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IMPACT OF FOREIGN DIRECT INVESTMENT ON POVERTY REDUCTION IN BOTSWANA: AN ARDL APPROACH

Mercy T. Magombeyi [1] and Nicholas M. Odhiambo

Abstract

This study investigates the dynamic impact of foreign direct investment inflows (FDI) on poverty reduction in Botswana from 1980 to 2014. The study employs the newly developed autoregressive distributed lag bounds test approach to cointegration and the error correction model to investigate the impact of FDI on poverty reduction. Unlike some studies that have relied on one poverty reduction proxy, this study uses three poverty reduction proxies, which are household consumption expenditure (Pov1), infant mortality rate (Pov2), and life expectancy (Pov3). The results from this study vary depending on the poverty reduction proxy used. FDI has a negative impact on poverty reduction in both the long run and the short run when Pov3 is used as a poverty reduction measure, while an insignificant relationship was revealed in both the long run and the short run when Pov2 is used as a proxy for poverty reduction. FDI has a negative statistically significant impact on poverty reduction in the short run and an insignificant impact on poverty reduction in the long run when Pov1 is used as a measure of poverty reduction. Past poverty reduction has a positive impact on current poverty reduction irrespective of the poverty reduction proxy used.

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JEL Classification: F21; I32.

1. Introduction

The debate on the poverty-foreign direct investment nexus has been raging for some time and has culminated in a number of studies that have attempted to disentangle the relationship. Although the theoretical literature suggests a positive impact of FDI on poverty reduction, the findings from previous studies have been mixed. The bulk of studies that have attempted to investigate the relationship between FDI and poverty reduction have focused on the impact of FDI on poverty reduction where poverty reduction is proxied by economic growth (see Hsiao and Hsiao, 2006; Almfraji et al., 2014). Studies on the direct impact of FDI on poverty reduction are limited, and the results are also inconclusive.

Foreign direct investment can have both direct and indirect effects on poverty reduction. Indirect effects include horizontal and vertical spill over effects (Gorg and Greenaway, 2004; Sumner, 2005). Horizontal spill over is achieved through labour movement and demonstration effects (Meyer, 2004). Vertical spill over, on the other hand, arises from consumer and producer surplus and is divided into backward and forward linkages. Backward linkages involve the sourcing of intermediate goods by a foreign subsidiary from domestic firms (Gorg and Greenaway, 2004; Liu et al., 2009). Forward linkages involve the growth of an industry that uses the output from the foreign subsidiary (Sumner, 2005). Direct effects consist of the creation of new jobs for the locals and an increase in investment capital (Klein *et al.*, 2001).

Although the theoretical literature proposes a number of channels through which FDI positively impacts on poverty reduction, the empirical evidence is mixed. The results have varied depending on the poverty reduction proxy used, study country or region, and the methodology employed. Among the studies that have investigated the direct impact of FDI on poverty reduction, there are some that have confirmed a positive impact of FDI on poverty reduction (see Jillian and Weiss, 2002; Fowowe and Shuaibu, 2014; Soumare, 2015). However, other studies have found FDI to have a negative impact on poverty reduction. Among these studies is Huang et al. (2010). Apart from studies that have confirmed either a positive or negative impact of FDI on poverty reduction, there are some studies that have found FDI to have no significant effect on poverty reduction (see Tsai and Huang, 2007; Akinmulegun, 2012). Thus, the mixed results from the empirical research suggest the need to consider the impact of FDI on poverty reduction on a case-by-case basis, necessitating a need to investigate such a relationship in Botswana.

This study differs from previous studies in a number of ways. First, the study investigates the impact of FDI on poverty reduction using the newly developed autoregressive distributed lag (ARDL) approach – an approach associated with a number of advantages. The ARDL bounds testing approach to cointegration provides unbiased estimates of the long-run model, even in cases where some variables are endogenous (Odhiambo, 2009). Another advantage of the ARDL approach is that it uses a reduced form single equation, while other conventional cointegration methods employ a system of equations (Pesaran and Shin, 1999). Second, the study employs three poverty reduction proxies – household consumption expenditure, infant mortality rate, and life expectancy. Unlike other studies that have relied on one poverty reduction measure, the three

poverty reduction proxies measure income and non-income dimensions of poverty. The poverty reduction proxies employed in this study, therefore, offer a more holistic measure of poverty reduction. Third, the study focuses on Botswana using time series data, unlike other studies that have relied on cross sectional data, which are unable to sufficiently capture heterogeneity across countries (see Odhiambo, 2009).

Botswana has been selected for this study because it has received little coverage on the direct impact of FDI on poverty reduction (see Fowowe and Shuaibu, 2014). Moreover, it is among the countries with the lowest population in Southern Africa in the upper middle income bracket receiving a fair share of FDI inflows (World Bank, 2016). While poverty levels have declined over the years, they remain high, with 43% of the population living below the poverty line of $1.90 in 1986 compared with 19% in 2010 (World Bank, 2016). Botswana creates much interest, and this study would shed some light on the impact of FDI on poverty reduction in this country.

