the causal linkages between FDI, ELC and GDP, the Granger causality tests will be based on the following regressions:

$$(1-L)\begin{bmatrix} GDP_{it} \\ ELC_{IT} \\ FDI_{IT} \end{bmatrix} = \begin{bmatrix} a_{iGDP} \\ a_{iELC} \\ a_{iFDI} \end{bmatrix} + \sum_{i=1}^{p} (1-L) \begin{bmatrix} \vartheta_{1.1ip} & \vartheta_{1.2ip} & \vartheta_{1.3ip} \\ \vartheta_{2.1ip} & \vartheta_{2.2ip} & \vartheta_{2.3ip} \\ \vartheta_{3.1ip} & \vartheta_{3.2ip} & \vartheta_{3.3ip} \end{bmatrix} \begin{bmatrix} GDP_{it-p} \\ ELC_{it-p} \\ FDI_{it-p} \end{bmatrix} + \begin{bmatrix} \beta_{GDPi} \\ \beta_{ELCi} \\ \beta_{FDIi} \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix}$$

Where ECT_{t-1} is the error-correction term, p denotes the lag length and $(1-L)$is the first difference operator and ECT_{t-1} stands for the lagged error correction term derived from the long-run co-integration relationship. An error correction model enables one to distinguish between the long-run and short run Granger causality. The short term dynamics are captured by the individual coefficients of the lagged terms. Statistical significance of the coefficients of each explanatory variable are used to test for the short run Granger causality while the significance of the coefficients of ECT_{t-1}gives information about long-run causality. It is also desirable to test whether the two source of causation are jointly significant.

10. Empirical result

10.1. Panel unit root tests

The panel unit root test is applied to test whether the panel time series used in the study are stationary or not. Before deciding the correlation among the variables, it is necessary to test the stationary of the panel series. We use panel unit root test on LIDE, LELC and LPIB before co-integration panel analysis.

To investigate the stationarity of the used series, we used the unit root tests on panel data Levin Lin and Chu, IM Pesaran and Shin, Breitung, Maddala and Wuand Hadri-test, this latter is a residual-based Lagrange Multiplier (LM) test where the null hypothesis is that there is no unit root. The results of these tests are presented in the tables following:

Table 1. Unit root tests for the variables of the first panel

Null: Unit Root							**Null: NO Unit Root**	
Methods	**Variables**	**Levin, Lin and Chu (LLC)**	**Breitung t-stat**	**Im, Pesaran And Shin (IPS) W-stat**	**MW–ADF Fisher Chi-square**	**MW–PP Fisher Chi-square**	**Hadri Z-stat**	**Heteroscedastic consistent Z-stat**
Level	***LOG GDP***	0.18245 (0.5724)	2.36148 (0.9909)	0.80664 (0.7901)	19.9797 (0.4592)	7.85918 (0.9928)	6.89313 (0.0000)*	5.28631 (0.0000)*
	LOG FDI	-1.16983 (0.1210)	-0.09122 (0.4637)	-1.24815 (0.1060)	30.3929 (0.0637)	23.8856 (0.2474)	5.59569 (0.0000)*	4.44380 (0.0000)*
	LOG ELC	-0.71581 (0.2371)	0.22519 (0.5891)	2.60975 (0.9955)	21.0664 (0.6348)	19.7351 (0.7117)	8.17865* (0.0000)	8.14917* (0.0000)
First difference	***ΔLOG GDP***	-6.69471 (0.0000)*	-2.59663 (0.0047)*	-7.44921 (0.0000)*	87.4328 (0.0000)*	71.9264 (0.0000)*	2.17829 (0.0147)	2.11256 (0.0173)
	ΔLOG FDI	-6.62408 (0.0000)*	-7.01993 (0.0000)*	-8.25013 (0.0000)*	96.4859 (0.0000)*	145.935 (0.0000)*	0.83061 (0.2031)	0.44990 (0.3264)
	ΔLOG ELC	-4.23123* (0.0000)	-4.12063* (0.0000)	-7.00247* (0.0000)	91.3343* (0.0000)	111.179* (0.0000)	4.00212* (0.0000)	6.13522* (0.0000)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

