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FDI AND POVERTY REDUCTION IN BOTSWANA: A MULTIVARIATE CAUSALITY TEST

Mercy T. Musakwa,
University of South Africa, Pretoria, South Africa
E-mail: tsile.musa@gmail.com

Nicholas M. Odhiambo,
University of South Africa, Pretoria, South Africa
E-mail: odhianm@unisa.ac.za

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ABSTRACT. In this study, the causal relationship between foreign direct investment (FDI) inflows and poverty is investigated using Botswana as a case study, 1980 to 2017, using a trivariate causality framework. The main objective of this study is to establish the direction of causality between FDI and poverty. Three proxies of poverty have been used: 1) household consumption expenditures; 2) infant mortality rate and 3) life expectancy. The study uses the ARDL-bounds testing approach and ECM-based Granger-causality model in a stepwise fashion to examine this linkage. The empirical results show that the causal relationship between FDI and poverty reduction in Botswana may be sensitive to the proxy used to measure the level of poverty reduction. When infant mortality rate and life expectancy are used as proxies for poverty reduction, a unidirectional causality from FDI to poverty is found to prevail both in the short and in the long run. However, when household consumption expenditure is used as a proxy, no causality is found, irrespective of whether the causality test is conducted in the short or in the long run. On the whole, the study found that Botswana could benefit from FDI inflows in the fight against poverty.

JEL Classification: F21, I32

Keywords: Botswana, household consumption expenditure, infant mortality rate, life expectancy, Granger causality.

Introduction

The causal relationship between poverty and FDI has received little coverage in literature. The majority of studies have mainly focused on the dynamic impact of FDI on poverty, and only a few studies have taken the analysis further in order to establish a causal relationship between the two. Further, some of the studies have used cross-sectional data to investigate the causal relationship between FDI and poverty, an approach that has its limitations. In addition, few studies that have attempted to establish causality between FDI and poverty have used a bivariate framework; although this technique is now known to suffer from the omission-of-bias limitation (Solarin & Shahzab, 2013). To address some of the limitations of the previous studies, the causal

relationship between FDI and poverty is investigated in a trivariate framework, and gross domestic product (GDP) has been selected as an intermittent variable. The inclusion of a third intermittent variable can alter the direction of causality and the magnitude of results (Loizides & Vamvoukas, 2005; Odhiambo, 2009b).

The few studies analyzing the causal relationship between FDI and poverty have found mixed results. Some studies have found unidirectional causality between FDI and poverty (Gohou and Soumare, 2012). Other studies have found a bidirectional causal relationship between the two variables (for example, Soumare, 2015). There are yet further studies that have found no causality between FDI and poverty (Ogunniyi & Igberi, 2014). The results from the studies that have investigated the causal relationship between FDI and poverty have varied depending on the poverty proxy used, sample period, and methodology employed, making a generalisation of the findings across all countries inappropriate.

The current study aims to establish the causal relationship between FDI and poverty in Botswana between 1980 and 2017 using the ECM-based Granger-causality test. The study differs from other studies in several ways. Firstly, the ARDL bounds testing approach to cointegration that has been used in this study has a number of advantages. For instance, the ARDL bounds approach to cointegration is robust in small samples (Odhiambo, 2008; Solarin & Shahbaz, 2013). Secondly, the study analyses the causal relationship between FDI and poverty in a trivariate framework. This overcomes the limitations of a bivariate framework that has been employed in some previous studies (Solarin & Shahzab, 2013). Thirdly, the study investigates the causal relationship between FDI and poverty using three poverty proxies: household consumption expenditure (Pov1), infant mortality rate (Pov2), and life expectancy (Pov3). Unlike some previous studies that have relied on one poverty proxy, the inclusion of three poverty measures gives another angle on the causal relationship between FDI and poverty and increases the robustness of the results. To our knowledge, this may be the first study of its kind to examine in detail the causal relationship between FDI and poverty in Botswana using modern time-series techniques.

Botswana was among the nations that signed the United Nation's Millennium Development Goals (MDGs) declaration in 2000 and the Sustainable Development Goals 2030 in 2015 (United Nations, 2000; United Nations, 2017). Apart from international collaboration, Botswana has also implemented poverty reduction policies through the National Development Plans and Vision 2016. The National Development Plan 10 aims to accelerate the achievement of Vision 2016, a long-term vision for Botswana, which was initiated in 1996. Pillar 3, which focuses on building a compassionate, just, and a caring nation has included poverty reduction and increased access to healthcare, education, and employment among other important poverty alleviation initiatives. The National Strategy for Poverty Reduction, launched in 2003, has taken initiatives to broaden and deepen programmes aimed at poverty alleviation. Government strategy on poverty reduction can be viewed as a three-pronged approach: (i) stimulating economic growth, economic diversification, employment creation, and income generation capacity and empowerment as the ways of drawing the poor from poverty trap; (ii) development of infrastructure to increase government capacity in service provision; and (iii) provision of social safety nets to capture those without access to economic development opportunities.

