EUROPEAN ACADEMIC RESEARCH
Vol. V, Issue 2/ May 2017

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

The effects of FDI, CO_2 emissions, and Inflation on Economic Growth: Evidence from Pakistan

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Abstract:

In this article, an attempt has been made to analyze the relation and the effect of foreign direct investment together with CO_2 emission and inflation on economic growth of Pakistan for the period 1971-2015. Since it's desirable to test the impact of foreign direct investment inflow using the recent facts and figure, the study uses GDP as dependent variable while foreign direct investment, CO_2, and inflation are used as independent variables. The study adopts ARDL to Cointegration methods for the empirical analysis. The empirical estimations shows that foreign direct investment has positive and significant association with economic growth which implies that foreign direct investment boost economic growth both in short and long run. The CO_2 emissions have negative and significant relation with economic growth in long run but hold insignificant in short run. Increase in inflation hinders the economic growth in long run because of the negative relation between GDP and inflation. These empirical insights provide policymakers with important policy recommendations.

Key words: CO_2 emission, Foreign direct investment, Economic Growth, Inflation.

1. INTRODUCTION

In the past few decades, economic growth and its elements have been a major focus of economists, especially for the developing economies. Investment act as a force for economic growth and is the engine for any economy, and it can be either domestic savings or through FDI (foreign direct investment). FDI provides direct capital financing that produce positive externalities, subsequently stimulate economic growth via transfer of technology, spillover effects, institution of new methods and procedures, and improved managerial skills (J. W. Lee, 2013). Indeed FDI adds to the host country in three ways, (1) FDI stimulate therefore economic growth process in the host country (Alfaro et al., 2010), (II) FDI is the source of external financing (Bustos, 2007) and (III) FDI shortens the link between domestic savings and target investments (Ndikumana & Verick, 2007). The effect of FDI on economic growth of host country is dependent of number of factors such as economic stability, investment and taxation policy, technological advancement of host country, human capital, trade openness, etc. (Pegkas, 2015). FDI helps in market development of host economy which further enhances the employment opportunities for skilled as well as non-skilled labor. More specifically, FDI inclines to be focused on those sectors and infrastructure that enjoy and have space for further comparative advantage. Normally FDI benefits the economic growth of the host country; it increase total level of investment by mobilizing the higher level of domestic investment, and by the combination of advanced technology together with the host's country human capital, FDI can be more efficient and productive as compared to domestic investment (Lim, 2001).

It is a confirmed fact that FDI do contribute and promote economic growth but it also has its environmental cost as well. The development and expansion of the industrial increase the demand of energy which is the major cause of CO_2 (Carbon dioxide) emissions (Shahbaz et al., 2015). Because developing economies have relaxed policies concerning environmental issues, multinational corporations are encouraged to make investments in such countries to increase their production along with the other benefits. Both environmental relaxation and reduced production cost are main reasons behind environmental deprivation in host country. There are different hypotheses regarding the effects of energy consumption in the form of CO_2 emissions. According to pollution haven hypothesis, developing countries undergo environmental deterioration because of weaken environmental protection laws as more of multinational corporations are attracted towards the benefits associated with these developing countries (Cole & Elliott, 2003). On the other hand, some economist argue that FDI gives advanced and efficient systems and coordinate through better management system that provide improved environment quality in host economy (pollution halo hypothesis). For developing countries to sustain economic growth, FDI encourage industrialization which in turn may promote emission of CO_2 at large (Pao & Tsai, 2011). Conclusively, it can be argued that CO_2 emissions can have significant relation with economic growth of the country because of the energy consumption associated with the industrialization process especially for the developing economies but also has its cost.

The key goals for macroeconomic policy of any country are to sustain high level of growth rate and low inflation rate. Price stability is the main component in determining the growth rate of the country. Both higher and very low inflation rate have bad consequences for the economy. For example, (Aiyagari, 1997) propose that cost of lowering the inflation rate below certain level i.e. towards zero, is more than the benefits.

