Impact of Foreign Direct Investment on Energy Saving in South Asian Countries

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Abstract

This study empirically investigates the impact of Foreign Direct Investment (FDI) on Energy Intensity (EI) in case of South Asia by using panel data set over the period of 1990 to 2013. To achieve this objective, Least Square Dummy Variable Model (LSDV), Fixed Effect Model (FEM) and Random Effect Model (REM) are used and for model selection we incorporated efficiency test (F-test) and Hausman specification test. Energy saving is important because it saves money but also help to produce more goods with less energy, FDI is one of the key channel with which energy knowledge spillover take place and economic growth happened. On the basis of Hausman specification test and model efficiency test we concluded that Fixed effect model is an appropriate model in which FDI remain insignificant with negative sign. So our results remain in line with previous literature on the subject. In our analysis, we have seen that FDI inflows are not responsible for the EI of the South Asia, since it depends also on other economic factors. In other words, South Asian countries emphasis on the attitude that needs to develop in order to attract and benefit from more FDI inflows and also use of issue-linkages, as for intended by the Kyoto Protocol (clean development mechanism), which explain such FDI that brings energy reducing technology transfer, which should be encouraged.

Keywords: FDI, Energy Intensity (EI), South Asia, LSDV, Random effect/Fixed effect

1. Introduction

In Developing countries energy saving technologies has been adopted because it concerns energy securities and climate changes. But on the other hand, it is difficult for developing countries to achieve such goals; it can only happen when developing countries absorb technology diffusion from developed economies. Developed economies are considered as potentially energy saving technologies which can save energy. This can be done by the outflow of foreign direct investment (FDI) of developed countries and inflow of FDI to developing economies. At international level technological diffusion is possible with key channel of FDI (Keller, 2004).

Economic sustainability[4] and growth are basic aims of any economy. But, it could cause some side effects like Greenhouse Gas[5] (GHG) emission, which is due to the increase in the energy demand. It is expected that demand of the world energy will grow at an average growth rate of 1.8% annually between 2005 and 2030 (IEA, 2007). In global energy demand contribution of developing countries will be 74%. Above of all 45% of increase in the energy demand of the world will only be due to the two countries China and India. Primary energy demand in China and India is expected to grow at an average annual growth rates 3.2%, 3.6%, respectively over the period of 2005 to 2030 (IEA, 2007). It is better to understand the determinants of energy demand that how the energy demand is going to change in the future

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[4] It is an ability or capacity of something to be maintained or to sustain itself.
[5] Such gas in our atmosphere which emits radiations and absorb too, within the range thermal infrared range. This is also the cause of greenhouse effect.

in emerging countries. GHG emissions in the world are 61.4% which comes from the energy sector[6] according to the world resources institute (WRI, 2010). GHG emissions mostly emitted by the developed economies and it will be the threat in future that GHG emissions will increases due to the economical growth of developing economies which will emit more GHG emission.

Yang & Todo (2012) explained that the FDI as a whole doesn't diffuse its energy saving technologies to all domestic firms. It favors only those domestic firms which are inferior to FDI in terms of energy saving, whereas this diffusion effect can't be applied to those clean domestic firms which have already surpassed FDI. In contrast, clean domestic firms[7] received a negative diffusion; their energy intensity was pushed up with more FDI inflows through competition. On the other hand, when FDI is limited to clean FDI only, defined as foreign firms which are more energy saving than industry average, an universal energy saving diffusion is observed for all domestic firms regardless of their status as being dirty or clean. Yet still, the dirty domestic firms have greater benefits than those clean domestic firms.

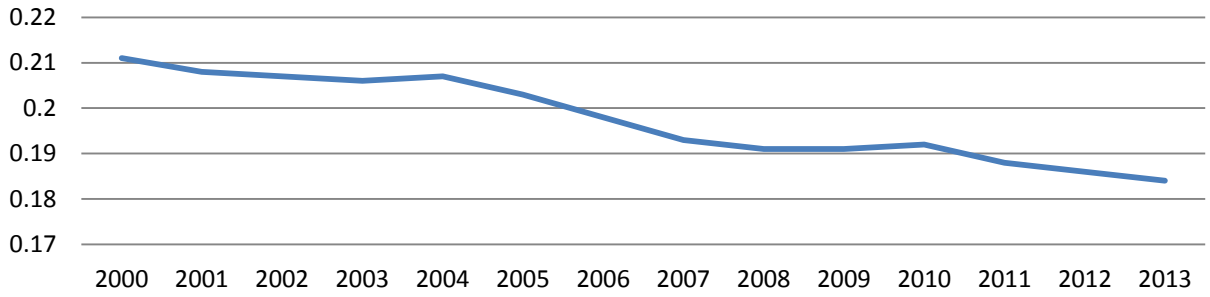
Energy has more than one meanings, it means something that has the ability to do work or do change. In other words, energy is the ability of something which does work. We require energy in every field of life whether it is industry, Agriculture, education sector, or households. The industrial sector is a major sector which consumes more energy than the other sectors of the economy, industrial sector consumed half of all the electricity around the globe and about 30 percent use of primary energy (SAARC CCI Policy, 2012).