Table 2. Unit root tests for the variables of the second panel

Null: Unit Root							Null: NO Unit Root	
Methods	Variables	Levin, Lin and Chu (LLC)	Breitung t-stat	Im, Pesaran And Shin (IPS) W-stat	MW–ADF Fisher Chi-square	MW–PP Fisher Chi-square	Hadri Z-stat	Heteroscedastic consistent Z-stat
Level	*LOG GDP*	4.76037 (1.0000)	3.35277 (0.9996)	7.99381 (1.0000)	6.01027 (0.9880)	4.61397 (0.9974)	6.63507 (0.0000)*	5.87860 (0.0000)*
	LOG FDI	2.91304 (0.9982)	-0.28172 (0.3891)	0.90812 (0.8181)	11.1908 (0.7976)	42.6623 (0.0003)*	4.93848 (0.0000)*	5.65964 (0.0000)*
	LOG ELC	-2.78746 (0.0027)	0.96647 (0.8331)	-3.61929* (0.0001)	41.2662* (0.0005)	47.7646* (0.0001)	3.33819* (0.0004)	3.65601* (0.0001)
First difference	*ΔLOG GDP*	-5.95121 (0.0000)*	-4.71429 (0.0000)*	-5.30568 (0.0000)*	59.8443 (0.0000)*	160.528 (0.0000)*	6.74271 (0.0000)*	6.07715 (0.0000)*
	ΔLOG FDI	-23.5555 (0.0000)*	-1.59257 (0.0556)	-14.8370 (0.0000)*	317.571 (0.0000)*	336.566 (0.0000)*	5.96003 (0.0000)*	6.32997 (0.0000)*
	ΔLOG ELC	-7.70849* (0.0000)	-5.47750* (0.0000)	-6.51160* (0.0000)	70.5238* (0.0000)	84.9900* (0.0000)	1.23897 (0.1077)	2.02103 (0.0216)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

Table3. Unit root tests for the variables in the third panel

Null: Unit Root							Null: NO Unit Root	
Methods	Variables	Levin, Lin and Chu (LLC)	Breitung t-stat	Im, Pesaran And Shin (IPS) W-stat	MW–ADF Fisher Chi-square	MW–PP Fisher Chi-square	Hadri Z-stat	Heteroscedastic consistent Z-stat
Level	*LOG GDP*	0.67954 (0.7516)	0.58127 (0.7195)	-0.35528 (0.3612)	6.24952 (0.3958)	2.95665 (0.8143)	6.38691 (0.0000)*	6.38288 (0.0000)*
	LOG FDI	6.07724 (1.0000)	1.11223 (0.8670)	-23.7979 (0.0000)*	0.28763 (0.9996)	0.35423 (0.9992)	4.08705 (0.0000)*	4.21464 (0.0000)*
	LOG ELC	1.68651 (0.9542)	3.01319 (0.9987)	2.92965 (0.9983)	0.51028 (0.9977)	0.47715 (0.9981)	4.44747* (0.0000)	4.28978* (0.0000)
First difference	*ΔLOG GDP*	-5.99719 (0.0000)*	-2.56740 (0.0051)*	-4.74958 (0.0000)*	30.0763 (0.0000)*	28.3804 (0.0001)*	-0.00629 (0.5025)	0.26325 (0.3962)
	ΔLOG FDI	-41.0678 (0.0000)*	-0.97839 (0.1639)	-31.5635 (0.0000)*	295.292 (0.0000)*	296.579 (0.0000)*	3.59396 (0.0002)*	2.04928 (0.0202)
	ΔLOG ELC	-4.76352* (0.0000)	-0.97633 (0.1645)	-7.21011* (0.0000)	51.2902* (0.0000)	61.3052* (0.0000)	0.48924 (0.3123)	0.65297 (0.2569)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