The Transitional Plan for Social and Economic Development of 1965 marked the implementation of socio-economic policies through the National Development Plans in Botswana (NDP) (Ministry of Finance and Economic Development, 2017). The government policy on FDI is enshrined in Pillar 2 in the NDP 10, which strives to build a prosperous, productive, and innovative nation (Ministry of Finance and Economic Development, 2017). The economy of Botswana in the 1980s was centred on mining, following the discovery of diamonds in 1967. The main focus was building capacity in the mining sector to exploit and negotiate foreign direct investment deals with

multinational companies (Criscuolo, 2008). Government policies that focused on attracting FDI included exchange control reforms, building a stable and sound macroeconomic environment, regulatory reforms, regional integration, and investment incentives, among other policy initiatives aimed at building an environment conducive to investment. Despite the reforms implemented, FDI inflows remained depressed between 1980 and 2014. Average FDI inflows as a percentage of gross domestic product (GDP) was at 3.2% during the period, with FDI inflows from 2000 accounting for the larger proportion of this figure (World Bank, 2016).

Poverty reduction in Botswana is guided by the National Development Plans that were rolled out since 1979 (Ministry of Finance and Economic Development, 2017). The National Development Plans build on each other in order to strengthen or provide new initiatives aimed at achieving targets set in the long term vision, Vision 2016 (African Development Bank, 2009). The poverty reduction strategy recurs in all National Development Plans, indicating an area of concern to government over the years. The government, through projects and policies such as the National Strategy for Poverty Reduction launched in 2003, has taken initiatives to broaden and deepen its programmes on poverty alleviation. Pillar 3, which is building a compassionate, just, and caring nation, has included poverty reduction and increased access to health, education, and employment among its important poverty alleviation initiatives (Ministry of Finance and Economic Development, 2017). Government policy and strategies are three pronged: First is stimulating economic growth, which includes economic diversification, employment creation, and income generation capacity and empowerment as ways of drawing the poor from the poverty trap (Seleka et al., 2007). Second are initiatives focused on the development of infrastructure to increase

government capacity in service provision (Seleka et al., 2007). Third is the provision of social safety nets designed to capture those without access to economic development opportunities (Seleka et al., 2007). There has been a positive response to poverty reduction policies, as shown by a reduction in poverty from 30.6% in 2002/3 to 19.6% in 2009/10 (Statistics Botswana, 2013). However, poverty levels vary depending on settlement type, sex, and district (Statistics Botswana, 2013).

The rest of the paper is organised as follows: Section two reviews related literature. Section three skeletons the estimation techniques. The fourth section presents the results and their analysis, while the fifth section concludes the study.

2. Empirical Literature Review

The impact of FDI on poverty reduction has received wide coverage in the literature, although the results are still inconclusive. The bulk of these studies have investigated the indirect impact of FDI on poverty, realised through the economic growth channel (see Hsiao and Hsiao, 2006; Dollar *et al.*, 2013; Feeny *et al.*, 2014). The results from these studies have varied from one study to the other. Of the few studies that have explored the direct impact of FDI on poverty reduction, the results are again inconsistent.

Some studies have found a positive impact of FDI on poverty reduction (see Zaman *et al.*, 2012; Gohou and Soumare, 2012; Shamim *et al.*, 2014; Fowowe and Shuaibu, 2014; Ucal, 2014; Israel, 2014; Soumare, 2015). Despite the empirical evidence in support of a positive impact of FDI on poverty reduction, there are some empirical studies that have found FDI to have a negative impact on poverty reduction. Among the studies to have found a negative impact of FDI on poverty are Huang *et al.* (2010) and Ali and Nishat (2010). The results of these studies reveal that FDI inflows lead to an increase in poverty levels, contrary to theoretical postulations. Some of the studies that have found FDI to have an insignificant impact on poverty include Sharma and Gani (2004), Tsai and Huang (2007), Akinmulegun (2012), and Gohou and Soumare (2012). Table 1 summarises studies that have investigated the impact of FDI on poverty reduction and their findings.