Energy Saving means minimize the amount of energy used while getting similar amount of output at the end. If we use less energy in the production process it has lots of benefits, one of them is that we can save and make precious natural resource live longer. It is very important to save energy because when we use less amount of energy, there will be less pressure to the available resources for supply of energy. Energy saving is necessary because use of energy increases rapidly not only in South Asia, but also in all over the World, because the use of energy per capita increases at rapid speed in the South Asian Region (WDI, 2012). Such increase in the energy use is alarming because the resources of energy whether they are renewable or non- renewable are limited and it is needed to search more energy sources, which is long term plan. Energy saving is big issue on the globe these days; in South Asia energy saving is very hot issue which is needed to be researched because energy uses increases with the passage of time in the region rapidly. EI of the world decreases 1.1% in 2013 and 1% average global annual energy intensity reduction since 2000 (Global Energy Statistical Yearbook, 2014).

[6] http://cait.wri.org/figures.php?page=World-FlowChart&view=100

[7] Clean and dirty firms: The real definition of "clean" or "dirty" domestic firms involves more complex investigations. The term of "clean" or dirty" used by Yang and Todo is simply to abbreviate two types of domestic firms. It is the same for "clean" FDI which simply presents foreign firms that are more energy saving than industrial average.

Figure No 1 Enery Intensity (Koe/$ 2005p)

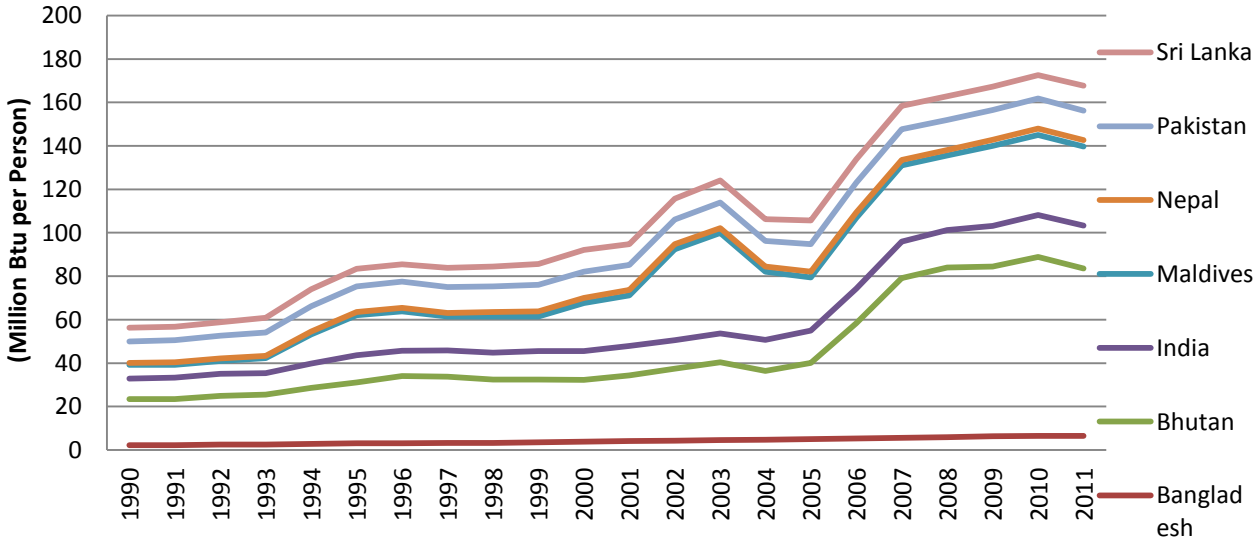


Source: EIA, 2014.

Improving the efficiency process, equipment and other descriptive factors can explain us to observe changes in the level of energy intensity. Decline in energy intensity can be used as a proxy for efficiency improvements or in other words energy saving.