Table 4. Unit root tests for the variables of the fourth panel

Null: Unit Root							**Null: NO Unit Root**	
Methods	**Variables**	**Levin, Lin and Chu (LLC)**	**Breitung t-stat**	**Im, Pesaran And Shin (IPS) W-stat**	**MW–ADF Fisher Chi-square**	**MW–PP Fisher Chi-square**	**Hadri Z-stat**	**Heteroscedastic consistent Z-stat**
Level	***LOG GDP***	3.55615 (0.9998)	-0.36530 (0.3574)	7.12587 (1.0000)	2.06494 (1.0000)	1.66068 (1.0000)	4.80862 (0.0000)*	3.68196 (0.0001)*
	LOG FDI	0.95427 (0.8300)	2.65693 (0.9961)	2.74044 (0.9969)	14.4434 (0.8850)	10.3991 (0.9823)	4.88032 (0.0000)*	5.03932 (0.0000)*
	LOG ELC	0.43027 (0.6665)	2.89521 (0.9981)	0.94197 (0.8269)	21.4924 (0.4905)	15.3907 (0.8449)	5.80805* (0.0000)	4.91717* (0.0000)
First difference	***ΔLOG GDP***	-7.69112 (0.0000)*	-5.89464 (0.0000)*	-7.90949 (0.0000)*	96.9286 (0.0000)*	99.8774 (0.0000)*	2.06159 (0.0196)	1.83756 (0.0331)
	ΔLOG FDI	-9.74759 (0.0000)*	-6.74023 (0.0000)*	-8.28488 (0.0000)*	101.633 (0.0000)*	102.338 (0.0000)*	1.87717 (0.0302)	2.46386 (0.0069)*
	ΔLOG ELC	-8.71385* (0.0000)	-0.91476 (0.1802)	-8.45679* (0.0000)	116.732* (0.0000)	407.535* (0.0000)	6.30591* (0.0000)	8.44075* (0.0000)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

Table 5. Unit root tests for the variables of the fifth panel

Null: Unit Root							**Null: NO Unit Root**	
Methods	**Variables**	**Levin, Lin and Chu (LLC)**	**Breitung t-stat**	**Im, Pesaran And Shin (IPS) W-stat**	**MW–ADF Fisher Chi-square**	**MW–PP Fisher Chi-square**	**Hadri Z-stat**	**Heteroscedastic consistent Z-stat**
Level	***LOG GDP***	1.49849 (0.9330)	2.31182 (0.9896)	0.00166 (0.5007)	36.6354 (0.6225)	17.8376 (0.9991)	9.34114 (0.0000)*	6.75363 (0.0000)*
	LOG FDI	7.62369 (1.0000)	4.25045 (1.0000)	0.82042 (0.7940)	48.7667 (0.1611)	51.4066 (0.1068)	6.72008 (0.0000)*	5.72350 (0.0000)*
	LOG ELC	4.88029 (1.0000)	6.03782 (1.0000)	5.98320 (1.0000)	23.1005 (0.9960)	13.9925 (1.0000)	8.86377* (0.0000)	9.02393* (0.0000)
First difference	***ΔLOG GDP***	-7.08514 (0.0000)*	-1.30838 (0.0954)	-7.64291 (0.0000)*	138.959 (0.0000)*	128.025 (0.0000)*	1.12017 (0.1313)	0.73621 (0.2308)
	ΔLOG FDI	-11.0836 (0.0000)*	0.12371 (0.5492)	-12.5475 (0.0000)*	229.849 (0.0000)*	654.592 (0.0000)*	0.07037 (0.4720)	1.26499 (0.1029)
	ΔLOG ELC	-9.16892* (0.0000)	0.15471 (0.5615)	-10.5505* (0.0000)	191.087* (0.0000)	363.264* (0.0000)	0.51831 (0.3021)	10.2108* (0.0000)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

Table 6. Unit root tests for the variables of the sixth panel

Null: Unit Root							Null: NO Unit Root	
Methods	**Variables**	**Levin, Lin and Chu (LLC)**	**Breitung t-stat**	**Im, Pesaran And Shin (IPS) W-stat**	**MW–ADF Fisher Chi-square**	**MW–PP Fisher Chi-square**	**Hadri Z-stat**	**Heteroscedastic consistent Z-stat**
Level	***LOG GDP***	-0.32135 (0.3740)	0.55743 (0.7114)	3.57091 (0.9998)	3.68599 (0.9604)	3.20722 (0.9761)	4.77064 (0.0000)*	4.49263 (0.0000)*
	LOG FDI	0.22360 (0.5885)	1.25494 (0.8953)	1.06715 (0.8570)	4.84897 (0.9010)	4.84757 (0.9011)	4.66907 (0.0000)*	4.20307 (0.0000)*
	LOG ELC	-0.79435 (0.2135)	-1.64957 (0.0495)	2.70146 (0.9965)	1.77804 (0.9978)	2.04441 (0.9960)	2.16938 (0.0150)	2.35179* (0.0093)
First difference	***ΔLOG GDP***	-8.13799 (0.0000)*	-4.45352 (0.0000)*	-9.22952 (0.0000)*	133.424 (0.0000)*	152.569 (0.0000)*	1.34088 (0.0900)	6.09390 (0.0000)*
	ΔLOG FDI	-5.31184 (0.0000)*	-3.63004 (0.0001)*	-6.53438 (0.0000)*	57.9281 (0.0000)*	57.8449 (0.0000)*	1.00364 (0.1578)	2.28399 (0.0112)
	ΔLOGELC	-8.55281* (0.0000)	-4.85332* (0.0000)	-10.6105* (0.0000)	92.6272* (0.0000)	94.4296* (0.0000)	0.88012 (0.1894)	1.40455 (0.0801)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

