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Direct impact of inflow of foreign direct investment on poverty reduction in Pakistan: a bonds testing approach

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ABSTRACT

This empirical study examines the relationship between foreign direct investment (FDI) and poverty reduction using some control variables in the context of Pakistan. The time-series data has been used to cover the period 1985–2016. The study found robust results of co-integration between FDI and poverty reduction in the long-run analysis. Moreover, to find the correlation between FDI and poverty reduction, this study used autoregressive distributed lag (ARDL) technique to check the co-integration between FDI and poverty. The short-run and long-run analysis results indicate that FDI, the mobile phone users (per 100 inhabitants), life expectancy, and government expenditure contributes to poverty reduction. The results of variance decomposition method showed that bidirectional causality found between FDI and poverty reduction or both are Granger cause of each other. The ratio of inflow of FDI is not too high in Pakistan, so government with scared financial resources should improve the policies regarding FDI inflow. This analysis suggests policymakers divert their attention towards the betterment of institutions, establish FDI attractive inflow trading zones like other emerging economies.

1. Introduction

Various prior studies have been discussed the indirect relationship between inward foreign direct investment (FDI) and poverty reduction because of the requirement to identify a poverty solution. Much theoretical debate has been done on the positive impact of FDI and poverty reduction, but some of the controversies found in the results of empirical analysis about the benefit of FDI and poverty reduction. The indirect relationship between FDI and poverty through the channel of economic growth has been examined by (Almfraji, Almsafir, & Yao, 2014; Dollar, Kleineberg, & Kraay, 2013; Hsiao & Hsiao, 2006). The results regarding nexus between FDI and poverty reduction are far from being consistent in these empirical studies. However,

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some empirical studies focused on growth as a critical source of poverty reduction and assume that it is beneficial to poverty reduction (Sumner, 2005, p. 275). Whereas the theoretical analysis could not found the exact relationship between FDI and poverty reduction, the results of various prior literature remain inconclusive. The literature of Jalilian and Weiss (2002), Zaman, Khan, and Ahmad (2012a), Gohou and Soumare (2012), Fowowe and Shuaibu (2014) and Shamim, Azeem, and Naqvi (2014) found a positive impact of FDI on poverty reduction. The Huang, Teng, and Tsai (2010); Ali, Nishat, and Anwar (2010) explored the negative influence of FDI on poverty reduction. Finally, the insignificant results regarding FDI and poverty reduction found by these studies such as Tsai and Huang (2007) and Akinmulegun (2012).

Economic growth and poverty reduction is highly associated with the inflow of FDI and is taken as a measure for the "oxygen" for all economies. Without this FDI induced policies, poverty cannot be minimized. The pace of globalization not only increases the level of economic growth and competition between the various economies but has also recently created an awareness of sustainable growth. In the 21st century, due to increasing competition and advanced information systems, all economies have become socially, economically, culturally and politically connected to each other. Billions of inhabitants in developing countries (especially Asian countries) are living in poverty. Rapid economic growth, including industrialization and production expansion, is required to lift these inhabitants out of poverty. Notably, more considerable government efforts can reduce poverty and can produce sustainable economic growth in developing countries. Various Asian transitional economies are currently expanding their production through the inflow of FDI and trade liberalization to achieve economic growth and to lift millions of people out of poverty.

In addition, the hunger and poverty alleviation goal of Millennium Development Goal (2015) has been succeeded at the global level, but various developing countries are still facing the problem of poverty (United Nations, 2015). In addition, to overcome the poverty issue, the United Nations (UN) assigned "Millennium development goals" (MDG). Financial constraints are the main cause of poverty in developing countries, so these countries need a foreign financial assistant in terms of FDI. However, some questions highlight policymakers on the empirical results of FDI and poverty nexus from liberal economic policies that encourage the inflow of FDI. Furthermore, less attention has been done on a simple, direct relationship between FDI and poverty reduction in the empirical literature.

The examination of FDI-poverty nexus is imperative for Pakistan, who have faced the problem of poverty and financial deficiency. The economy of Pakistan is facing many challenges, whereas poverty is one of them. So, there is a need for substantial foreign investment to overcome this poverty issue. To identify the long run and short run nexus between FDI and poverty reduction, whether FDI helpful in poverty reduction, what policies should be adopted by the government are the key objectives of this study.

Figure 1 illustrates the FDI inflow trend in different years in the context of Pakistan, the highest increasing trend shown in the year 2008. After 2008 the inflow of FDI is shown a decreasing trend. Slightly rise is shown in the year 2016 after decreasing trend of FDI inflow.
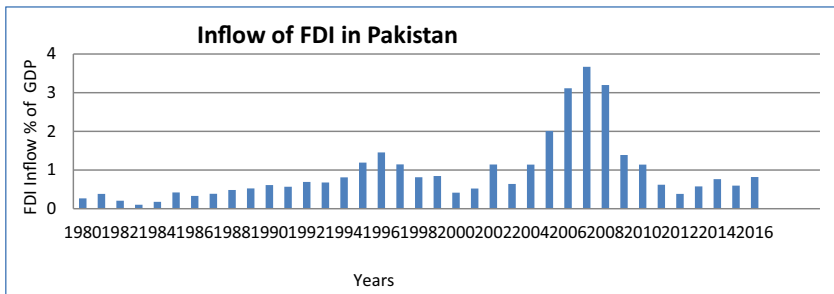
Figure 1. The trend of FDI inflows (% GDP) in Pakistan: 1980–2016.
Source: The Government of Pakistan (2017).

Moreover, significant interest has been shown by various policymakers and researchers in foreign direct investment to reduce poverty, for developing economies like Pakistan with scarce capital needs international financial assistance to overcome the problem of poverty. The economy of Pakistan is facing political instability, the war against terrorism, massive debt (internal and external) and low growth to be a significant hurdle in the way of FDI inflows. Despite all these challenges, this study tries to provide some suggestion to policymakers how to increase FDI and its direct impact on poverty reduction in the short run and long run time horizons. The trends of poverty in Pakistan are shown in the following Table 1.

Table 1 reports the trends of poverty in Pakistan; decreasing trend can be shown in different periods. The rate of poverty is higher in rural zones as compared to urban zones, but overall poverty is declining over the period. So there is a need to increase the inflow of FDI toward poverty reduction.