With the development in the last two decades there is an increase in technology transfer from developed to developing countries, this evidence is observed by different economists (Keller, 2004; Haskel et al., 2002; Bin, 2000). The inflow of FDI has different macroeconomic implication, such as impact on EI. Role of FDI in other macroeconomic indicators like economic growth, term of trade, current account balance, budget balance, saving & investment behavior are address consistently. However there is another important factor which is linked to inflow of FDI, which is energy consumption. There are multiple views about the impact implication of FDI over EI, which are studied in the recent literature. But there is still ambiguity in the many regions of the World like South Asia region. Where inflow of FDI have always positive growth & also facing energy problems in the region previously, some empirical studies like Mielnik et al, 2002; Harrison, 1999 have signify the FDI is improving EI, However this evidence is neglected in other studies which concluded that FDI has no role in decreasing the EI (Hubler & Keller, 2008; Tag, 2007). This important link is needed to examine in the other parts of the world like South Asia.

Figure No 2 Total Primary Energy Consumption per Capita



Source: IEA, 2014.

Sri Lanka is a country of the region where the per capita energy consumption is higher than the other regional countries. While if you look at the consumption of Pakistan it stands 2nd in the region, similarly Nepal is at third position; Maldives, India, Bhutan & Bangladesh are the countries respectively at 4th 5th 6th & 7th place. Use of such higher energy consumption per capita is alarming in the region. It needs not only to be address but also sort out this problem that how this per capita energy consumption can be decrease.

1.1 Research Questions

1- Does FDI bring spillover of energy saving technologies to the host South Asian countries?
2- Does FDI bring about spillover of energy saving technologies to the host South Asian countries, along with control variables to check robustness of findings?

2. Literature Review

FDI is viewed as a growth catalyst since it offers the capital required for investment, increases competitiveness in the home country industries and helps local companies in becoming more productive by implementing better technology or by investing in human capital and physical assets. FDI is a potential contributor to economic growth in a considerable way due to its stability compared to other forms of capital flows and its advantages consist of the creation of capital and employment, smoothing the right of entry to foreign markets and engendering technological and efficiency spillover to home-grown firms. It is anticipated that due to these benefits, FDI will without doubt progress the incorporation of the home country into the global economy and raise growth. FDI is viewed as "a key driver of economic growth and development. FDI does not only increase capital but also enriches the quality of capital stock."

Harrison & Hadded (1992) investigated empirically the panel data of Morocco manufacturing and found that there is no spillover of technology diffusion; the study rejected the hypothesis that presence of foreign investment increases the productivity of the local firms in 1980's. Also there is no evidence that foreign investors protect the local markets.

Velazquez (2003) empirically estimated and observed that technology spillover take place among Organization for economic co-operation & development (OECD's) but there is problem of overlapping of variables which lead to misleading results. The study reviewed the existing literature and opposes them on the basis of overlapping of variables used in those studies.

Hubler & Keller (2008) empirically estimated the panel data from 1975-2004 of 60 developing countries, by using the regression of (Mielnik & Goldemberg, 2002) The results, however, are not so meaningful in that it was built on simplified regression and with no control for other factors influencing the energy use, and don't follow the Stationarity assumptions. The results of study found that there is no evidence of energy saving through FDI in these countries.

Tang et al., (2011) investigated the impact of FDI to energy consumption in China by mixing the input-output method and LMDI, The result of the study elaborated that by increasing the FDI China's energy consumption intensity decreased and output effect goes against energy consumption intensity. Thus China should strengthen such investment which is FDI oriented. This leads to minimize the negative impact of FDI and increase the positive impact on China.

Sbia et al., (2013) studied the association among clean energy, FDI, trade openness, economic growth & carbon emissions in case of United Arab Emirates (UAE) from the period of 1975-2011. The ARDL is applied to observe the co-integration by accommodating structural breaks stemming in the series. Vector error correction model (VECM) is also applied to examine the connecting relationship among the variables, the empirical investigation of the study confirm the existence of co-integration among the series. It also

found that carbon emission, FDI and trade openness decrease energy demand. There is positive impact on energy consumption of Economic growth and clean energy.

Sadorsky (2009) used the panel data set of 22 emerging economies from 1990-2006 to investigate empirically the impact on energy demand of financial development. The results of the study showed positive relationship and statistically significant between the financial development and energy consumption. It means when financial development happened then use of energy increases, but financial development help to use less energy than before.