Table 7. Unit root tests for the variables of the seventh panel

Null: Unit Root							Null: NO Unit Root	
Methods	**Variables**	**Levin, Lin and Chu (LLC)**	**Breitung t-stat**	**Im, Pesaran And Shin (IPS) W-stat**	**MW–ADF Fisher Chi-square**	**MW–PP Fisher Chi-square**	**Hadri Z-stat**	**Heteroscedastic consistent Z-stat**
Level	***LOG GDP***	4.26922 (1.0000)	1.41980 (0.9222)	6.33950 (1.0000)	0.92017 (1.0000)	0.51117 (1.0000)	6.68075 (0.0000)*	5.96662 (0.0000)*
	LOG FDI	-0.48591 (0.3135)	1.05470 (0.8542)	0.52859 (0.7015)	9.39101 (0.8052)	9.81893 (0.7753)	5.36275 (0.0000)*	4.80087 (0.0000)*
	LOG ELC	-0.03378 (0.4865)	1.58793 (0.9438)	1.14813 (0.8745)	14.6261 (0.5522)	14.4346 (0.5664)	5.69191* (0.0000)	5.18558* (0.0000)
First difference	***ΔLOG GDP***	-4.18601 (0.0000)*	-4.08446 (0.0000)*	-5.48039 (0.0000)*	56.2758 (0.0000)*	63.3233 (0.0000)*	1.55321 (0.0602)	2.43131 (0.0075)
	ΔLOG FDI	-8.84835 (0.0000)*	-5.86712 (0.0000)*	-8.18544 (0.0000)*	80.6747 (0.0000)*	125.847 (0.0000)*	2.77174 (0.0028)*	3.48344 (0.0002)*
	ΔLOG ELC	-9.66861* (0.0000)	-8.00263* (0.0000)	-12.2475* (0.0000)	134.526* (0.0000)	407.499* (0.0000)	4.99168* (0.0000)	6.70836* (0.0000)

* Indicates statistical significance at 1% level. Δ is the first difference operator.

From the results of the unit root tests performed to the seven panel of the study, we can draw the following conclusions: All statistics are not significant at the 1% level for all variables (GDP, FDI and ELC). After differentiation into first degree data we notice a significant way that all data are stationary for the three variables. These results led us to a logical way to test for the presence or absence of a long-term relationship between GDP, FDI and ELC by applying Co-integration tests.

10.2. Panel Co-integration results

Co-integration requires that all the variables are integrated of the same order. The results of panel unit root test indicate that GDP and FDI are integrated at the first-order, we proceed to test co-integration panel, and that by relying on tests Pedroni. The results are as follows:

Table 8. Co-integration tests for the first panel

Methods	**Within dimension (panel statistics)**			**Between dimension (individuals statistics)**		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP, LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	0.873278	0.1913	**Group ρ-statistic**	1.475406	0.9299
	Panel rho-statistic	0.667134	0.7477	**Group pp-statistic**	0.338334	0.6324
	Panel PP-statistic	0.342301	0.6339	**Group ADF-statistic**	0.134091	0.5533
	Panel ADF-statistic	0.432597	0.6673			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	1.055489	0.1456			
	Panel rho-statistic	0.402287	0.6563			
	Panel PP-statistic	-0.117869	0.4531			
	Panel ADF-statistic	-0.105610	0.4579			