Both growth and inflation are highly influential in determining the economic stability and in achieving the present and future targets for the country. In the recent few decades, number of studies has investigated the relation between inflation and economic growth. The results of these researches and empirical evidence have also been mixed. Vinayagathasan (2013) categorized the inflation/growth trade-off in four different ways. The first view proposed no effect of inflation on growth rate (Cameron et al., 1996). The second view proposed that inflation has negative effect on growth rate (Saaed, 2008). The third view support that there exist a positive relation between inflation and economic growth (Mallik & Chowdhury, 2001). Also, (Feldstein, 1996) proposed, "shifting the equilibrium rate of inflation from two percent to zero would cause a perpetual welfare gain equal to about one percent of gross domestic product (GDP) a year." These days, most of the studies proposed negative effect of inflation on economic growth in the long run (Aydın et al., 2016), however, what's the optimal level, if or not there is any threshold particular to each economy group, and how long it takes to achieve stable growth after the general level prices is reduced to desired level is always the question for economists.

Among the various sector of economies, industrial sector in Pakistan serves as a main contributor to the economy i.e. about 25% of GDP (GOP, 2014). Rising industries requires increased mobilization of both domestic and foreigner resources, being the most important determinant of progress in industrial sector (A. H. Khan & Kim, 1999), so Pakistan is taking initiative towards sound macroeconomic policies to build trust and catch the attention of foreigner investors. An increasing trend has been growing to find out the nexus between economic growth, FDI, CO_2 emission, etc. but the empirical evidences are ambiguous with controversial results. Less developed economies often face the problem of macroeconomic stability and dependent upon international agencies and organizations

to stabilize their economies, so inflation has to do a lot with the economic growth of the country. Like other developing economies, very little is known about the contribution of these factors to the economic growth which provides the motivation to identify the relation of these factors to the growth trade-off. The purpose of the study is to investigate the relation and effect of FDI, CO_2 emission and inflation towards economic growth of Pakistan. The rest of the study is organized as follow. Section 2 provides the brief review about literature. Section 3 is about data selection and methodology. Section 4 covers empirical results and analysis, and Section 5 concludes the study.

2. LITERATURE REVIEW

To sustain economic growth, most of the developing countries consciously devalue the environmental standards to attract the foreign investment. For this reasons, foreigners' investor shift their operations to less developed economies and to get other advantages associated with these economies. Majority of the studies, both on developed and developing economies indicated the positive effect of FDI towards economic growth, which is dependent on number of factors such as human capital, infrastructure, technology, environmental issues, trade openness, etc. Blomstrom et al. (1992) perform the analysis on both developed (23 countries) and developing (78 countries) and found that FDI has significant positive influence on economic growth. Borensztein et al. (1998) show that FDI is an important mean in transferring advanced technology and contribute towards economic growth and its impact is greater in host countries with the higher level of human capital. Campos and Kinoshita (2002) examine the effect of FDI on economic growth of Central and Eastern European and Soviet Union transition economies and provide evidence that FDI has significant positive effect on economic growth of every selected economy.

Pegkas (2015) perform the analyses on Eurozone countries to study the relation and effect of FDI on economic growth for the year 2002-12. Their empirical result indicated the positive long-run cointegration between FDI stocks and economic growth and also the stock of FDI is a significant factor that positively affects the economic growth of Eurozone countries. Kivyiro and Arminen (2014) find that for Sub-Sahara African countries, CO_2 emissions, economic development, FDI, and energy consumption move in the same direction in long run. Omri et al. (2014) show bi-directional causality between economic growth and FDI flows and CO_2 emission and FDI. The results for all the studies are not same as some researchers provide different relation between economic growth, FDI and CO_2 emission, for example (Al-mulali & Tang, 2013; Chandran & Tang, 2013) studies on ASEAN nations and Gulf Cooperating Council provide evidence that economic growth and energy usage are the source of CO_2 emissions, but FDI doesn't have any role in CO_2 emissions. Cole et al. (2011) find U-shaped relation between per capita industrial emission and income in China, where economic growth also lead to increase in pollution.