Blackman & Wu (1998) empirically examined the impact of FDI on energy efficiency on China's power sector & also check the impact of FDI on such factors which limits its impact. Using the survey level data of US private investors, official Chinese statistics and other sources, firstly results of the study found that the volume of FDI in China decrease between the period of 1995-2000, due to the tough restrictions on the FDI. Secondly study found that process of FDI through central government is lengthy and above all FDI is in small scale in the coastal areas they prefer imported equipment. Thirdly study found that, FDI has positive impact on the energy efficiency. Most of the FDI plants used such advanced technologies which are more efficient. Fourthly there is biasness of in the favor of small scale plants which are not efficient that the large scale plants this is one of the main reason which hampered the FDI. And finally, the most important barrier to FDI is the uncertainty for the approval of FDI projects.

Yuan & Wang (2010) empirically investigated the affect of FDI on regional industrial energy efficiency by regional industries' data from 2005-2007. By empirical test, study found that FDI can increase the energy efficiency on the whole as FDI owes more advanced technology than local firms. In addition, study also get FDI from Hong Kong is of smaller scale, less environmental protection thought and lower production and environmental technology than FDI from other countries, which induces FDI from other countries like Japan etc has bigger impact than that from Hong Kong, Macao and Taiwan as these two kinds of FDI are different in some ways. What's more, it's very robust in some sense. So, these findings mean that we must guide the FDI especially, that from Hong Kong to more energy-saving and environmental protection direction when study dedicated to attracting more FDI. In addition, it also found that RD, relative energy price, industrial composition, real income per capita and state-owned firms' share also have significant effect on the energy efficiency.

Zhang & Zhong (2008) said that technological innovation input, human resource accumulation and FDI technological spill-over effect all have a positive effect on the technological progress. But there is a great difference result when the study divided the whole industries into divisions by the different property right organization. The technological progress of state-owned enterprises is mainly rooted in human resource accumulation rather than the technological innovation input and has a disadvantage influence from FDI technological spill-over effect. On the contrary, the technological progress of foreign capital enterprises is mainly rooted in FDI technological spill-over effect rather than the technological innovation input nor human resource accumulation.

Luo & cheng (2013) used the method of data envelopment analysis in China from 1997-2008 and computed total factor energy efficiency of the region. They discussed the control of regional FDI on domestic energy efficiency. Results of the empirical study showed that by technical and structural Effect channel FDI improved china's average level of energy utilization efficiency.

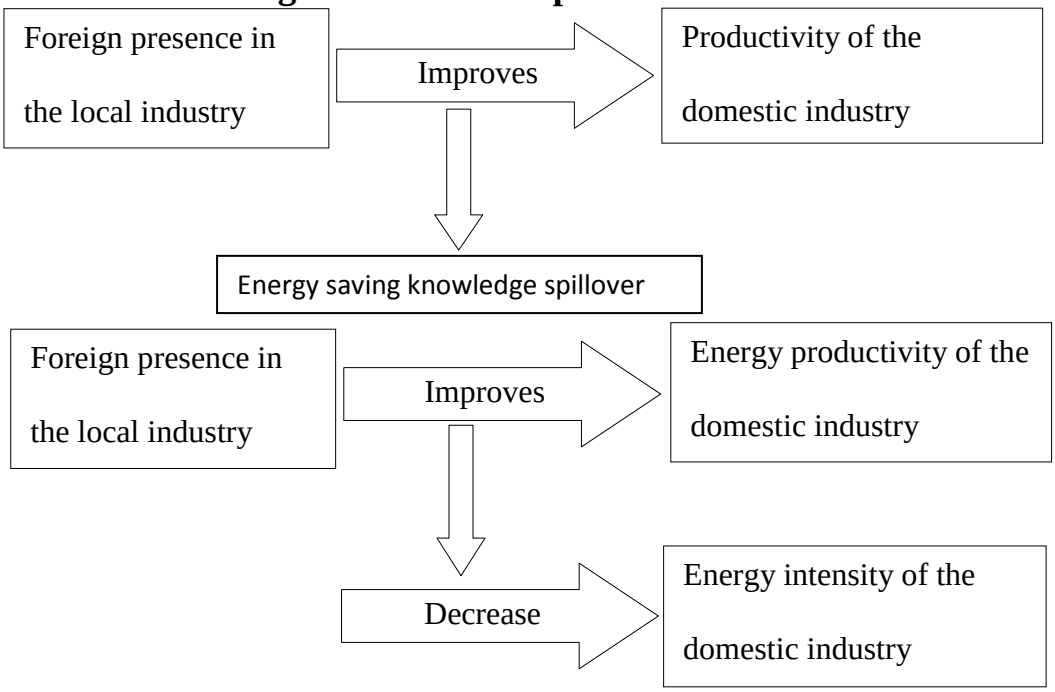
Elliott et al., (2013) investigated the association among the EI of Chinese cities and the place of overseas firms employing a unique dataset of 206 of the major prefecture-level cities from 2005 to 2008. Results of the empirical study showed that there is inverted-U shaped relationship among EI and city-level per capita income with the bulk of cities on the

descending (downward) slope of the curve. The Study also found that there is negative and significant relationship among FDI and city level EI.