Table 1: Summary of Empirical Studies on the Impact of FDI on Poverty Reduction

Author (s)	Title	Region/Country	Impact
Jalilian and Weiss, 2002	Foreign direct investment and poverty in the ASEAN region	ASEAN	Positive association between FDI and poverty reduction
Zaman *et al.*, 2012	The relationship between foreign direct investment and pro-poor growth policies in Pakistan	Pakistan	Positive association between FDI and poverty reduction
Gohou and Soumare, 2012	Does foreign direct investment reduce poverty in Africa and are there any regional differences?	Africa	Positive association between FDI and poverty reduction in Central and East Africa
Shamim *et al.*, 2014	Impact of foreign direct investment on poverty reduction in Pakistan	Pakistan	Positive association between FDI and poverty reduction
Fowowe and Shuaibu, 2014	Is foreign direct investment good for the poor? New evidence from African countries	Africa	Positive association between FDI and poverty reduction

Ucal, 2014	Panel data analysis of foreign direct investment and poverty from the perspective of developing countries	Developing Countries	Positive association between FDI and poverty reduction
Israel, 2014	Impact of foreign direct investment on poverty reduction in Nigeria 1980-2009	Nigeria	Positive association between FDI and poverty reduction
Soumare, 2015	Does foreign direct investment improve welfare in North Africa countries?	Northern Africa	Positive association between FDI and poverty reduction
Huang *et al.*, 2010	Inward and Outward Foreign Direct Investment and Poverty: East Asia and Latin America	East Asia and Latin America	Negative association between FDI and poverty reduction
Ali and Nishat, 2010	Do foreign inflows benefit Pakistan poor?	Pakistan	Negative association between FDI and poverty reduction
Sharma and Gani, 2004	The effects of foreign direct investment on human development	Middle and low income countries	Insignificant impact
Tsai and Huang, 2007	Openness, growth and poverty: The case of Taiwan	Taiwan	Insignificant impact
Gohou and Soumare, 2012	Does foreign direct investment reduce poverty in Africa and are there any regional differences?	Africa	Insignificant impact in Southern and Northern Africa
Akinmulegun, 2012	The impact of foreign direct investment on poverty reduction in Nigeria	Nigeria	Insignificant impact

3. Empirical Model Specification and Estimation Methods

3.1 ARDL Approach to Cointegration

The ARDL bounds testing approach was selected because of a number of advantages. First, the ARDL approach does not require all variables to be integrated of the same order (Pesaran *et al.*, 2001). Variables can be integrated of order [I (1)], order 0 - [I (0)], or fractionally integrated (Pesaran *et al.* 2001: 290). Second, the ARDL bounds approach involves the use of a single

reduced form equation, unlike other methods that use a system of equations (see Duasa, 2007). Third, the ARDL approach to cointegration is robust in a small sample (Odhiambo, 2009; Solarin and Shahbaz, 2013). Fourth, the ARDL bounds testing approach to cointegration provides unbiased estimates of the long-run model, even in cases where some variables are endogenous (Odhiambo, 2009). It is against this background that the ARDL bounds approach was selected in this study.

Variables

The dependent variables are household consumption expenditure (Pov1), infant mortality rate (Pov2), and life expectancy (Pov3), while the explanatory variables include FDI and other control variables. The control variables included in the study are human capital (HK), price level (CPI), trade openness (TOP), and infrastructure (FTL). Variable description is given in Table 2.

Table 2: Variable Description

Variable	Description
Pov1	household final consumption expenditure per capita
Pov2	infant mortality rate
Pov3	life expectancy
FDI	foreign direct investment inflows as a proportion of GDP
HK	gross primary school enrolment
TOP	a summation of imports and exports as a proportion of GDP
CPI	consumer price index
FTL	infrastructure captured by fixed telephone lines

3.2 Model Specification

The study employs three models to investigate the impact of FDI on poverty reduction. Model 1 investigates the impact of FDI on poverty reduction proxied by household consumption expenditure (Pov1). Model 2 investigates the impact of FDI on poverty reduction proxied by infant mortality rate (Pov2), and Model 3 analyses the impact of FDI on poverty reduction using life expectancy (Pov3) as a poverty reduction proxy. Models 1-3 are specified in equations 1-3, respectively.

Model 1

$$Pov1 = \alpha_0 + \alpha_1 FDI + \alpha_2 TOP + \alpha_3 HK + \alpha_4 CPI + \alpha_5 FTL + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Model 2

$$Pov2 = \alpha_0 + \alpha_1 FDI + \alpha_2 TOP + \alpha_3 HK + \alpha_4 CPI + \alpha_5 FTL + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Model 3

$$Pov3 = \alpha_0 + \alpha_1 FDI + \alpha_2 TOP + \alpha_3 HK + \alpha_4 CPI + \alpha_5 FTL + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where α_0 is a constant and $\alpha_1 - \alpha_5$ are coefficients and ε is the error term

The ARDL model and the error correction specification are given in equations 4, 5, and 6 for Model 1, Model 2, and Model 3, respectively.