Table 9. Co-integration tests for the second panel

Methods	**Within dimension (panel statistics)**			**Between dimension (individuals statistics)**		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP,LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	-0.275198	0.6084	**Group ρ-statistic**	1.827453	0.9662
	Panel rho-statistic	0.877947	0.8100	**Group pp-statistic**	-0.167165	0.4336
	Panel PP-statistic	-1.322553	0.0930	**Group ADF-statistic**	-0.880923	0.1892
	Panel ADF-statistic	-1.943331	0.0260			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	-0.105774	0.5421			
	Panel rho-statistic	0.713525	0.7622			
	Panel PP-statistic	-1.282546	0.0998			
	Panel ADF-statistic	-2.263598	0.0118			

Table 10. Co-integration tests for the third panel

Methods	Within dimension (panel statistics)			Between dimension (individuals statistics)		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP,LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	1.241470	0.1072	**Group ρ-statistic**	1.697957	0.9552
	Panel rho-statistic	0.872933	0.8087	**Group pp-statistic**	1.425731	0.9230
	Panel PP-statistic	0.498575	0.6910	**Group ADF-statistic**	0.167863	0.5667
	Panel ADF-statistic	-1.010286	0.1562			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	1.479252	0.0695			
	Panel rho-statistic	0.881444	0.8110			
	Panel PP-statistic	0.521104	0.6989			
	Panel ADF-statistic	-0.857958	0.1955			

Table 11. Co-integration tests for the fourth panel

Methods	Within dimension (panel statistics)			Between dimension (individuals statistics)		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP,LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	0.276886	0.3909	**Group ρ-statistic**	1.898948	0.9712
	Panel rho-statistic	1.024655	0.8472	**Group pp-statistic**	-0.291615	0.3853
	Panel PP-statistic	-0.229526	0.4092	**Group ADF-statistic**	-2.649474	0.0040
	Panel ADF-statistic	-1.561460	0.0592			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	0.639584	0.2612			
	Panel rho-statistic	0.784162	0.7835			
	Panel PP-statistic	-0.736516	0.2307			
	Panel ADF-statistic	-2.497904	0.0062			

Table 12. Co-integration tests for the fifth panel

Methods	Within dimension (panel statistics)			Between dimension (individuals statistics)		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP,LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	4.150241	0.0000	**Group ρ-statistic**	2.195143	0.9859
	Panel rho-statistic	-0.931220	0.1759	**Group pp-statistic**	-0.723060	0.2348
	Panel PP-statistic	-3.929363	0.0000	**Group ADF-statistic**	-4.266177	0.0000
	Panel ADF-statistic	-6.354611	0.0000			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	2.683271	0.0036			

Panel rho-statistic	0.749407	0.7732
Panel PP-statistic	-1.484116	0.0689
Panel ADF-statistic	-3.786901	0.0001

Table 13. Co-integration tests for the sixth panel

Methods	**Within dimension (panel statistics)**			**Between dimension (individuals statistics)**		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP,LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	10.12991	0.0000	**Group ρ-statistic**	-0.623582	0.2665
	Panel rho-statistic	-1.346807	0.0890	**Group pp-statistic**	-2.375203	0.0088
	Panel PP-statistic	-2.590755	0.0048	**Group ADF-statistic**	-4.559447	0.0000
	Panel ADF-statistic	-3.174505	0.0008			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	6.659935	0.0000			
	Panel rho-statistic	-0.768077	0.2212			
	Panel PP-statistic	-1.710062	0.0436			
	Panel ADF-statistic	-2.618618	0.0044			

Table 14. Co-integration tests for the seventh panel

Methods	**Within dimension (panel statistics)**			**Between dimension (individuals statistics)**		
	Test	**Statistique**	**Prob**	**Test**	**Statistique**	**Prob**
LGDP,LFDI, LELC						
Pedroni (1999)	**Panel v-statistic**	4.564695	0.0000	**Group ρ-statistic**	1.241088	0.8927
	Panel rho-statistic	-0.396737	0.3458	**Group pp-statistic**	-0.048751	0.4806
	Panel PP-statistic	-1.578918	0.0572	**Group ADF-statistic**	0.885361	0.8120
	Panel ADF-statistic	-0.238203	0.4059			
Pedroni (2004)(Weighted statistic)	**Panel v-statistic**	1.086122	0.1387			
	Panel rho-statistic	1.127544	0.8702			
	Panel PP-statistic	0.300888	0.6183			
	Panel ADF-statistic	0.784509	0.7836			