3. Theoratical Framework and Methodology

In the earlier studies it is proved that Energy intensity decreases in the developing countries with the help of FDI (Mielnik et al, 2002; Harrison, 1999). When FDI comes in developing countries, the training to the local workers, managers and technical assistance provided by the foreign firms can increase the labor turnover, competition among local and foreign firms and demonstration of technology and practices. All the firms use efficient workers and new technology to keep their place in the market which increases productivity of the firms which ultimately decreases the energy intensity.

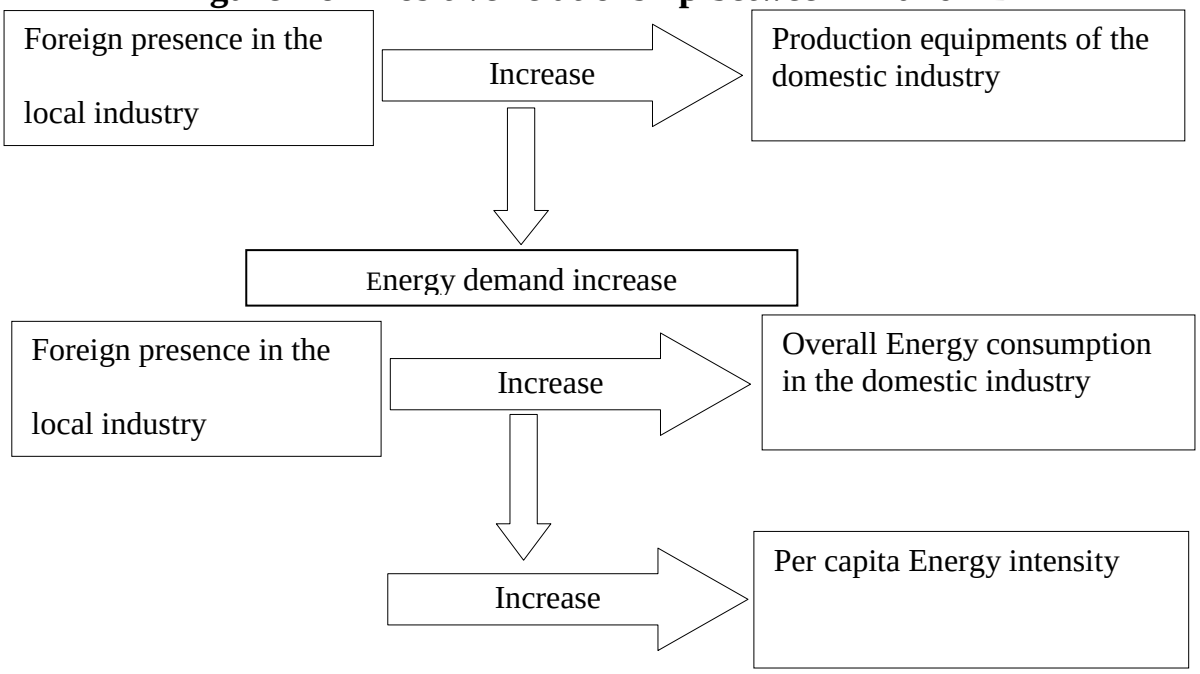
Figure 3: Energy productivity and Energy saving knowledge spillover Negative relationship between EI and FDI



Source: Yang & Todo, 2012

When FDI comes in the local industry, first of all it enhances the productivity of local firms. There are number of theoretical channels which include new technology, skills, and knowledge. Foreign presence not only brings new technologies but also skills, which increase the productivity of host nation. FDI does not only bring modern technology but also transfer knowledge which saves the energy in the local firms, in other words EI decreases in the peers. Inflow of FDI can affect the energy use by three effects, technical, composition and scale effect (Hubler & Keller, 2008). Productivity and technology of local firms improves when foreign firms demonstrate new technology after entering in the market. Foreign firms not only provide technical assistance to local customers and suppliers but also train the local managers and workers (Kokko, 1993). Other empirical studies also develop theoretical links between FDI and EI by incorporating channels like capital accumulation, diffusion of technology, productivity efficiency and the introduction of new methods and procedures (Caves, 1982; Borensztein et al., 1998; Bende et al., 2003). In these studies it is showed that FDI indirectly promotes economic growth via technology diffusion, which enhances the knowledge through skill acquisition and labour training.