This study presents an extensive detail of literature review including, theoretical and empirical perspectives of foreign direct investment (FDI) and poverty reduction. Prior literature reveals that Few empirical studies have established that FDI helps to reduce poverty, on the other hand, some studies have established that FDI has an unpleasant effect on poverty reduction, while rest of the studies have established an insignificant impact of FDI on poverty reduction. Though the finding of prior studies on FDI and poverty reduction varied for different countries due to study time-period consideration, methodology and proxy of poverty employed. Finally, following the global agenda for reducing poverty, this study investigated the FDI and poverty relationship to provide suggestions for further policymaking.

This study seeks to fill the gaps in previous literature and overcome the FDI-Poverty reduction relationship, Therefore; it is opposite to the background that our study tries to investigate the impact of FDI on poverty reduction in the context to Pakistan. Our study contributing to prior literature by employing the latest developed model like Autoregressive Distributed Lag (ARDL), whereas, our findings of short-run and long-run analysis found that FDI, life expectancy, government expenditure and Cell phone user (100 per occupants) added to poverty reduction. Due to the beneficial properties of time series data over the other data techniques, first, we used the ARDL approach with it is in small samples for robustness. Then secondly, our study highlights on Pakistan by implementing the time series data. Overall, our study

Table 1. Trends of poverty in Pakistan (based on the poverty line).

Statistical years	Headcount ratio of poverty			Poverty gap ratio (%)			An extreme level of poverty (%)		
	Urban zones	Rural zones	Overall (%)	Urban zones	Rural zones	Overall (%)	Urban zones	Rural zones	Overall (%)
1992–93	20.0	27.6	25.5	3.4	4.6	4.3	0.9	1.2	1.1
1993–94	15.9	33.5	28.2	2.7	6.3	5.2	0.7	1.8	1.4
1996–97	15.8	30.2	25.8	2.4	5.3	4.4	0.6	1.4	1.1
1998–99	20.9	34.7	30.6	4.3	7.6	6.4	1.3	2.4	2.0
2001–02	22.7	39.3	34.5	4.6	8	7	1.4	2.4	2.1
2004–05	14.9	28.1	23.9	2.9	5.6	4.8	0.8	1.8	1.5
2005–06	13.1	27.0	22.3	2.1	5.0	4.0	0.5	1.4	1.1
2007–08	10.0	20.6	17.2	–	–	–	–	–	–
2010–11	7.1	15.1	12.4						

Source: The Government of Pakistan (2014).

is unlikely the prior studies that trust in the cross-sectional data, which is inadequate to detain the heterogeneity issue across economies (see Odhiambo, 2009). Third, our study examined the nature of the relationship between FDI and poverty reduction in Pakistan through 1985–2016, which advanced the robustness of our findings.

The section 2 is related to the theoretical and empirical literature review. Section 3 is devoted to the data description and methodology. Section 4 based on results and discussion and finally, Section 5 concludes the results and suggests policy perspective.

2. Theoretical arguments on FDI and poverty reduction

The evolution of FDI can be characterised by its two main trends. The first is started from the end of World War II and late 1990s (end of the cold war). Developed countries divert their attention to the developing countries and direction of FDI moving towards these economies on the political bases rather than by socioeconomic motives. Secondly, the inflows of FDI divert in those countries where they subsidised foreign investors and provide them with monetary benefits and incentives. The welfare of the economy and poverty reduction is the main goals of developing economies. To overcome these social issues, there is a need for the financial matter regarding FDI to solve these issues in terms of job creation, local skill development and technological progress and adoption of the latest technology.

Human development is the main contributor of the human capital, so FDI is most important to identify the nexus between FDI and welfare of the society in terms of human development. The level of poverty incidence can be reduced through direct or indirect influence of inflow from FDI on the economy. A direct effect of FDI on the society is related to spillover effects (backward and forward linkages) to the private sector. Positive (vertical) spillovers effects are beneficial for the economy because local investors can take benefits from these foreign firms (forward linkages). The positive impact of horizontal spillovers of FDI is creating by competency among local and foreign firms and due to these competitive environments, new technologies to be implemented by local firms. These positive impacts on local firms due to FDI inflow create more jobs for local workers, if the flow of FDI on the pro-poor sector (agriculture), thus betterment of this sector has the valuable impact on poverty and welfare. However, if the FDI is the only resource of endowment and using these raw materials

from outside the host country, then it cannot improve welfare. Thus those countries cannot be achieved benefit from FDI in the scope of positive spillovers effects.

2.1. Empirical literature review

The extensive attention has been given to the indirect impact of FDI on poverty alleviation in the empirical analysis, but inconclusive results found in this literature. The Warr (2000), Hsiao and Hsiao (2006), Dollar et al. (2013) and Feeny, Iamsiraroj, and McGillivray (2014) explored the nexus FDI and poverty through economic growth channel, whereas, limited research has been done on the direct relationship between FDI and poverty reduction. Moreover, several past studies revealed a strong and positive impact of FDI on poverty reduction, but few studies such as Huang et al. (2010) and Ali et al. (2010) found that FDI influences inversely on poverty reduction. These studies concluded that FDI increasing poverty in these countries and these results are contractions to theoretical hypotheses. Tsai and Huang (2007) and Akinmulegun (2012), examined the insignificant impact of FDI on poverty reduction.

Ganic (2019) investigate the validity of nexus between FDI and poverty reduction in twelve European countries through 2000–2015. The study divides European countries into two regions based on transition and post-transition, i.e. (the Western Balkan region and the Central Europe region). The study concludes that nexus between FDI and poverty reduction changes in both regions. However, in the Western Balkan region, the FDI and poverty reduction relationship has a positive effect, while in the Central European region, it has an insignificant and negative effect. Furthermore, the results validate a few prior assumptions that FDI has substantial impacts on poverty reduction in emerging countries such as the Western Balkan region as compared to wealthier countries like the central European region.

Magombeyi and Odhiambo (2017) present a comprehensive survey of the literature on the impact of FDI and poverty reduction. The study outlines the empirical and theoretical relationship between FDI and poverty reduction. The study separated from prior studies as it emphasises on the direct impact of FDI on poverty reduction as well as it provides a comprehensive review of nature between both variables relationship.