Zhu et al. (2016) investigated the relation of FDI, economic growth, and energy consumption on CO_2 emissions on ASEAN nations and found heterogeneous effect of the above variables on CO_2 emissions across quantiles with higher level of trade openness can condense the increase in CO_2 emission particularly in high and low emission nations. Omri et al. (2014) investigate the causality relation between FDI, CO_2 emissions and economic growth for 54 countries for the year 1990-2011 and give the empirical evidence of "bidirectional causality between FDI inflows and economic growth for all the panels and between FDI and CO_2 for all the panels, except Europe and North Asia." For Pakistan, (Bakhsh et al., 2017) made an attempt to find the effect of FDI on industrial pollution and economic growth for the period 1980-2014 and found that increase in economic growth leads toward increase

in industrial pollution and economic growth drops as industrial pollution crosses a certain level. Similarly, FDI is also found to be positively related with CO_2 emissions.

Though a lot of studies have examined the relationship between economic growth and inflation, no specific trend is found to be associated between the inflation and economic growth. Most of the latest research show inflation as constraint to economic development and have negative impact on economic growth. Normally inflation helps economic growth when it's below a certain threshold level but has negative effect when inflation is above that threshold value. Sarel (1996) proposes the existence of point of level which is almost 8%. Ghosh and Phillips (1998) demonstrate a considerably lower inflation threshold level i.e. 2.5% a year. M. S. Khan and Ssnhadji (2001) determined the different threshold level for industrialized (1-3%) and developing (11-12%) countries and revealed that inflation hinders economic growth considerably beyond this level. For Asian economies, (Vinayagathasan, 2013) find inflation negatively affect growth when it exceed 5.43% but don't have effect below this level.

C. G. Lee (2009) examines the relation between economic growth, FDI, and industrial pollution and found that variables are interrelated in long run in case of Malaysia. The effect of FDI inflows and CO_2 emissions on the host economy have always been an issue because of the controversial results, and also there is also little know about Pakistan's economy. In addition to above independent variables (FDI and CO_2 emissions), inflation has been added to study the relation and effect on economic growth both for short and long run.

3. DATA AND METHODOLOGY

The study covers the period from 1971-2015 for Pakistan. Three independent variables i.e. FDI, CO_2 emissions and inflation are used to study the relation and effects on economic growth. The

data is collected from World Development Indicators. Table I provides information about variables description.

Table 1 Variable definitions

Variable	Definition	Source
CO_2	Carbon dioxide emissions (metric tons per capita)	WDI (2015)
FDI	Foreign direct investment, net inflows (% of GDP)	WDI (2015)
GDP	Real Gross domestic product per Capita	WDI (2015)
INF	Average percentage change of CPI for the year	WDI (2015)

Notes: All of the data are annual over the period 1971-2015.

Following (Halicioglu, 2009) Autoregressive distributed lag approach (ARDL) is used to study the long run and short run relationship between economic growth (dependent variable) and FDI, CO_2 emission and inflation (independent variables). The regression equation is given as follows

$$\mathrm{GDP}_{t-1} = \beta_0 + \beta 1\mathrm{GDP}_{t-1} + \beta 2\,\Delta\mathrm{FDI}_{t-1} + \beta 3\,\ln\mathrm{CO2}_{t-1} + \beta 3\,\mathrm{INF}_{t-1} + \varepsilon_t$$

Here GDP is the real GDP, Δ is the first difference operator, FDI is the foreign direct investment, $\ln CO_2$ is the log of Carbon dioxide emissions, INF is the inflation rate and ε_t is the error term. FDI directly affects the economic growth and is expected to have positive relation with the economic growth. CO_2 emission is expected to have negative sign because of its damaging effect. Inflation is also expected to have negative relation as the inflation rate above the threshold level hinders the economic growth.

4. EMPIRICAL RESULTS AND ANALYSIS

Table II Augmented Dickey-Fuller and Phillip-Perron unit root test results

	ADF		**Phillips-Perron**	
Level				
Variable	**Intercept**	**Trend & Intercept**	**Intercept**	**Intercept & Trend**
GDP	0.000***	0.000***	0.000***	0.000***
FDI	0.08*	0.001***	0.341	0.689
CO_2	0.90	0.01**	0.898	0.232
INF	0.026**	0.07*	0.016**	0.053*
First Difference				
GDP	0.000***	0.000***	0.000***	0.000***
FDI	0.000***	0.001***	0.001***	0.007***
CO_2	0.000***	0.000***	0.000***	0.000***
INF	0.000***	0.000***	0.000***	0.000***

$p<0.01$***, $p<0.05$**, $p<0.1$*

Table II displays the results of the stationary test for Augmented Dickey-Fuller test (ADF) and Phillip-Perron (PP) for the case of Pakistan. Both tests i.e. ADF and Phillips-Perron show that GDP is significant at level. All the other variables are found to be significant at first difference, therefore, reveals that the variables are I (1). As the results figure out that the variables are either I(0) or I(1), thus suggesting that we can assuredly apply the ARDL approach to above model as using ARDL requires the data to be stationary at the level I(0) and first difference I(1) and is according to the definitions from (Narayan, 2005).