Model 1: ARDL Specification

$$\Delta Pov1_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{n} \alpha_1 \Delta Pov1_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta FDI_{t-i} + + \sum_{i=0}^{n} \alpha_3 \Delta TOP_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta HK_{t-i}$$

$$+ \sum_{i=0}^{n} \alpha_5 \Delta CPI_{t-i} + \sum_{i=0}^{n} \alpha_6 \Delta FTL_{t-i} + \vartheta_1 Pov1_{t-1} + \vartheta_2 FDI_{t-1} + \vartheta_3 HK_{t-1}$$

$$+ \vartheta_4 TOP_{t-1} + \vartheta_5 CPI_{t-1} + \vartheta_6 FTL_{t-1} + \mu_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4a)$$

Where $\alpha_1 - \alpha_6$ and $\vartheta_1 - \vartheta_6$ are regression coefficients, α_0 is a constant and, μ_{1t} is white noise error term.

The error correction model for Model 1 is specified as follows:

$$\Delta Pov1_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta Pov1_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta TOP_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta HK_{t-i}$$

$$+ \sum_{i=o}^{n} \alpha_5 \Delta CPI_{i-1} + \sum_{i=o}^{n} \alpha_6 \Delta FTL_{t-i} + \gamma_1 ECM_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4b)$$

Where $\alpha_1 - \alpha_6$ and γ_1 are coefficients, α_0 is a constant ECM_{t-1} is lagged error term and μ_t is white noise error term.

Model 2: ARDL Specification

$$\Delta Pov2_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta Pov2_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta TOP_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta HK_{t-i}$$

$$+ \sum_{i=0}^{n} \alpha_5 \Delta CPI_{t-i} + \sum_{i=0}^{n} \alpha_6 \Delta FTL_{t-i} + \vartheta_1 Pov2_{t-1} + \vartheta_2 FDI_{t-1} + \vartheta_3 TOP_{t-1}$$

$$+ \vartheta_4 HK_{t-1} + \vartheta_5 CPI_{t-1} + \vartheta_6 FTL_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5a)$$

Where $\alpha_1 - \alpha_6$ and $\vartheta_1 - \vartheta_6$ are coefficients, α_0 is a constant and ε_t is a white noise error term.

The error correction model for Model 2 is specified as follows:

$$\Delta Pov2_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta Pov2_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta TOP_{t-i} + \sum_{i=0}^{n} \alpha_4 HK_{t-i}$$
$$+ \sum_{i=o}^{n} \alpha_5 \Delta CPI_{i=0} + \sum_{i=o}^{n} \alpha_6 \Delta FTL_{t-i} + \gamma_2 ECM_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots (5b)$$

Where $\alpha_1 - \alpha_6$ and γ_2 are coefficients, α_0 is a constant ECM_{t-1} is lagged error term and μ_t is white noise error term

Model 3: ARDL Specification

$$\Delta Pov3_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta Pov3_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta TOP_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta HK_{t-i}$$
$$+ \sum_{i=0}^{n} \alpha_5 \Delta CPI_{t-i} + \sum_{i=0}^{n} \alpha_6 \Delta FTL_{t-i} + \vartheta_1 Pov3_{t-1} + \vartheta_2 FDI_{t-1} + \vartheta_3 TOP_{t-1}$$
$$+ \vartheta_4 HK_{t-1} + \vartheta_5 CPI_{t-1} + \vartheta_6 FTL_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6a)$$

Where $\alpha_1 - \alpha_6$ and $\vartheta_1 - \vartheta_6$ are coefficients, α_0 is a constant and ε_t is a white noise error term.

The error correction model for Model 3 is specified as follows:

$$\Delta Pov3_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta Pov3_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta TOP_{t-i} + \sum_{i=0}^{n} \alpha_4 HK_{t-i}$$

$$+ \sum_{i=o}^{n} \alpha_5 \Delta CPI_{i=0} + \sum_{i=o}^{n} \alpha_6 \Delta FTL_{t-i} + \gamma_3 ECM_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6b)$$

Where $\alpha_1 - \alpha_5$ *and* γ_3 *are coefficients,* α_0 *is a constant* ECM_{t-1} *is lagged error term and* μ_t *is white noise error term.*

3.3 Data Sources

The study employed time series data from 1980 to 2014 to investigate the direct impact of FDI on poverty reduction. The data was obtained from the World Bank Development Indicators. Data analysis was done using Microfit 5.0.

4. Empirical Analysis

4.1 Unit Root Test

Although the ARDL bounds testing approach employed in this study does not require pre-testing of the unit root of variables included in the model, pretesting was done to determine if the variables are integrated of the highest order of one – I [(1)]. Table 3 shows the unit root test results using Dickey Fuller Generalised Least Squares (DF-GLS), Phillips Perron (PP), and Perron unit root test (PPUroot test).