Figure No 4 Positive relationship between EI and FDI



Source: Tag, 2007

Some studies have developed the positive relationship between FDI and percapita energy intensity, with increase of foreign assistance in the local industry. There is scale of production with emergence of new production / some extra electronic equipment in production. That will cause an increase total energy demand in production sector and thus will lead to enhance overall energy consumption in the industries; this will technically shift upward pressure on percapita EI (Tag, 2007).

3.1 The Model

Our model for the determination of the impact of FDI on energy saving in South Asian countries is taken from Hubler & Keller (2008), Mielnik & Godemberg (2002), and Yang & Todo (2012). In order to determine the impact of FDI on energy saving, we develop our model as follows.

$$EI_{it} = \beta_1 + \beta_2 FDI_{it} + \beta_3 IM_{it} + \beta_4 AID_{it} + \beta_5 \mathrm{GFCF}_{it} + \beta_6 YPC_{it} + \beta_7 IND_{it} + \mu \ldots\ldots (1)$$

Table No 1 Definition of variables used in the estimation

Variables	Definition	Unit	Data sources
EI	Energy intensity in purchasing power parity (total primary energy supply divided by GDP in PPP)	Btu per US$ per year	IEA
FDI	Net inflows of foreign direct investment, as a share of GDP	in % of GDP	WDI
IM	Imports, as a share of GDP	in % of GDP	WDI
AID	Official Development Assistance and Official Aid inflows, as a share of GDP	in % of GDP	WDI
GFCF	Gross fixed capital formation, as a share of GDP	in % of GDP	WDI
YPC	Per capita income (measured by GDP in PPP)	PPP(constant 2011 international $)	WDI
IND	Share of industrial value added in GDP	in % of GDP	WDI

4. Empirical Procedure

Firstly we set our statistical software (STATA-11) to specify that we are operating with panel data. After having conducted the regression under OLS, we perform regressions for the FEM and REM while saving the results after each test. The Hausman Specification Test (HST) is then carried out so as to decide which model is the most suitable for our study. If the HST shows that the FEM is to be used, we further perform the BP-LM test so as to confirm that FEM is the most suitable model. On the contrary, if FEM comes up, we move forward to conducting robustness with the regression. If that is not the case i.e. REM is significant, we move on to testing serial correlation and heteroscedasticity in the regression for both REM and FEM. The above mentioned econometric steps are carried out for South Asian Countries. Having scrutinized the steps we are going to use for the econometrics framework for South Asia, we proceed to the tests mentioned and interpret the results obtained in the next chapter.

4.1 Results and Discussions

In order to determine which model is more appropriate for our study (FEM or REM), the HST is carried out. To back up our result, i.e. REM is to be used, the BP-LM test is also performed and the results are shown in tables given below. After having the thorough discussion regarding the methods used in the current study we have reached on the following results. This chapter is about the results with incorporating methodology discuss in the 4th chapter which are Ordinary Least Square Model (OLS), Least Square Dummy Variable Model (LSDV), Random and Fixed Effect Models, we followed Akbar et al., (2011) and Rajasekar & Deo (2014) to estimate the comprehensive results of the current panel study. We started with the simple Descriptive Analysis.

Table 2: Descriptive Analysis

Variables	Obs.	Mean	S.D	Min	Max
FDI	168	1.5	6.9	-0.2	14.1
GFCF	168	26.9	10.9	12.5	69.1
IND	168	24.9	7.1	11.3	45.4
IMP	168	37.5	23.2	8.3	112.3
YPC	168	3845.5	2336.8	1238.7	11282.8
AID	168	1.9	2.3	0.02	12.6
EI	168	5224.7	3930.2	1324.3	19566.6

Descriptive analysis of the study shows that there are 168 observations included in the analysis of seven variables, included one dependent and six independent variables. Main (target) variables of the study are Energy Intensity (EI), which is measured in Btu per US$ per year and Foreign Direct Investment (FDI), which is measured in percentage of GDP. Other control measures which qualify the model are Gross Fixed Capital Formation (GFCF), Industrial Value Added (IND), imports (IM), Per capita Income (YPC), Official Development Aid (AID). The mean value of the FDI in last 24 years of South Asia is 1.5 % of GDP; Standard Deviation is 6.9, and over the period minimum value of FDI is -0.2 while Maximum value is 14.1.