The tables above reports both the within and between dimension panel co-integration test statistics for each panel data set about panel 1, 2,3,4,5,6 and 7. These statistics are based on averages of the individual autoregressive coefficients associated with the unit root tests of the residuals for each country in the panel. These results suggest that the null hypothesis of no co-integration cannot be rejected at a significance level of 5%, so there exist at least one probability values are less than 5 %, It is mainly (Panel pp-Statistic in the case of Europe, Latin America and North Africa) and (Panel ADF-Statistic in the case of Latin America and Europe) and (Panel PP-statistic in the case of North Africa) regarding intra-individual tests, and we have (Group ADF-Statistic in the case of Latin America,Europe and North Africa) for testing inter-individual. Thus, the evidence suggests that in all panel data sets there is a co-integration long run relationship between GDP, FDI and electricity consumption ELEC for our panel of continents. In this step, we estimate the long-term relationships using FMOLS methods and DOLS estimators proposed by Pedroni, Kao and Chiang and Mark and Sul.

11. The FMOLS and DOLS estimations

Having established that the variables are stationary and exhibit long-run co-integration panel in the previous sub-sections, we estimate now the long-run impact of Foreign direct investment FDI on economic growth GDP of North Africa ,African, Asian and Oceanic, Middle east, North America and Latin America countries . The results of FMOLS panel method estimator are similar to DOLS estimators, all results are presented in following:

Table 15. FMOLS AND DOLS LONG-RUN FOR Panel 1

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.103123 10.63884 (0.0000)*	[0.124121 6.350709 (0.0000)*
Between Results	[0.170846 15.03520 (0.0000)*	[0.128420 5.943213 (0.0000)*
Variable	***ELEC***	***ELEC***
Within Results	[0.671182 22.46244 (0.0000)*	[0.586641 10.28217 (0.0000)*
Between Results	[0.464153 6.073400 (0.0000)*	[0.641757 5.815424 (0.0000)*

Table 16. FMOLS AND DOLS LONG-RUN FOR Panel 2

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.097363 4.144796 (0.0000)*	[0.072376 3.253817 (0.0013)*
Between Results	[0.138049 9.654868 (0.0000)*	[0.111350 5.765616 (0.0000)*
Variable	***ELEC***	***ELEC***
Within Results	[0.491826 4.780329 (0.0000)*	[0.596669 5.509445 (0.0000)*
Between Results	[0.287285 3.674569 (0.0003)*	[0.533077 5.418818 (0.0000)*

Table 17. FMOLS AND DOLS LONG-RUN FOR Panel 3

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.123562 2.448518 (0.0149)*	[0.227288 7.754330 (0.0000)*
Between Results	[-0.00709 -0.210640 (0.8337)*	[0.209693 5.887483 (0.0000)*
Variable	***ELEC***	***ELEC***
Within Results	[-4.11537 -7.858667 (0.0000)*	[-0.15835 -0.882091 (0.3808)*
Between Results	[1.463244 4.731304 (0.0000)*	[0.141901 0.519323 (0.6050)*

Table 18. FMOLS AND DOLS LONG-RUN FOR Panel 4

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.123562 2.448518 (0.0149)*	[0.129653 9.593686 (0.0000)*
Between Results	[0.054621 3.687545 (0.0003)*	[0.075203 3.993706 (0.0001)*
Variable	***ELEC***	***ELEC***
Within Results	[0.295240 1.847904 (0.0655)	[0.371208 8.122316 (0.0000)*
Between Results	[0.752933 11.76980 (0.0000)*	[0.724031 13.03881 (0.0000)*

Table 19. FMOLS AND DOLS LONG-RUN FOR Panel 5

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.019613 5.149020 (0.0000)*	[0.016468 5.001193 (0.0000)*
Between Results	[0.093498 19.89890 (0.0000)*	[0.096054 12.55499 (0.0000)*
Variable	***ELEC***	***ELEC***
Within Results	[0.808814 20.88869 (0.0000)*	[0.813536 19.15127 (0.0000)*
Between Results	[0.682748 14.41840 (0.0000)*	[0.646939 7.920517 (0.0000)*

Table 20. FMOLS AND DOLS LONG-RUN FOR Panel 6

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.107577 5.176397 (0.0000)*	[0.068117 2.041460 (0.0432)*
Between Results	[0.126705 5.550805 (0.0000)*	[0.091563 2.530419 (0.0126)*
Variable	***ELEC***	***ELEC***
Within Results	[0.633342 12.08086 (0.0000)*	[0.744871 8.880966 (0.0000)*
Between Results	[0.651157 13.53309 (0.0000)*	[0.677950 9.339812 (0.0000)*