Staníčková (2017) examine the social development convergence and divergence trends among the EU member states in the background of the Europe 2020 strategy. The study draws attention to the issue of income disparities, labour market and poverty reduction. The study also discusses the current changes in social inequalities that have been related to the business cycles, notably with the ease of accessibility of the labour market and evidently with income disparity. The study of Pernica (2017) evaluated the relationship between the minimum wage rate and poverty and found that the low wage rate is the main cause of poverty in the Czech Republic.

Prior empirical studies show that limited research work has been done in context to direct impact of FDI on poverty reduction, and findings are also inconsistent. According to prior literature, three findings from past studies can be obtained

regarding the direct impact of FDI on poverty reduction, first portion of studies conclude that FDI has a positive impact on poverty reduction (e.g. Fowowe & Shuaibu, 2014; Gohou & Soumare, 2012; Israel, 2014; Shamim et al., 2014; Ucal, 2014; Soumare, 2015). Similarly, few studies conclude that there is a negative impact of FDI on poverty reduction (e.g. Ali et al., 2010; Huang et al., 2010). The findings of these studies present in Table 2 that inflows of FDI lead to a rise in the level of poverty, opposite to theoretical predictions (Table 2). However, the third studies reveal that FDI has an insignificant impact on poverty reduction (e.g. Akinmulegun, 2012; Gohou & Soumare, 2012; Tsai & Huang, 2007).

3. Theoretical framework and the empirical model

The theoretical guidance has been providing by the arguments as mentioned above that the relationship between FDI and poverty reduction with some controlled variables. Since the studies of Fowowe and Shuaibu (2014), Fowowe and Abidoye (2013) and Gohou and Soumare (2012) have explored the connection between FDI and poverty reduction. Our study based on Pakistan economy and differs from the prior studies, which are based on poverty measure using the poverty line decided by 2350 calories. Due to data constraint, the people living below the poverty line by the World Bank cannot be used. The general form of model specification is mentioned below,

$$\text{Poverty} = \alpha + \beta \times \text{FDIN} + \sum \tau_{1i} \times \text{ other control variables}_i \tag{1}$$

Although the indirect interrelationship between FDI and poverty reduction is widely discussed in prior literature, various important macroeconomic variables must be incorporated into this analysis to facilitate sustainable policy formulations regarding the direct FDI and poverty reduction nexus across the world.

$$\ln\text{PVE}_t = \alpha \ln\text{FDN}_t + \ln\text{CELPN}_t + \ln\text{LIFEX}_t + \ln\text{CNG}_t + \varepsilon_t \tag{2}$$

3.1. Data and methodology

This study has examined the causal relationship between FDI and poverty reduction in Pakistan from 1985 to 2016. The net inflow of FDI and poverty as the main variables to detect the impact of FDI on poverty reduction is used here. Various control variables are also used in this analysis. The data of FDI net inflows (% of GDP) (FDN) of is taken from World Bank statistics (World Bank, 2016) and data on FDI (the US $at current rice in millions) (FDN) from United Nations Conference on Trade and Development statistics (UNCTAD) for Robustness checking of the analysis. The Prior literature has focused only on the FDI nexus poverty through growth process using GDP per capita and progress toward improved welfare. The data based on people below the poverty line and human development index not used due to the scarcity of data in the case of Pakistan. So data is taken from Household Integrated Economic Survey as well as various issues of Pakistan Integrated Household Survey, and Economic Survey of Pakistan, where national poverty line(PVE) is measured as 2350 calories (as the cut-off point for Pakistan).

Table 2. Empirical literature review on FDI–poverty nexus.

Researcher(s)	Area of Study	Region/State	Impact
Jalilian & Weiss, 2002	Foreign direct investment (FDI) and poverty in the Association of South-East Asian Nations region	Association of South-East Asian Nations (ASEAN)	The positive association between FDI and poverty reduction
Zaman et al., 2012a	The relationship between foreign direct investment and pro-poor growth policies in Pakistan	People Republic of Pakistan	Positive
Gohou & Soumare, 2012	Does foreign direct investment reduce poverty in Africa and are there is Magombeyi and Odhiambo (2017) present a comprehensive survey of the literature on the impact of FDI and poverty reduction. The study outlines the empirical and theoretical relationship between FDI and poverty reduction. The study separated from prior studies as it emphasises on the direct impact of FDI on poverty reduction as well as it provides a comprehensive review of nature between both variables relationship.	African countries	Positive
	Staníčková, M. (2017) examine the social development convergence and divergence trends among the EU member states in the background of the Europe 2020 strategy. The study draws attention to the issue of income disparities, labour market and poverty reduction. The study also discusses the current changes in social inequalities that have been related to the business cycles, especially with the ease of accessibility of the labour market and evidently with income disparity.		
	Prior empirical studies show that limited research work has been done in context to direct impact of FDI on poverty reduction, and findings are also inconsistent. According to prior literature, three findings from past studies can be obtained regarding the direct impact of FDI on poverty reduction, first portion of studies conclude that FDI has a positive impact on poverty reduction, e.g. Gohou and Soumare (2012), Shamim et al. (2014), Fowowe and Shuaibu (2014), Ucal (2014), Israel (2014), and Soumare (2015).		
	Other studies conclude that there is a negative impact of FDI on poverty reduction, e.g. Huang et al. (2010) and Ali et al. (2010). The findings of these studies present that inflows of FDI lead to a rise in the level of poverty, opposite to theoretical predictions. However,		

(*continued*)

Table 2. Continued.