Table III ARDL Bounds Test for Co-integration

Lag Structure					1,1,0,2	
F-Statistics	**1 % Critical value**		**5 % Critical value**		**10% Critical value**	
11.91753	1 (0)	1 (1)	1 (0)	1 (1)	1 (0)	1 (1)
K=3, N=43	4.29	5.61	3.23	5.35	2.72	3.77

Table III displays the co-integration test analysis, and the existence of a long-run relationship has been established among

the models variables. Results demonstrate that the computed F-statistics are 3.77. The relevant critical value bounds at ten percent level (with unrestricted intercept and no trend) are 5.61 and for the lower and upper bounds respectively. Subsequently, the computed F-statistics is higher than the critical value of the upper bound, which implies that there exist a long run co-integration relationship between dependent and independent variables.

Lag selection criteria AIC

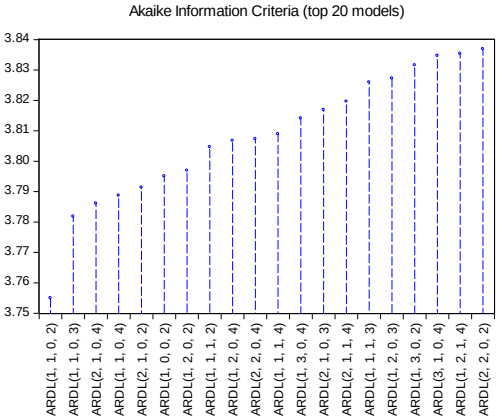

Figure I Akaike Information Criteria

The table IV shows the coefficients values for the long run estimations; the table indicated that D(FDI) is significant and positive relationship at 5 percent level and it indicates that one percent increase in FDI increases GDP by 1.12 percent. This implies that FDI boost up economic growth in long run. The LN(CO_2) has negative and significant association with GDP at 10 percent level and once percent increase in LN(CO_2) reduces GDP by 1.20 percent, which means that increase in environmental pollution reduces GDP in long run. Inflation also affects significantly and has negative association with economic growth in long run at 5 percent level, one percent increase in inflation reduces GDP by 0.14 percent. All the diagnostics tests

show that our data is free from normality, Heteroskedasticity and Serial Correlation problems. Moreover, CUSUM and CUSUMQ tests are also stable which reveals that model is stable for long run.

Table IV Estimation results for long run relation

Lag structure		1,1,0,2
Dependent variable Gross: Domestic Product (GDP)		
Regressors	Coefficient	T-Ratio (Prob)
Constant	2.715	4.341(0.000)
D(FDI)	1.125	2.046(0.048)
LN(CO_2)	-1.200	-1.727(0.0929)
INF	-0.142	-2.298(0.0276)
Diagnostic Test		
T-statistics	LM version	F version
Jarque-Bera(normality)	1.223(0.542)	Not Applicable
LM test (1) correlation	2.624(0.269)	1.072(0.353)
Heteroskedasticity Test	8.079(0.325)	1.156(0.351)
CUSUM test	Stable	Stable
CUSUMQ test	Stable	Stable

The Table V shows the short-run association between GDP and other explanatory variables; The D(LNCO_2) hold positive but insignificant association with economic growth. D(FDI) has positive and significant relation with GDP at 10 percent level, and one percent increase in D(FDI) increases GDP by 1.2 percent. Inflation has negative but insignificant association with GDP. However the lag value of inflation, D(INF-1) indicated the lag value of inflation for economic growth and each previous value reduces GDP by 0.14 percent. The error correction term which indicates short run dynamics, the coefficient value is -1.09 and significant which implies the model will converge to the equilibrium by -1.097 percent each and thus model holds the convergence property.