Table 3: Unit Root Test Results

ADF-GLS Test					PP Test				PPU(root) Test			
Variable	Stationarity of Variable in Levels		Stationarity of Variable in First Difference		Stationarity of Variable in Levels		Stationarity of Variable in First Difference		Stationarity of all Variables in Levels		Stationarity of all Variables in First Difference	
	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend
Pov1	0.3101	-1.6834	-3.3884***	-4.0486***	1.3915	-1.4722	-3.6249**	-3.986**	-3.4651	-3.8583	-5.5122**	-5.8573**
Pov2	-1.4923	-3.7760***	-2.5819**	-	-5.4574**	-7.0294***	-	-	-3.5099	-3.4544	-5.6275**	-5.6766**
Pov3	-3.2170***	-4.0536***	-	-	-5.4574**	-7.0294***	-	-	-5.3438**	-6.4219**	-	-
FDI	-2.0556**	-3.5211**	-	-	-7.6039***	-3.5258*	-	-	-2.0697	-3.7092	-7.9948***	-7.8471***
HK	-5.0376***	-3.5367*	-	-	-5.0552***	-3.5268*	-	-	-3.7728	-3.6926	-6.6889***	-6.8612***
TOP	-1.3683	-1.4212	-5.8520***	-6.0774***	-1.6144	-0.8638	-5.7635***	-6.1730***	-2.2649	-2.9423	6.6783***	-7.0319***
CPI	-1.6320*	-3.0676*	-	-	8.9875***	1.0739	-	-4.2593**	-2.0121	-2.9262	6.1979***	-6.2723**
FTL	-0.6823	-1.9411	-2.9058***	-3.0126*	-0.6902	-1.5857	-2.9202*	-7.7360***	-3.2912	-3.9225	-5.9789***	-5.8747**

Note:*, ** and *** denote stationarity at 10%, 5% and 1% significance levels respectively

The unit root results presented in Table 3 tend to vary from one unit root test to the other; overall. the results reveal that all variables are stationary in levels or in first difference. This confirms the suitability of ARDL based analysis

4.2 Bound F-statistic to Cointegration

The results of the bounds test and the critical values are presented in Table 4.

Table 4: Cointegration Results and Critical Values

Model	Independent Variables	Function		F -statistic		Cointegration Status	
1	Pov1	F(FDI, HK, TOP, INF, FTL)		4.8086***		Cointegrated	
2	Pov2	F(FDI, HK, TOP, INF, FTL)		3.6931*		Cointegrated	
3	Pov3	F(FDI, HK, TOP, INF, FTL)		9.1131***		Cointegrated	
Asymptotic Critical values (unrestricted intercept and no trend)							
Pesaran *et al.*(2001:300) critical values(Table CI(iii) Case III		10%		5%		1%	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
		2.26	3.35	2.62	3.79	3.41	4.68

Note: *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively

The calculated F-statistics in all the Models – Models 1-3 are 4.81, 3.69, and 9.11, respectively. The calculated F-statistics are compared to the Pesaran *et al.* (2001) critical values, also reported in Table 4. In all the models, the calculated F-statistic is greater than the critical values – Model 1 at 1%, Model 2 at 10%, and Model 3 at 1% significance level. Therefore, cointegration is confirmed in all the models.

4.3 Impact Analysis

The ARDL procedure is used in the estimation of the three models after confirming a long-run relationship in Model 1-3. The next step in the estimation process is the optimal lag length selection for all the models. The optimal leg length selected for Model 1 is ARDL (2 1, 0, 1, 0, 2): Model 2 is ARDL (2, 3, 1, 1, 0, 0) and for Model 3 is ARDL (2, 2, 2, 2, 0, 0) The long-run and short-run coefficients for Model 1, Model 2 and Model 3 are presented in Table 5.

Table 5: Long-Run and Short-Run Coefficients: Model 1, Model 2, and Model 3

Panel A: Long-Run Coefficients (Dependent Variables)						
Model	**Model 1 (Dependent Variable is Pov 1)**		**Model 2 (Dependent Variable is Pov 2)**		**Model 3 (Dependent Variable is Pov 3)**	
Regressor	**Coefficient**	**T-ratio**	**Coefficient**	**T-ratio**	**Coefficient**	**T-ratio**
C	0.4415	-0.3030	11.2368**	2.6702	0.0591	0.3867
FDI	-0.0013	-0.6400	-0.0086	-1.1329	-0.5956*	1.8081
HK	0.0166	1.3571	-0.0646*	-1.8772	-0.0019	-1.6615
TOP	-0.3433	-0.9470	-0.3359	-0.0373	0.0089	1.5591
CPI	0.0232***	11.1035	-0.0114*	-1.9936	0.7067**	2.5184
FTL	-0.6164**	-2.8145	0.0227**	6.2546	0.0591	0.3867
Panel B: Short -Run Results						
	Coefficient	**T-value**	**Coefficient**	**T-value**	**Coefficient**	**T-value**
ΔPov1	0.6836***	5.0760	-	-	-	-
ΔPov2	-	-	0.3980**	2.1637	-	-
ΔPov3	-	-	-	-	0.9654***	3.9538
ΔFDI	-0.0024***	-3.0389	-0.0018	-1.4208	-0.9681	-0.8302
ΔFDI(1)	-	-	0.8424	0.2656	0.2686**	2.4576
ΔFDI(2)	-	-	0.4416	0.1797	-	-
ΔHK	0.0095	1.4139	-0.0605*	-2.0254	0.1032	0.4843
ΔHK(1)	-	-	-	-	0.2662	1.2031
ΔTOP	0.5139*	1.9795	0.1504	0.3171	-0.1382	-0.485 1
ΔTOP(1)	-	-	-	-	-0.7804**	-2.5135