Researcher(s)	Area of Study	Region/State	Impact
	the third studies reveal that FDI has an insignificant impact on poverty reduction, e.g. Tsai and Huang (2007), Akinmulegun (2012), and Gohou and Soumare (2012). regional differences?		
Shamim et al., 2014	Impact of foreign direct investment on poverty reduction in Pakistan	People Republic of Pakistan	Positive
Fowowe & Shuaibu, 2014	Is foreign direct investment suitable for the poor? New evidence from African countries	Africa countries	Positive
Ucal, 2014	The study tries to detect the impact of FDI on poverty using panel data analysis	LDC'S	Positive
Israel, 2014	FDI - poverty nexus (Nigeria 1980-2009)	Nigeria	Positive
Soumare, 2015	Explored FDI- welfare in North Africa countries?	N. Africa	Positive
Huang et al., 2010	Identify FDI (inward and outward) and poverty in East Asia and Latin America	East Asia Latin America and East Asia	Negative
Ali et al., 2010	Foreign inflows and checked its benefit concerning Pakistan	Republic of Pakistan	Negative
Tsai & Huang, 2007	The study based on Taiwan's openness, growth and poverty.	Taiwan	Results are insignificant
Gohou & Soumare, 2012	Discussed FDI and poverty (in Africa)	African countries	Results are insignificant
Akinmulegun, 2012	Discussed FDI and poverty (in Nigeria)	For Nigeria	Results are insignificant

3.1.1. Description of control variables

This empirical analysis is used for control variables. The proxy of infrastructure variable is the mobile phone users per 100 inhabitants (CELPN) used as an economic and policy variable. The life expectancy at birth (LIFEX) is used as the proxy of human capital development, Pakistan as a developing country and all level of education of the population is low so for measurement of human capital development cannot be possible due to incomplete data. Moreover, Pakistan's as a low human capital development economy as a result of low educational and health outcomes which increase poverty and negate FDI inflows. Improved health facilities imply a healthier working population and increase the income of the people and reduced the poverty level. Whereas, the working population with an increase in the rate of life expectancy at birth (a proxy of human capital development), is projected to improve the level of poverty in Pakistan. The data of the mobile phone users per 100 inhabitants (CELPN) and life expectancy at birth are taken from WDI (2016) statistics. Public expenditure by the government is also an important control variable to check the impact of FDI and poverty reduction. Data is obtained from WDI (2016) statistics. The empirical results of this analysis are concluded through Eviews software.

Three steps are involved in the estimation process. First, to examine the stationary of data, this study used different unit-roots test, namely Phillip-Perron (PP), Kwiatkowski–Phillips–Schmidt–Shin (KPSS) and well known augmented Dickey-Fuller (ADF). Prior literature describes that when the size of the sale is small, the test of PP and ADF have no strong power, so that is why the use of KPSS is more significant. Secondly, the next step is related to find out the co-integration between variables in a

model. The autoregressive distributed lag (ARDL) model is applied in this step (Pesaran, Shin, & Smith, 2001) to test the presence of co-integration between FDI, poverty and its control variables. Several benefits have found of this bond test in terms of the Johansen co-integration test. This test is applicable even for the small sample size and results for small sample size is also more robust (Narayan, 2005). The other advantage is related to the order of integration; if the order of integration is not the same, it still used efficiently, the same order of integration is required for Engle-Granger or Johansen-Juselius. If regressor found the endogeneity problem in the model, the results from this procedure still will be robust, depends on the Monte Carlo (explained by Pesaran et al., 2001).

3.2. The co-integration analysis (ARDL)

The ARDL or bound testing approach is a recently developed technique. The approach of ARDL to co-integration is a stepwise procedure. The ARDL method is more preferred that the method of Johansen's (1992) maximum likelihood and the method of Pesaran et al. (2001). The ARDL method is used to test for the existence of a relationship between poverty and its important variables adopted for the following reasons. The ARDL method does not impose the most restrictive assumption, for example, that all variables related to the specific model should have the same order of integration, and it can be used whether the order of integration of variables is I(0), I(1) (Hashem & Pesaran, 1997). Besides this, ARDL estimators with its small sample properties are more superior to the co-integration techniques of Johansen and Juselius, and long-run coefficients of estimators based on ARDL are hugely consistent in small sample sizes (Pesaran & Shin, 1999). Moreover, the endogeneity problem is less in the framework of the ARDL method because it is free of residual correlation. The ARDL method overcomes the issues causing from non-stationary time series data (Laurenceson & Chai, 2003). The ARDL framework can be written as below:

$$\Delta \ln PVE = \alpha_1 + \alpha_{PVE} ln PVE_{t-1} + \alpha_{FDN} ln FDN_{t-1} + \alpha_{CELPN} ln CELPN_{t-1}$$

$$+ \alpha_{LIFEX} \ ln LIFEX_{t-1} + \ \alpha_{CPNI} ln CNG_{t-1} + \ \sum_{j=0}^{q} \alpha_j \Delta \ln PVE_{t-j}$$

$$+ \sum_{i=1}^{P} \alpha_i \Delta \ln FDI_{t-i} + \sum_{k=0}^{m} \alpha_k \Delta \ln CELPN_{t-k} + \ \sum_{l=1}^{n} \alpha_l \Delta \ln LIFEX_{t-l}$$

$$+ \sum_{U=0}^{V} \alpha_c \Delta ln CNG_{t-C} + \mathcal{E}_{1i} \tag{3}$$

The Intercepts of the above equations are α_1, β_1, μ_1, $\emptyset_1$, and σ, respectively and $\mathcal{E}_i$ is error term (supposed) to be white noise. If the (null hypothesis) is rejected and H_2 is accepted, it shows the existence of long-run co-integrating correlation among variables. The other part of statistical coefficients such as sum and lags of variables capture short-run dynamics.

The non-standard statistics are asymptotic distributions test regardless of whether the factors are at the level or first difference such as I (0) or I (1). The asymptotic critical values are taken from the computed sets of Narayan's (2005), these values are

related to lower bond values (LB) or (I (0)), and other critical values are I (1) related to upper bounds (UB) critical values. The null hypothesis of no co-integration is rejected, if the value of computed F–test is more magnificent than UB. If the computed F–statistics test is between UB and LB, results are called inconclusive. This study used the Akaike Information Criterion (AIC) to take the optimal lag length for the selected model. The diagnostics test are used to satisfy the assumptions of the model, these tests namely, Bera-Jarque test for normality of data, for detection of serial correction we applied Lagrange multiplier (LM) test, for functional form of the data, the Ramsey/RESET is used, to check the stability of the model we used the CUSUM and CUSUMSQ statistical test is used. The ARCH test is used to check the issue of Heteroscedasticity (the regression of squared residuals on squared fitted values).