EI shows 5224.7 Btu per US$ as a mean valve, its Standard Deviation is 3930.2 Btu from mean. Minimum value of the EI is 1324.3 Btu while its maximum value is 19566.6 Btu. Per capita income of 168 observations of the 7 countries is calculated 3845.5 as mean, with deviation of 2336.8, however maximum value is 11282.8. A large deviation in the values is

because of the diversified sample in which different characterized countries included. We can elaborate the other variables as well.

Table 3: Correlation Matrix

	FDI	GFCF	IND	IM	YPC	AID	EI
FDI	1.0						
GFCF	0.106	1.0					
IND	-0.208	0.553	1.0				
IM	0.694	0.516	-0.150	1.0			
YPC	0.775	0.292	0.056	0.683	1.0		
AID	-0.096	0.510	0.179	0.309	-0.067	1.0	
EI	0.141	0.648	0.526	0.271	0.252	0.486	1.0

The correlation matrix shown in table 5.2 shows a positive relationship between FDI and EI. In line with our expectations, GFCF is also positively related to EI and so are IND, IM, YPC and AID positively correlated to EI. According to the matrix, there is no serious multicollinarity issue in the data.

To check which model is appropriate for our study, we use F-test (efficiency test) for models between OLS and Fixed Effect Model (FEM) / Random Effect Model (REM).

$$F_{Groups\ effect} = \frac{(R^2_{fix} - R^2_{pooled})/(N-1)}{(1-R^2_{LSDV})/(NT-N-K)}$$

$$F = \frac{(0.9308 - 0.5711)/(7-1)}{(1-0.9308)/(168-7-6)}$$

$$F = \frac{0.3597/6}{0.0692/155}$$

$$F = 55.7535/0.4152$$

$$F = 134.2810$$

F-test value is more than 10, which shows that it is highly significant. So we can say that OLS results are not appropriate so we incorporate REM or FEM for appropriate results. However OLS Model is not appropriate for our study but its results can be seen in the Appendices C.

Table 4: Model Selection Tests

Specification Test	P-Value	Tested	Selected Model
F-test	0.000	OLS/FEM	Fixed
Breusch and Pagan	0.000	OLS/REM	Random
Huasman test	0.0005	REM/FEM	Fixed

The important thing of these pooled OLS results is that FDI co-efficient shows positive value and p-value 0.001 which is highly significant. These results are robust in nature because we have used a diversified panel data set. So for further discussion on the analysis we regress Least Square Dummy Variable (LSDV) Model for EI, by incorporating 6 Dummy Variables for each country excluded Pakistan.

Table 5: Fixed Effects Model (LSDV) for Energy Intensity Data

Variable	Co. efficient	Std. Error	t-Statistics	P-Value
Constant	4.670	1.160	4.03	0.000
FDI	-0.139	0.113	-1.23	0.220
IM	0.009	0.020	0.43	0.664
GFCF	-0.165***	0.023	-7.07	0.000
IND	0.055	0.052	1.06	0.290
YPC	0.001***	0.000	3.32	0.001
AID	-0.424***	0.124	-3.42	0.001
Bang (D)	-0.864	0.509	-1.70	0.092
Bhut (D)	14.379	1.469	9.79	0.000
Indi (D)	3.764	0.449	8.38	0.000
Mald (D)	2.600	1.325	1.96	0.052
Nep (D)	-0.136	0.501	-0.27	0.787
S.Lanka (D)	-2.707	0.634	-4.27	0.000
R^2 = 0.93				
F- Test = 147.94				
Prob > F^2 = 0.000				
*** Significant at 1% level, ** Significant at 5% level , *Significant at 10% level				

Table 5.4 showed opposite results from the Pooled OLS particularly in the case of FDI, Where the co-efficient of FDI is negative and insignificant with t- statistic -1.23 and the p-value is 0.220 which showed negative relation between EI and FDI, it means FDI does not effects the EI which justify the study of Hubler and Keller (2008). 1% change of FDI to GDP decrease EI by 1390 Btu, t-statistics and p-value shows that there is negative insignificant week relationship between FDI and EI. Other measures included in our model as control variables; IND and IM shows insignificant in changing to EI in South Asia, however YPC become significant. GFCF and AID both are significant but are negative, t-value of GFCF is 7.07 and p-value 0.000 and AID t-statistics is 3.42 significant at 1% level of significant. This change with comparison to OLS Model is may be because of incorporating Dummies in the regression. As we can see in the case of Nepal, Sri Lanka, and Bangladesh there are negative signs with comparison to Pakistan , while of India, Maldives, Bhutan are positive when compare to Pakistan.