ΔCPI	0.0132***	4.4621	-0.0057	-1.7009	0.6416**	2.3540
ΔFTL	0.0389	0.8688	0.0114*	2.0595	0.3909	1.5689
ΔFTL(1)	0.1015*	2.0513	-	-	-	-
ECM(-1)	-0.5715***	-5.0829	0.5016**	-2.2010	-0.0908***	-7.5954
	Model 1		**Model 2**		**Model 3**	
R-squared	0.7237		0.7139		0.9926	
R-bar-squared	0.4474		0.5332		0.9869	
F-statistic	3.2742		5.2669		226.4561	
Prob (F-statistic)	0.012		0.001		0.000	
DW statistic	1.8988		2.1987		1.8079	
SE of Regression	0.2748		0.1030		0.1030	
Residual Sum of Squares	0.0748		0.2016		0.7558	
Akaike Info. Criterion	31.6425		22.6729		174.1465	
Schwartz Bayesian Criterion	20.1706		13.1456		164.1086	

Notes: *, ** and *** denotes stationarity at 10%, 5% and 1% significance levels respectively; Δ=first difference operator.
ΔPov1=Pov1-Pov1 (-1); ΔPov2=Pov2-Pov2 (-1); ΔPov3=Pov3-Pov (-1); ΔFDI=FDI-FDI (-1); ΔHK=HK-HK (-1); ΔTOP=TOP-TOP (-1); ΔCPI=CPI-CPI (-1);

ΔFTL=FTL-FTL (-1)

The results in Table 5, Panel A and Panel B, for Model 1 reveal that FDI has an insignificant impact on poverty reduction in the long run. However, a negative and statistically significant relationship was confirmed in the short run. The results suggest that FDI worsens poverty levels in Botswana only in the short run. Although these results were not expected, they are not unique to Botswana. Huang *et al.* (2010) and Ali and Nishat (2010), among others, found the same results. The coefficient on ΔPov1 is positive and statistically significant. Thus, past poverty reduction efforts have a positive impact on current poverty reduction. This implies that poverty reduction efforts are not only felt in the current period but also have spill over effects to the next period.

Long-run and short-run results for other variables reveal that (i) human capital (HK) is insignificant in both the long run and the short run; (ii) trade openness (TOP) is insignificant in the long run, although in the short run, the coefficient of trade openness (ΔTOP) is positive and statistically significant; (iii) price level (CPI) is positive and statistically significant in both the long run and the short run; (iv) infrastructure (FTL) is negative and has a statistically significant impact on poverty reduction in Botswana in the long run, while in the short run, a positive significant impact was registered at a 10% level of significance; (v) the error correction term lagged once [ECM (-1)] is negative and statistically significant at 1%, and thus adjustment to equilibrium following a shock to the economy is anticipated at the rate of 57% per annum; and (vi) the explanatory power of Model 1 is 79%, as reported in Table 7.3, Panel B.

The empirical results presented in Table 5, Panel A and Panel B, for Model 2 confirm that FDI is insignificant in the short run and the long run when infant mortality rate is used as a poverty reduction measure. The results imply that FDI has no impact on poverty reduction in Botswana, irrespective of the time frame under consideration. The results suggest that Botswana may not target FDI as a policy instrument solely for poverty reduction purposes. The results were not expected, but they compare favourably with other studies (see Sharma and Gani, 2004; Tsai and Huang, 2007; Gohou and Soumare, 2012, among other studies). The coefficient for infant mortality rate (ΔPov2) in the short run is positive and statistically significant at 5%. The results imply that past poverty reduction assists in reducing poverty in the current period.

Other long-run and short-run results confirm that (i) human capital (HK) is negative and statistically significant in the long run and in the short run; (ii) trade openness (TOP) is insignificant in the short run and the long run; (iii) price level (CPI) is negative and statistically significant in the long run and insignificant in the short run; (iv) infrastructure (FTL) is positive and statistically significant in the long run and in the short run; (v) the lagged error correction ECM (-1) is 0.50 and statistically significant at 5%, implying that it takes two years to have full adjustment to the equilibrium when there is disequilibrium in the economy; and (vi) Model 2 is a perfect fit, as shown by an R-squared of 71%.