3.3. Sensitivity analysis

The theoretical analysis recommends that FDI effects poverty and the level of poverty is also related to FDI. Both variables with control variables are treated as endogenous (placing on the right-hand side) violates the assumptions of exogeneity. An ARDL model is used with an appropriate lag structure to overcome the issue of exogeneity. According to Pesaran, Shin, and Smith (2000), the appropriate orders of the ARDL model can be used to remove the problem of the endogenous regressor and correction of residual serial correlation. The causality based ARDL and ECM- method is used in this empirical analysis. The ARDL method efficiently works, or robust even the sale size is small (Odhiambo, 2009; Solarin & Shahbaz, 2013). This approach has not restrictive assumption regarding the order of the variables of integration like other conventional approaches (Pesaran et al., 2001, p. 290; Solarin & Shahbaz, 2013).

When we used different variables in the system of vector autoregressive (VAR) model, the problem of endogeneity can be minimised because such conditional factorisation in the VAR system is made a priori. The alternative of this, endogeneity of the variables can be tested later, and then restricted them to be exogenous. These aspects motive our selection of the VAR and ARDL approaches for investigating the interaction between FDI and poverty with its control variables. To overcome the problem of endogeneity, this study uses some sensitivity analyses method. First, in this analysis, each variable is used as endogenous by using the sets of simultaneous equations. Due to this, we can check the required variation in the analysis; in this case, the lag length can vary in our analysis. To identifying the regression robustness, the equations can be rerun separately by omitting the FDI and poverty. In this case, every endogenous variable is performing as predetermined variables, and it is represented as a reduced form of the equation. In these cases, in the long run, FDI, and control variables tend to influence poverty. Second, to identify the impact of each variable empirically, the Granger-causality technique looks to be an essential tool. According to the context of this study, if after lagged FDI and poverty reduction are used for this test, where Granger-causality running from FDI (lagged) to poverty reduction is found to be positive and significant, and the FDI variable acting as an endogenous variable. If no Granger causality found in the long run and Granger causality (in the medium term) found negative, then we can say in favour of FDI being exogenous. So these results conclude that if causality does not

found in a bivariate setting than in multivariate setting, the causality cannot be found. For this purpose, then we can be checked the robustness of our results.

3.4. Innovative accounting approach (IAA)

The identification of a long-run association between forcing variables of poverty is related to co-integration test, but at this stage, the direction of causality will be not fully vibrant. The critical enquiry in this study is to detect the causality of series interdependencies, but co-integration does not give any indication about this. For repudiating the test of Granger non-causality, the co-integration test plays a necessary but not a sufficient condition. Therefore, we use the Granger causality test when the variables are cointegrated or long-run relationship found between the variables. The causality test depends on a vector error-correction model (ECM) if the variables are cointegrated (Johansen & Juselius, 2009). Nevertheless, beyond the selected period, the technique of the Granger causality failed to control the comparative strength of the effects of causality (Shahbaz & Rahman, 2012). This study used IAA techniques to overcome the VECM Granger causality test's limitations; this technique tries to explore the casual association among FDI and poverty and its control variables. The integration of the series and endogeneity issues are avoided in the IAA technique. The advantage of this approach is forecasting the results or analysing the casual association ahead of the selected sample period. The variance decomposition (VED) and impulse response function (IMRF) are the two main components of the IAA method. The IMRF is related to the response of the endogenous variables when a shock is given to the other variables and itself variable over different periods in a series (Shan, 2002). Each series of the model depends on the forecast error variance and shock of standard deviation (to a specific variable) when it puts to a variable, and this explains about the strongly impacted series or variables (Enders, 2010). For instance, when a shock in FDI has an impact on poverty significantly, but if minimum affects coming in FDI when the shock is occurring in poverty. These results follow the unidirectional causality runs from FDI to poverty.

When the impact of FDI on poverty or the effects of poverty on FDI is significant, this relates to the bidirectional causality. If causality does not find among these variables even shock occur in FDI and poverty, then there is no bidirectional or unidirectional causality in the model. Thus the objective of IMRF to identify the time path of the effects of shocks (sets of variables) in the system of VAR. This function describes that significance response of the poverty to shocks in FDI than other factors. This analysis includes poverty, FDI and some control variables to explore the casual correlation between FDI and poverty reduction in the system of VAR approach.

The following equation describes the system of VAR (Shan, 2005):

$$\text{VARM}_t = \sum_{i=1}^{k} ß_i \text{VARM}_{t-i} + u_t \tag{4}$$

Where the value of $\text{VARM}_t = (PVE_t, \ FDN_t, CELPN_t, LIFEX_t, CPNI_t)$ and

$$u_t = (u_{PVE}, \ u_{FDN}, \ u_{CELPN}, u_{LIFEX}, u_{CPNI}) \tag{5}$$

4. Empirical results and analysis

The statistical results of ADF test, PP test and KPSS test with and without trend term are mentioned in Table 3. It showed that some variables are stationary at the level and some found stationary at first differences. Although, the results found that some variables are stationary at I (0) at 1 and 5% and series are I (1) at the 1% significant level. Thus our results of variables are satisfied the order of integration understudy is I (1) for the ARDL bounds testing approach.

The ADF test used the SIC criterion to select the lag length, the Newey-West and Barlett-Kernel method is using for PP and KPSS's bandwidth. Null hypothesis (H_o) = Series are Non-stationary for ADF and PP test while Null hypothesis = Series are stationary for KPSS, respectively. *, **, and * indicates 1 and 5 at the level of significant, respectively.

4.1. Bound test for co-integration: WALD (F) statistics

The statistical results of bond test analysis are mentioned in Table 4. The results indicate that the null hypothesis of no co-integration is rejected at 5% significant level in all equations. Before arranged to test of co-integration analysis, the intermediate step is to choose the optimal lag length of the selected variables. For this purpose, three optimal lag length criteria are according to the conventional method. Followed the AIC, we selected the lag length; after this, the ARDL bound testing technique to co-integration is used to examine the long-run association among all variables. The ARDL approach showing the critical values of F-test indicated by Narayan (2005).

This study used PVE_t, FDN_t, $CELPN_t$, $LIFEX_t$, CNG_t based equations and results found the existence of a long run relationship between the variables. According to statistical results taking each variable as a dependent variable, this analysis concludes that variables are co-integrated in long run (existence of long run correlation among variable).