Table 21. FMOLS AND DOLS LONG-RUN FOR Panel 7

Dependent Variable	FMOLS	DOLS
" GDP "	**Independent Variables**	**Independent Variables**
Variable	***FDI***	***FDI***
Within Results	[0.225520 7.616533 (0.0000)*	[0.200345 7.747457 (0.0000)*
Between Results	[0.197786 8.777381 (0.0000)*	[0.168599 7.511960 (0.0000)*
Variable	***ELEC***	***ELEC***
Within Results	[0.426592 3.811743 (0.0002)*	[0.608056 5.267747 (0.0000)*
Between Results	[0.432671 4.414263 (0.0000)*	[0.723937 7.516480 (0.0000)*

The tables above reports the long-run elasticity estimates from FMOLS and DOLS for the seven panels (coefficients can be interpreted as elasticity, because the variables are expressed in natural logarithms). It is interesting to note that the within-dimension results do not differ from between-dimension results.

Modeling the within-dimension allows us to take into account the heterogeneity of individuals in their temporal and/or individual dimension. The within estimation eliminates the individual specific effects (persistent differences between countries over the period); it favors the temporal information.

All of the estimated coefficients indicate that FDI and ELC are correlated positively and significantly with economic growth at the 1% level. Overall, the results of FDI and economic growth regression panel demonstrate a strong long-term relationship between both, and show the importance of foreign direct investment for economic growth in the analysis of these regions.

The results obtained for all panel such as Asia and oceanic, Middle east, north America , Latin America ,Europe ,North Africa, Africa indicate that a 1% increase in foreign investment increases the GDP , respectively 0.32% ,0.26% ,0.22% ,0.24% ,0.17%, 0.35% , 0.29%, and an increase of 1% in electricity consumption Increases the GDP, respectively 0.67%, 0.59%, 1.46%, 0.37%, 0.64%, 0.63%, 0.72%. Respectively for the seven panel. It should be noted that all continents have positive results and statistically significant at the 1% significance whatsoever for FMOLS method or the DOLS, these results presented above indicate that the flow of FDI have a positive and significant long-run effect on economic growth in our overall sample and also in the different geographical regions under consideration.

11.1. Panel Granger causality results

The existence of co-integration implies the existence of causality at least in one direction. Having found that there is a long-run relationship between FDI, ELC and GDP the next step is done objectively to test the causality between these variables by using the test of Panel Granger causality.

This paper focuses on the relationship between FDI, electricity consumption and economic growth. A Granger-causality analysis is carried out in order to assess whether there is any potential predictability power of one indicator to the other.

The results of Granger-causality test for all panels are summarized in following Table. It should be noted that optimal lag was established using the Akaike and Schwarz information criteria.

Table 22. Panel granger causality test results

Lags [1-3]				*FDI*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	1.0408 (0.3545)	1.0162 (0.3864)	2.0114 (0.1193)	3.4631* (0.0167)	9.9977* (0.0000)	0.5383 (0.6568)	0.69897 (0.5538)
GDP	3.0767* (0.0476)	2.536* (0.0576)	13.160* (0.0000)	4.3513* (0.0051)	4.0472* (0.0179)	7.4164* (0.0001)	4.0142* (0.0085)
				ELEC			
GDP	3.8088* (0.0106)	11.0939* (8 E-07)	0.89787 (0.4463)	1.98569 (0.1161)	5.9236* (0.0006)	4.2693* (0.0065)	8.99533* (1 E-05)
	3.3704* (0.0190)	1.5994 (0.1905)	0.61636 (0.6065)	0.12494 (0.9453)	1.68614 (0.1688)	2.9550* (0.0349)	2.00573 (0.1146)

The Granger causality test results in table shows null hypothesis— FDI does not Granger Cause GDP is rejected for all panels at 10% level, this suggests that flows FDI, Granger-cause GDP in the long-run.

The results indicate that unidirectional causality exists between foreign direct investment and economic growth for Asia and oceanic, Middle East, North America North Africa and central Africa. Furthermore, there is bidirectional causality FDI and GDP for Latin America and Europe. The conclusion can be drawn is that causality running from foreign direct investment to economic growth is stronger compared to causal relationship from economic growth to foreign direct investment in all panel.