Long-run results presented in Table 5, Panel A, for Model 3 show that FDI has a negative and statistically significant impact on poverty reduction in the long run, while in the short run a positive

and statistically significant relationship was revealed. The results suggest that FDI worsens poverty reduction in the long run but aid in poverty reduction in the short run. Thus FDI has short term benefits to poverty reduction when life expectancy is used as a poverty measure. Although a negative statistically significant relationship was confirmed in the long run, these results were not expected, but the compare favourably with findings by Huang *et al.* (2010). A positive statistically significant impact of FDI on poverty reduction was expected. Some studies also support the results (Israel, 2014; Uttama, 2015). Thus, the timing on the use of FDI as a policy instrument to positively affect poverty reduction is important in Botswana. Past poverty reduction is positive and statistically significant at 1%. The results imply that past poverty reduction contributes positively to current poverty reduction.

Other long-term and short-term results presented in Table 5, Panel A and Panel B, for Model 3 show that (i) human capital (HK) is statistically insignificant in both the short run and the long run; (ii) trade openness (TOP) is insignificant in the long run, while there is a negative and statistically significant impact in the short run; (iii) price level (CPI) is positive and statistically significant in the long run and in the short run; (iv) infrastructure (FTL) is insignificant in the short run and in the long run; (v) the error correction term ECM (-1) is 0.09 and statistically significant at 1%, implying that it takes over 10 years to get a full adjustment in the economy when there is disequilibrium; and (vi) the explanatory power of the model is 99%, as confirmed by the R-squared reported in Table 5, Panel B.

Diagnostic tests were performed on Model 1-3 for serial correlation, functional form, normality, and heteroscedasticity. Model 1 and Model 2 passed all the tests, while Model 3 passed the serial correlation, normality, and heteroscedasticity tests but failed the functional form. The results for the diagnostic tests are presented in Table 6.

Table 6: Diagnostic Test: Model 1-3

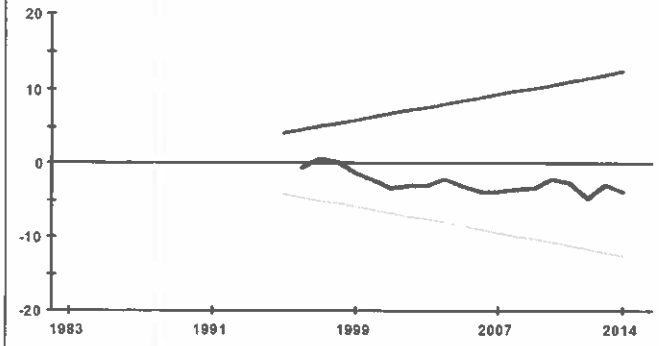
LM Test Statistic	**Results**		
	Model 1	**Model 2**	**Model 3**
Serial Correlation(CHSQ 1)	1.1546 [0.283]	1.454 [0.228]	0.262 [0.609]
Functional Form (CHSQ 1)	0.2763 [0.599]	0.884 [0.664]	10.263 [0.001]
Normality (CHSQ 2)	0.4323 [0.806]	3.435 [0.179]	0.028 [0.986]
Heteroscedasticity (CHSQ 1)	1.4447 [0.229]	0.563 [0.453]	0.125 [0.724]

The plot for Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) are given in Figure 1, Panel C, Panel D, and Panel E for Models 1-3, respectively.

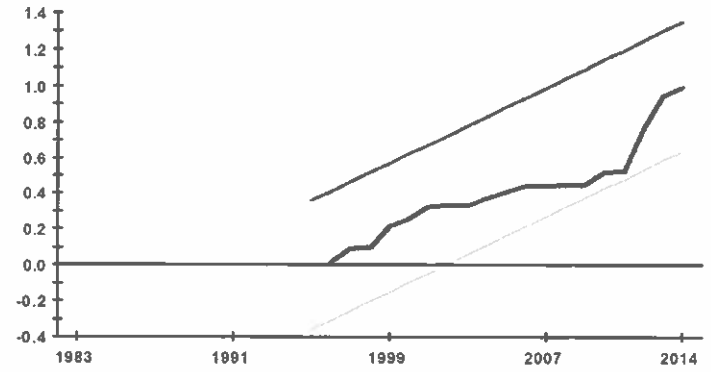
Figure 1: Plot of CUSUM and CUSUMSQ for Model 1-3