4.2. Estimation of the ARDL model and robustness

The results of the ARDL model showed all the variables found co-integrated in the previous section, to identify the long-run co-integration between the dependent and independent variables. The next stage is related to long-run estimation for all variables from the ARDL statistical method. The results of the long-run estimated ARDL co-integration model is reported in Table 5. However, different variables with lags can be used (Duasa, 2007).

The findings of normalised long-run coefficients statistics reported in the Table 5, we concluded that FDI describes poverty reduction by 1.11%. The result shows that one unit of change in the FDI will induce a 1.11 per cent decrease in poverty. A positive relationship exists between FDI and poverty reduction in the long run and the short run; it is supported by theory where the inflow of FDI increase is essential in stimulating the production of goods and services in an economy and creates more jobs. The results of (Fowowe & Shuaibu, 2014, Fowowe & Abidoye, 2013, Gohou & Soumare, 2012, and findings of Zaman et al., 2012a) are supported in our study. The FDI and poverty found significant but low coefficient in the context of Pakistan. The

Table 3. Results of unit root analysis.

	ADF test		PP test		KPPS test	
Variables	Intercept	Intercept and tend	Intercept	Intercept and trend	Intercept	Intercept and trend
PVE_t	−2.89***	−2.93***	−2.84***	−2.89***	0.16**	0.10**
$\Delta lnPVE_t$	−7.49***	−7.22***	−7.47***	−7.27***	0.08***	0.08***
FDN_t	−2.7**	−5.3***	−1.77	−1.73***	0.35***	0.06
$\Delta lnFDN_t$	−7.49 ***	−7.28***	−3.76 **	−3.58**	0.07***	0.05***
$CELPN_t$	−8.0***	−7.87***	1.17	−0.56	0.49**	0.18
$\Delta lnCELPN_t$	−4.05***	−4.4 5***	−1.76**	−1.73	0.41***	0. 08
$LIFEX_t$	−1.22	−2.41***	−3.71***	−2.38	0.70***	0.19***
$\Delta lnLIFEX_t$	−1.62	−1.39	−1.42	−2. 06	0.56	0.12
CNG_t	−2.60	−2.94	−2.50	−2.39	0.16	0.11
$\Delta lnCNG_t$	−4.28 ***	−4.17***	−4.29 ***	−4.19***	0.15***	0.14***

Note: *, **, *** presents level of significance at 10 %, 5 % and 1 %, respectively.
Source: Author's own estimation by using EViews software.

Table 4. Statistical results of bond tests analysis.

Equations	F- stat	Lag	95% CBV
F_{PVE} (PVE_t FDN_t, $CELPN_t$, $LIFEX_t$, CNG_t)	5.29	3	LCBV: 3.25 UCBV: 4.49
F_{FDN} (FDN_t PVE_t $CELPN_t$, $LIFEX_t$, CNG_t)	8.75	3	LCBV: 2.86 UCBV: 4.22
F_{CELPN} ($CELPN_t$ PVE_t, FDN_t, $LIFEX_t$, CNG_t)	5.32	3	LCBV: 2.86 UCBV: 4. 02
F_{LIFEX} ($LIFEX_t$ PVE_t, FDN_t, $CELPN_t$, CNG_t)	9.43	3	LCBV: 2.80 UCBV: 4.22
F_{CNG} (CNG_t \ PVE_t, FDN_t, $CELPN_t$, $LIFEX_t$)	4.96	2	LCBV: 2.25 UCBV: 4.49
Diagnostic tests			
R^2	0.82		
J-B (normality) test	0.62(0.73)		
Breusch–Godfrey (Lm test)	2.72(0.13)		
Breusch-Pagan-Godfrey statistics	11.62(0.43)		
Ramsey Reset test	1.150.73)		

Note: *, **, *** presents level of significance at 10 %, 5 % and 1 %, respectively.
Source: Author's own estimation by using EViews software.

cell phone users (per 100 inhabitants) used as a proxy of an infrastructure, contributes to poverty reduction is only 0.13%, where the result shows that one unit of change in the infrastructure will induce a 0.13 per cent decrease in poverty. A positive relationship exists between FDI and poverty reduction in the long run and the short run, and it is supported by a theory where robust infrastructure is imperative in stimulating an economy. Whereas poor institutional quality slightly impacts on poverty reduction in the case of Pakistan, endorsed by Gohou and Soumare (2012). The influence of life expectancy and government expenditure to poverty reduction is 0.67% and 2.18% respectively; The life expectancy and government expenditure, contributes to poverty reduction is only 0.67% and 2.18% respectively, both variables are contributing in poverty reduction as in suggested by Fowowe and Shuaibu (2014).

4.3. Error correction model (ECM)

The model of an ECM is applied to check the long-run stability of the parameters and the short-run relationship between variables. The long-run normalised coefficients method is used in the estimation of ECM. The ARDL model, with its lags terms, is transferred with the model of ECM. The results for the ECM model are reported in Table 6.

Table 6 reported that the model is well fitted, the estimated values of R-squared (0.87) and adjusted R-squared (0.82), respectively. The diagnostic results showed that

Table 5. Results of normalized long run coefficients.

Variables	Coefficients	t-scores	Probability (p values)
ln FDN$_t$	1.11	3.20	0.0013***
ln CELPN$_t$	0.131	13.10	0.0000***
ln LIFEX$_t$	0.676	3.10	0.0000***
ln CNG$_t$	2.182	5.18	0.0000***
C	97.56	3.11	0.0010***

Note: *, **, *** presents level of significance at 10 %, 5 % and 1 %, respectively.
Source: Author's own estimation by using EViews software.

data is free from any severe econometric issues in the ARDL co-integration model. The ARCH test and Breusch–Godfrey LM test for heteroskedasticity and no serial correlation respectively and results found neither issue of heteroskedasticity and nor serial correlation (H$_0$ (null hypothesis). The Ramsey reset test indicated that the model is correctly specified and Jarque Bera (J.B test) showed that data is normally distributed. This study accepted the null hypothesis for heteroskedasticity, no serial correlation; Ramsey reset the test and Jarque Bera (J.B test), as statistical χ^2 and p-values in brackets. The ECM term, with its one period, lagged (ECM (−1)) found highly significant at the 1 per cent level with an expected negative sign. When a short-run shock occurs, the 0.82 or 82% speed of adjustment required to move towards their long-run equilibrium position.