Table 6: Corresponding Cross-Section/ Country Value (Fixed Effect)

Intercept	Country	Value
1	**Pakistan**	4.669645
2	**Bangladesh**	5.533949
3	**Bhutan**	-9.709445
4	**India**	0.905571
5	**Maldives**	2.070089
6	**Nepal**	4.8052406
7	**Sri Lanka**	7.377141

Intercepts for different countries used in the panel data are shown in the table 5.5 it is clear from them that Pakistan intercept value is 4.669645 which is less than the intercept values of Bangladesh, Sri Lanka and Nepal. However Maldives and India's intercept values are less than Pakistan. So we can say that Energy Intensity is high in Sri Lanka, Bangladesh, Pakistan and Nepal respectively.

Table 7: Breusch and Pagan Lagrangian Multiplier Test for Random Effect

	Var	Sd = sqrt (var)
EI	15.446	3.930
E	1.255	1.120
μ	0	0
Chi^2 (1) = 430.85 Prob > Chi^2 = 0.000		

To test the hypothesis for RE in the model, the value of chi^2 is 430.85 and probability is 0.000 which reject H_0 and Accept the H_1. It means RE is not perfect in our analysis so we follow the FE Model which is good for our analysis. And the results of FEM already discussed in table 5.5 which clear define that there is no effects of FDI on EI which are similar to Hubler & Keller (2008).

Table 8: Hausman Test

Variable	Coefficients		Difference
	Fixed Effect(b)	Random Effect(B)	(b-B)
FDI	-0.069	0.552	-0.620
GFCF	-0.167	0.160	0.327
AID	0.089	0.125	-0.035
IM	0.005	-0.057	0.062
AID	-0.312	0.630	-0.942
YPC	0.000	0.000	0.000
Chi^2 (6) = 24.15 Prob>chi^2 = 0.0005			

There is a test which can help to choose REM or FEM developed by Hausman in 1978. The Hausman test clearly rejects the null hypothesis for estimated chi^2 value. The probability of chi^2 is 0.005 which is < 0.05 as a result we can reject REM (ECM) in favor of FEM. This table also shows the difference between RE and FE.

The study's findings about the hypothesis which is empirically examined in penal of 7 South Asian countries shown very similar results with the previously conducted studies. However, we cannot neglect the importance of FDI in transferring the efficient technology from developed nations to South Asian countries where energy situation is quit alarming. There is dire need to enhance efficiency in the energy appliances to reduce the energy intensity. So that the rising demand of energy can be tackled through the transfer of efficient energy appliances from the developed regions to south Asian economies.

5. Conclusion

This study investigates the impact of Foreign Direct Investment on Energy Saving of Seven South Asian Countries for the period 1990-2013 by using the Pooled OLS, Random Effect (RE) and Fixed Effect (FE) Models. The literature has identified different determinants of energy saving including imports, official development aid, industrial value added, per capita income, fixed capital formation and FDI. Recent literature has identified that FDI is an important macroeconomics indicator which has impact on the energy intensity, which leads to energy saving (Mielnik & Goldemberg, 2000; Eskeland & Harrison, 2003; Fisher-Vanden et al., 2004; and Blackman & Wu, 1998). We conclude that, although energy saving

technology transfer to South Asian countries through FDI probably takes place, we find FDI is insignificant in energy saving and empirically there is no general or uniform influence of FDI on EI. We suppose that the effects of FDI inflows on energy use depend on country-specific characteristics in a way that certain characteristics and policies enhance energy reductions from FDI.

Our regressions with interaction terms aim at identifying such influences, but do not yield significant results. Moreover, we acknowledge that FDI flows do not represent a homogenous category but rather very different kinds of investment. While some FDI might reduce energy intensity via technology transfer, other FDI might induce a shift towards more energy intensive production via a change in the sectoral composition of production. The significance of the results thus possibly suffers from the fact that we cannot disentangle technology transfer and the composition effect. Our results imply that policies aiming at reducing energy intensities in South Asian countries should take country-specific characteristics into account, when actively supporting FDI inflows, and that a "one-size-fits-all" policy approach can be rather ill-designed. For example, further research can attempt to reveal the influence of the sectoral structure of the host country on international technology transfer. Furthermore, it is sensible to make use of issue-linkage, as for instance intended by the clean development mechanism of the Kyoto Protocol, to explicitly encourage foreign direct investment that brings along energy reducing technology transfer.

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