Panel C: Model 1

Cumulative sum of recursive residuals

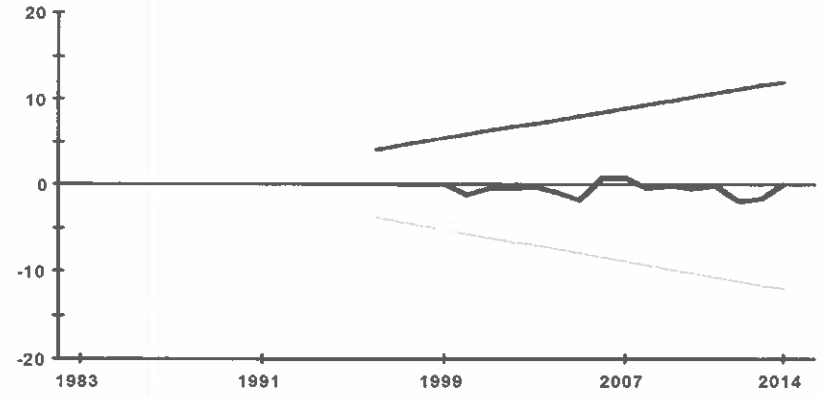


Cumulative sum of squares of recursive residuals

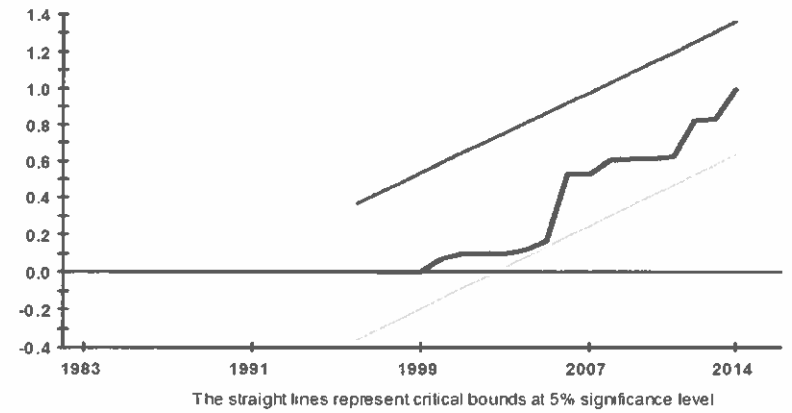


Panel D: Model 2

Cumulative sum of recursive residuals

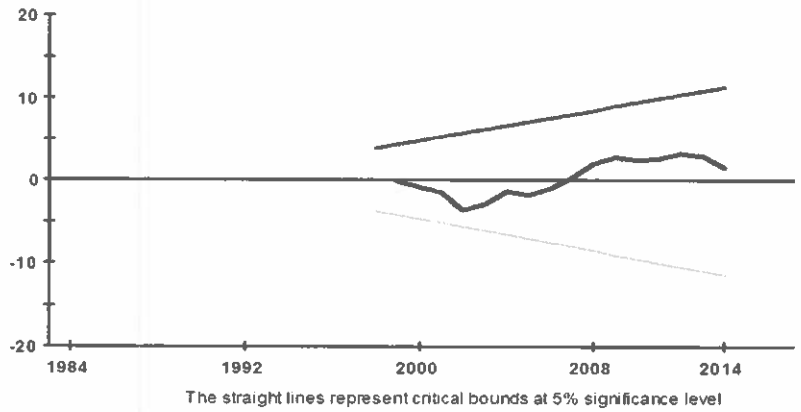


Cumulative sum of squares of recursive residuals



Panel E: Model 3

Cumulative sum of recursive residuals



Cumulative sum of squares of recursive residuals

Note: Straight lines represent critical bounds at 5% level of significance

The CUSUM and CUSUMQ plots show that parameters in the models are stable at 5% bounds.

5. Conclusion

This paper investigated the dynamic impact of FDI on poverty reduction in Botswana between 1980 and 2014. The impact of FDI on poverty reduction has received much attention, but only a few studies have investigated the direct impact of FDI on poverty reduction. The majority of previous studies have investigated the indirect impact of FDI on poverty reduction, realised through economic growth. Of the few studies that have investigated the direct impact of FDI on poverty reduction, the results are inconclusive. This study attempted to investigate the direct impact of FDI on poverty reduction in Botswana. Furthermore, the study also employed the ARDL bounds testing approach because of its various known advantages. The study also used three poverty reduction proxies to investigate the impact of FDI on poverty reduction. This allowed the study to adequately measure multi-dimensional aspects of poverty. The results of this study reveal that FDI has a negative statistically insignificant impact on poverty reduction in the short run, while an insignificant relationship was confirmed in the long run when household consumption expenditure (Pov1) was used as a poverty reduction proxy. The results also confirm that FDI has a negative impact on poverty reduction irrespective of the time considered when life expectancy – Pov3 is used as a poverty reduction proxy. When infant mortality rate (Pov2) is used as a poverty reduction proxy, FDI is statistically insignificant in both the long run and the short run. The findings from this study confirm the importance of timing if the positive effects of FDI on poverty reduction are to be harnessed. Thus, the impact of FDI on poverty reduction is sensitive to the poverty reduction proxy used and timing. The results also show that one past period poverty reduction has a positive impact on current poverty reduction, despite the poverty reduction proxy used.

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