4.4. Stability tests

However, to check the stability of the model, the CUSUM and CUSUMSQ tests are used for the estimated ARDL for PVE$_t$, FDN$_t$, CELPN$_t$, LIFEX$_t$, CPNI$_t$ as a dependent variable are revealed in Figure 2. The CUSUM and CUSUMSQ results show the assessment of plots which lies between the 5% critical bounds lines. The values of variables coefficient in short, as well as long-run in the specified model, is stable, and in the regression model the coefficients are constant.

4.5. Results of innovative accounting approach

Innovative accounting approach is a better method to the VECM Granger causality, and it forecasts error variance decomposition. These methods are based on the fraction of variation in data due to others and its shocks (Enders, 1995). The forecast error variance decomposition method applies in a vector error system (VEC) system to check the role of one shock (standard deviation) to innovations of each variable and can find the impact of this variable; This study took over a 10-period forecast horizon. The findings of variance decomposition statistics reported in Table 7, we conclude that FDI describes poverty reduction by 20%, supported by Fowowe and Shuaibu (2014), Fowowe and Abidoye (2013), Gohou and Soumare (2012), and findings of Zaman et al. (2012a), the FDI and poverty found significant but low coefficient in the context of Pakistan). The cell phone users (per 100 inhabitants) used as a proxy of an infrastructure, contributes to poverty reduction is only 5.7%, as poor institutional quality slightly impacts on poverty reduction in case of Pakistan, endorsed by Gohou and Soumare (2012). The role of poverty reduction itself is described by 6.15%. The influence of life expectancy and government expenditure on

Table 6. Results of error correction model.

Variables	Co-efficient	T-scores	Prob (p values)
D(ln FDN$_t$)	2.510	1.433	0.095*
D(ln CELPN$_t$)	0.228	2.928	0.0068*
D((ln LIFEX$_t$))	0.912	1.867	0.071*
D(ln CNG$_t$)	2.83	7.893	0.0000***
ECM(−1)	−0.82	6.671	0.0001***
Diagnostic tests			
R-squared	0.87		
Adjusted R-squared	0.82		
J-B normality test	2.2 9 (0.77)		
Breusch–Godfrey LM test	3.17(0.53)		
ARCH test	2.48 (0.22)		
Ramsey reset test	1.46(0.78)		
Durbin-Watson stat	2.190		

Note: * and *** indicates 10% and 1% at the level of significant, respectively.
Source: Author's own estimation by using EViews software.

poverty reduction is 0.6% and 12.8% respectively; both variables are contributing to poverty reduction as in suggested by Fowowe and Shuaibu (2014).

The contribution of poverty reduction and cell phone to FDI is 21.8% and 2.3% respectively. The role of itself is explained by 69.3%. The influence of poverty reduction, FDI, life expectancy and government expenditure to a cell phone are 7.5%, 35.0%, 4.4%, and 9.9% respectively, and itself impact of a cell phone is 43.0%. Additionally, the as innovative shock given in poverty reduction, FDI, cell phone and government expenditure reveal life expectancy by 23.0%, 72.6%, 0.6%, and 0.4% respectively. A 3.1% fraction of life expectancy is described by itself. Finally, the influence of poverty reduction, FDI, life expectancy and cell phone to government expenditure is 38.5%, 25.8%, 3.6%, and 4.3% respectively, and itself impact of government expenditure is 28.1%. The aim of this methodology in a VAR system to identify the shock's influence of independent variables on the dependent variables. The results concluded that the impact of the shock of FDI on poverty reduction is not too much strong, but the impact of the shock of poverty reduction on FDI is comparatively stronger. The results of variance decomposition method showed that bidirectional causality found between FDI and poverty reduction or both are Granger cause of each other. The cell phone and poverty found feedback effects. The life expectancy and poverty reduction found unidirectional relationship and causality running from poverty reduction to life expectancy. The bidirectional also found between poverty reduction and government expenditure.

4.6. Results of the impulse response function

The second important method of innovation accounting approach is the impulse response function. Figure 3 illustrates the results of the impulse response function, which also endorse the results of (in Table 7 variance decomposition. In the vector error system (VEC) system, we check the dynamic feedback to shocks to explanatory variables with the help of IMRF method. Figure 3 depicts the multiple graphs of impulse response function; the fluctuation can be seen in different graphs because current volatility is affected by the past volatility of a variable.

Figure 3 (row a) illustrates the poverty reduction's response to impulses in all variables and their past values contribution to the most significant variance in poverty
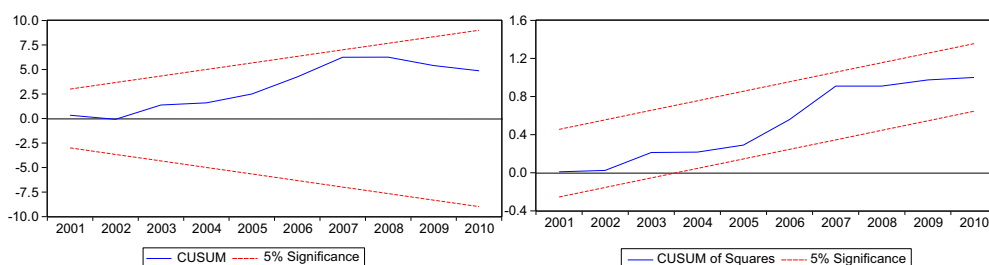
Figure 2. The CUSUM and CUSUMSQ tests.

Table 7. Results of variance decompositions method.