Regarding energy consumption and economic growth, the results show a relationship of unidirectional causality from GDP to ELC for Asia and Oceanic, Middle East, Europe, North Africa and Central Africa, and a relationship from ELC to GDP only for Asia and Oceanic and North Africa.

12. Conclusions and policy implications

The paper examines the relationship between foreign direct investment, electricity consumption and economic growth for the countries in different regions by using panel co-integration test and panel causality. The findings reveal that FDI flows are positively and significantly correlated and affect GDP in the long run which support the existing literatures.

Using a panel data for 65 countries during the period covered of 1980–2010, we draw conclusions from the empirical analysis as follows:

Unit root tests show that LFDI and LGDP are first-order integrated, co integration panel analysis shows that there is a long-run equilibrium relationship between FDI and economic growth .The regression results FMOLS and DOLS have confirmed the long-term equilibrium relationship and positive impact of FDI on economic growth for all countries .The result of panel Granger Causality test shows that there exists reciprocal causation between FDI and economic growth in the Latin America and Europe. In addition, the direction of causality between growth and FDI flows are unidirectional positive in the long-term for other panel.

The results of the study have policy implications can be concluded such as: the tests and estimators indicate that FDI contributes positively and significantly to the economic growth way is principally made in developing countries. This contribution is evaluated between 0.22 and 0.32 (FMOLS and DOLS estimators) in terms of elasticity .In Indeed, the participation is very important of FDI to GDP in these economies, which shows that FDI as the demand factor has effects on GDP in these regions.

FDI figure is the growth engine as it provides capital, which these countries are in great need, necessary for investment and increased competition in the industries in host countries while improving the productivity of local firms by adopting more efficient technologies or investing in human capital and / or physical regarding Europe and Latin America as it is shown in the empirical evidence, the relationship between FDI and economy growth is bidirectional in the Latin America and Europe, this means that GDP is well considered as a determined of foreign Direct Investments in these two regions the fact that countries as Europe needs considerable input into foreign resources in order to reduce gaps in savings and budget deficits and the lack of capital and especially in developing countries.

These results may help a government to establish priorities regarding the diversification of the resources for national strategies to economic growth and investment at long run. We find that the countries under review (including the developing countries) that promote freedom of economic activities gain significantly from the FDI.

We consider this is an important result, because it validated the relationship long run between GDP and FDI. Finally to maximize their impact in terms of growth, FDI need a good absorption capacity of the country, related to the level of education, the development of financial markets, infrastructure, and a favorable public face (tax, quality of institutions, governance, customs agreements or investment protection, fluidity business major developmental projects etc…).

On the other hand the governments should further improve the mechanism of domestic investment and developed the infrastructures for attracting more flows of FDI.

We find evidence of co-integration between electricity consumption and economic growth and, therefore, the existence of a long-run equilibrium relationship.

Regarding the short-term dynamics, can be said that economic growth has a positive and significant effect on the consumption of electricity in the short term. An increase in real GDP is likely to affect the demand for energy in several ways: first, at the household level, the increase in per inhabitant income can stimulate the consumption of electricity; people seeking to improve their comfort can spend more for additional energy services. Second, economic growth can lead to an increase in demand for electricity, as electricity is a major input into the production system.

Thus, an increase in real GDP increases the electricity consumption in the short term, and can increase production in the real sector.

In contrast, in the long term, the consumption of electricity that causes the growth of GDP in the country.

Regarding the electricity and GDP per inhabitant consumption, there is no causality in the short term but in the long term, an increase in electricity consumption leads to an increase in GDP per inhabitant.

The implications of our results are relevant. According to our findings, the current policies of the power and potential of those countries in the study directed towards a more efficient use of existing capacity, investment in new production technologies and the improvement of interconnections are in good direction if the objective is to promote economic growth.

This will require significant inhabitant investment, but since energy is a prerequisite for economic growth and that current trends in energy consumption are not environmentally sustainable, these investments are inevitable.

Energy consumption and, more specifically, the power consumption is a driver key of economic growth in these countries. Therefore, the challenge of providing adequate and reliable energy cannot be separated from the other challenges faced by these countries. Energy poverty cannot be separated from the many challenges facing the countries of the study should be addressed.

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