Table V Estimation results for short-run relation

Lag Structure		
Dependent Variable: Gross Domestic Product (GDP)		
Regressors	Coefficient	T-Ratio (Prob)
D($LNCO_2$)	8.536	1.119(0.270)
D(FDI, 2)	1.235	1.912(0.0640)
D(INF)	-0.070	-1.17(0.247)
D(INF-1)	0.147	2.378(0.023)
CointEq(-1)	-1.097	-7.682(0.000)
Cointeq = GDP - (-1.2006*LNCO2 + 1.1251*D(FDI) -0.1421*INF + 2.7155)		

Given below, figures 2 and 3 show the CUSUM and CUSUM of Squares respectively. Both the figures show that our model is stable at 5 % significant level.

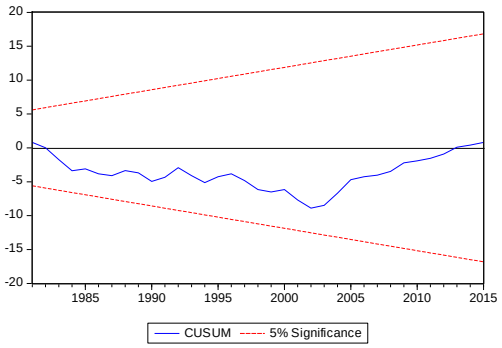

Figure 2 CUSUM Test

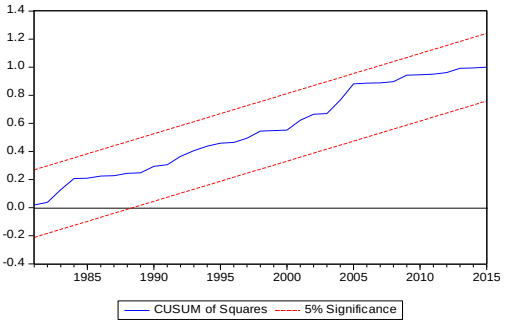

Figure 3 CUSUM of Squares

5. CONCLUSION

The purpose of this paper is to two fold, to analyze the effects and relation of FDI together with CO_2 emissions and inflation on the economic growth of Pakistan as measured by GDP for the period 1971-2015. Since FDI plays important role in boosting up economic growth and massive literature has already discussed this issue, however it desirable to test the impact of FDI inflow on GDP in case of Pakistan using the current and recent figures and data. Since massive declination has been witnessed after 2008 and massive energy shortage that leads to low level of FDI inflow in Pakistan. Therefore this model is particularly focus FDI and economic growth using the recent data.

The study uses data for the period 1971-2015, the data for the relevant variables are obtained from the World Bank Indicators. The model contains GDP as dependent variable Foreign Direct Investment (FDI), Carbon dioxide (CO_2) emissions and inflation as explanatory variables. We applied ARDL to cointegration for the data analysis; the results shows a significant association between GDP and FDI (Campos & Kinoshita, 2002), and that FDI boost up GDP in long run but short run FDI doesn't have any relation. This indicates due to adjustment process, FDI take long time to contribute to economic growth in Pakistan. While Inflation holds long run and negative association this indicates that inflation impede economic growth in long run (Vinayagathasan, 2013). The environmental pollution is shown through CO_2, and it shows that in long run CO_2 holds negative relationship with economic growth, which reveals that environmental pollution hinders economic growth and is in according with (Bakhsh et al., 2017), for Pakistan Environmental pollution causes a decline in economic growth for long-run.

Since FDI is positively affecting economic growth in long run, there is need of proper policy implementation to increase

the FDI in the country; First government needs to cover the energy shortage in the country that will attract more FDI in the country. There is also need to improve the law and order situation as poor peace conditions negatively affects the investment opportunities. Inflation is also a major economic issue of Pakistan; there might be several reasons for the inflation both monetary and non-monetary. Therefore first need to determine the roots of inflation; if monetary factors are the responsible for higher prices in economy government should control money supply in the economy; in case if the inflation are due to non-factors then government should be control non-monetary factors. Since environmental degradation is the hurdle in the way of long-run economic growth, therefore actions are needed to keep the pollution below certain level. Also, proper legislation is required to control the level of CO_2 emissions.

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