Forecast error variance (%)	Typical shock in				
	PVE_t	FDN_t	$CELPN_t$	$LIFEX_t$	CNG_t
PVE_t	60.15	20.50	5.76	0.69	12.88
FDN_t	21.84	69.30	2.39	5.88	0.56
$CELPN_t$	7.58	35.03	43.04	4.41	9.91
$LIFEX_t$	23.06	72.65	0.65	3.19	0.43
CNG_t	38.05	25.86	3.60	4.30	28.17

Source: Author's own estimation by using EViews software.

reduction. The results showed that poverty reduction remains steady. The feedback of the poverty to itself shock is found fluctuated. The response of FDN to PVE in a row (b) in the first three quarters is negative than showing an increasing trend and after the ninth quarter, its start decreasing. The response of CELPN, LIFEX and CNG remains steady. The feedback of the FDN to itself shock is found decreasing initially than decrease, and after the 9th quarter, it starts increases. The feedback of CELPN depicts in a row (3); the response of CELPN to various shocks is quite different. Poverty is reducing due to technological development and CELPN exert a negative impact on poverty; FDI found a positive impact on CELPN and life expectancy rate and government expenditure remains steady. The response of LIFEX and CNG shows in a row (4) and row (5) respectively. Row (2) indicates the feedback of life expectancy and CELPN exert a negative impact on poverty, FDI found a positive impact on CELPN and life expectancy rate and govern, where poverty found negative and increasing trend found in the response of LIFEX to FDN. The response of LIFEX to CNG remains steady. The row (5) indicates that the response of CNG contrasts across all variables. The response of CNG to PVE and LIFEX found negative over the entire time horizon. Furthermore, feedback of CNG to FDN found an increasing trend in quarter two than decreasing, after 6th quarter it starts rising. The CELPN in quarter 2 shows a decreasing trend and then found remains steady, the same trend found in self-shock.

5. Conclusion

This empirical study examines the relationship between FDI and poverty reduction using some control variables in the context of Pakistan. The time-series data has been used covering the periods 1985–2016, the study found robust results of cointegration between FDI and poverty reduction in the long-run analysis. In order to better
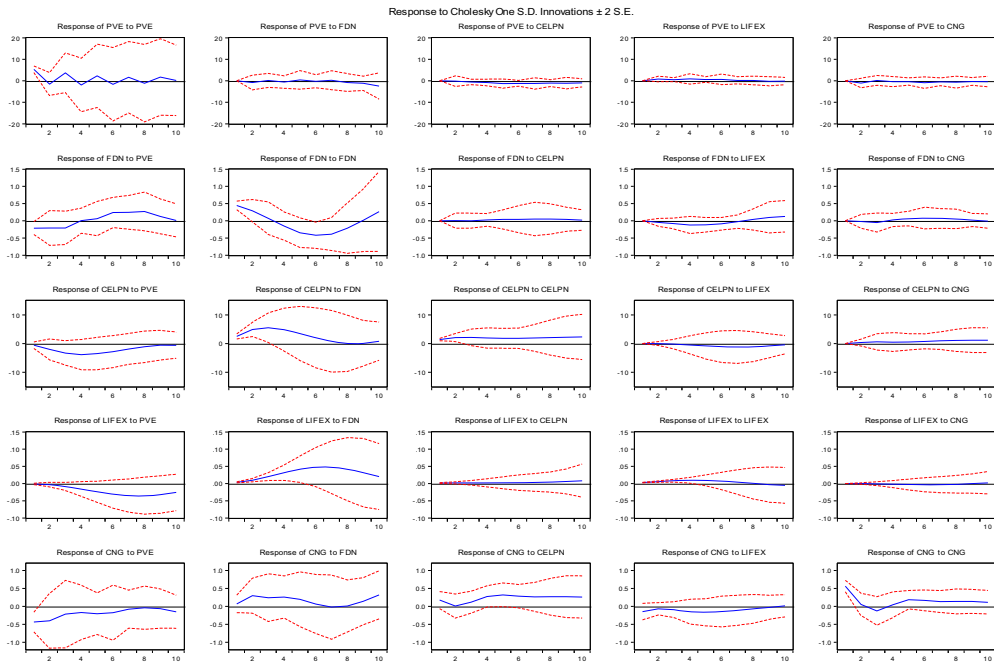
Figure 3. Multiple graphs of impulse response function.

understand the causal relationship between FDI and poverty reduction, the ECM test is used. The short-run and long-run analysis results indicate that FDI, the mobile phone users (per 100 inhabitants), life expectancy, and government expenditure contribute to poverty reduction. The results of variance decomposition method showed that bidirectional causality found between FDI and poverty reduction or both are Granger cause of each other. The cell phone and poverty found feedback effects. The life expectancy and poverty reduction found unidirectional relationship and causality running from poverty reduction to life expectancy. The bidirectional also found between poverty reduction and government expenditure.

This study employed a national poverty line is measured as 2350 calories (as the cut-off point for Pakistan), statistical results showed that FDI inflow decreases poverty from Pakistan both short-run as well as long-run analysis. The ratio of people below the poverty line is decreased as the inflow of FDI increases. The Government expenditure on the public is also contributing a significant role in poverty reduction. The ratio of inflow of FDI is not too high in Pakistan so government with scared financial resources should improve the policies regarding FDI inflow. This analysis suggests policymakers divert their attention towards the betterment of institutions, establish FDI attractive inflow trading zones like other countries. The findings of the study reveal that poverty reduction is strongly affected by FDI in Pakistan. These results are endorsed by Brenton, DiMauro, and Lücke (1999) and Buch, Kokta, and Piazolo (2001) in the Eastern Europe region and Gohou and Soumare (2012) in Africa. Ali et al. (2010) examined the role of FDI on poverty reduction in Pakistan and found that there is a need for best utilization of foreign inflow and proper allocation of

resources in the country. Proper allocation of resources would reduce not only poverty but also boost the other sectors of the economy. Zaman, Shah, Khan, and Ahmad (2012) suggested that FDI is the significant contributor to economic growth in Pakistan.

This study will efficiently give suggestions for further research to various researchers, and the study provides theoretical and empirically-based practical suggestions for poverty reduction. Based on the findings from this study, it is suggested that the government should enhance the FDI policies, such as market reforms and government expenditure, that direct FDI to productive sectors of the economy that are pro-poor and investment in social infrastructure. For future analyses, this study is also not free from limitations under a discussion of the essential factors and its impact on poverty reduction. Furthermore, the essential roles of human capital development, macroeconomic stability, financial development, trade openness for poverty reduction are crucial for further analysis. Different poverty proxies can be used to enhance the robustness of results.

Disclosure statement

No potential conflict of interest was reported by the authors.

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