There has been a positive response to poverty reduction policies, as shown by poverty headcount, poverty gap and the income share of the bottom 20% of the population. Poverty improved from 42.6% in 1985 when considering poverty headcount at $1.90 to 16.1% in 2015 (World Bank, 2019). Poverty headcount at $3.30 recorded 63.8% and 81.6% at $5.50 in the same

period (World Bank, 2019). During the same period, poverty severity improved across all poverty lines. For instance, poverty gap at $1.90 declined from 17.9% in 1985 to 4.3% in 2015 (World Bank, 2019). According to the World Bank (2019), poverty in Botswana tends to increase sharply when higher poverty lines are considered. The share of the bottom 20% in Botswana remains depressed from 3.6% in 1985 to 3.9% in 2015 (World Bank, 2019). Although a slight increase has been recorded over the years, the figures remain thin in comparison to income held by the highest 20% of the population recorded at 58.9% and 58.5% in 1985 and 2015 respectively. Although there was a reduction in poverty and a marginal increase in the percentage of income held by the bottom 20% of the population, variations in poverty levels across sex of a household head and at district level were noted (Statistics Botswana, 2013).

The government has also implemented policies in support of investment from both domestic and foreign sources, and the policies have been enshrined in the National Development Plans (NDP). Government policy on FDI is enshrined in Pillar 2 in the NDP 10 that strives to build a prosperous, productive and innovative nation. The Ministry of Trade and Industry (MTI) spearheads internal and external mobilisation of funds for economic growth, among other key economic roles. Government policies that focuses on attracting FDI included exchange control reforms, building a stable and sound macroeconomic environment, regulatory reforms, trade agreements, regional integration, investment incentives, and building of special economic zones, among others. The government has also made a concerted effort to channel diamond proceeds towards stimulating economic development, which is important for investment. Botswana received modest FDI inflows from 1980 to 2000, with an average of 2.9%, and a gradual increase was recorded from 2000 to 2017, with an average of 3.7% although characterised by huge fluctuations (United Nations Conference on Trade and Development (UNCTAD), 2019). During the same period, the highest FDI inflows were received in 2015 with inflows of $679 million (UNCTAD, 2019).

The rest of the paper is divided as follows: Section 1 provides a brief review of literature; Section 2 outlines the methodological approach, covering variable definition, the specification of the models and data sources; Section 3 discusses the results of the study.

1. Literature review

The literature on the causal relationship between FDI and poverty is limited, especially on African countries, though growing. Among the studies that have attempted to analyse this relationship the results are inconclusive. Some studies have found unidirectional causal relationship; other studies have found bidirectional causality between these variables; while another set of studies have found no causal relationship between FDI and poverty. The causal relationship between these variables varies depending on the domain, poverty measure, and sample period. Lack of consistency in the results makes a generalisation on the causality results from one study to another unsuitable.

Gohou and Soumare (2012) investigated the causality between FDI and poverty in five regional economic communities and five customs and monetary unions in Africa. Using the Human Development Index (HDI) as a measure of welfare, a unidirectional causal relationship was found running from FDI to HDI. Fauzel et al. (2015) carried out a causality study on selected African countries and, employing Granger-causality analysis, found unidirectional causality running from FDI to poverty. In a separate study, Soumare (2015) studied the causal relationship

between FDI and poverty in North Africa between 1990 and 2011. Using the Granger-causality test, unidirectional causality was found running from FDI to HDI in Egypt, Morocco, Tunisia, and Mauritania.

Besides studies that have found unidirectional causality, other studies have found a bidirectional causal relationship between FDI and poverty. Gohou and Soumare (2012) investigated the causal relationship between FDI and poverty in five regional economic communities and five customs and monetary unions in Africa from 1990 to 2007. In their study, GDP per capita was used as a poverty proxy and the Granger-causality test was employed. A bidirectional relationship between GDP per capita and FDI was found in the whole region. In a study on North African countries from 1990 to 2011, Soumare (2015) employed the Granger-causality test and found bidirectional causality between FDI and HDI in Algeria. In the same study, when real per capita GDP was used as poverty proxy, bidirectional causality was found in all countries with the exception of Libya.

Conversely, other studies have found no causal relationship between FDI and poverty. Ogunniyi and Igberi (2014) investigated the causal relationship between FDI and the standard of living in Nigeria between 1980 and 2012. Using per capita income as a standard of living proxy and employing the Granger causality test, they found no causality between FDI and poverty. Thus, empirical findings on the causal relationship between FDI and poverty are inconclusive.

2. Methodological approach

In this study, the autoregressive distributed lag (ARDL) bounds test for cointegration and ECM-based causality testing were employed. The tests were selected because of their numerous advantages. The ARDL approach to cointegration is robust in small samples (see Odhiambo, 2009a; Solarin and Shahbaz, 2013). While other conventional approaches to cointegration have a restrictive assumption on the order of integration of variables, the ARDL-bounds test can be used even when series have a different order of integration (Pesaran *et al*., 2001: 290; Solarin & Shahbaz, 2013). Another advantage of using the ARDL approach to cointegration is that it provides unbiased estimates of the long-run model, even in cases where some variables are endogenous (see Odhiambo, 2009a). The ARDL approach also uses a reduced form single equation, while other conventional cointegration methods employ a system of equations (Pesaran and Shin, 1999). Given these advantages, the study uses the ADRL-bounds testing approach to cointegration. To determine cointegration, the null hypothesis of no cointegration is tested against the alternative hypothesis of cointegration. The calculated F-statistic is compared to the critical values provided by Pesaran *et al*. (2001). If the calculated F-statistic falls above the critical value, the null hypothesis of no cointegration is rejected. Alternatively, if the F-statistic falls below the lower bound, we conclude that there is no cointegration. However, if the F-statistic falls between the upper and the lower bound, the results are inconclusive.

After confirming the existence of a long-run relationship, the next step is to establish the direction of causality. The presence of cointegration only indicates the presence of a long-run relationship and the existence of causality at least in one direction (Narayan & Smyth, 2004). The causal relationship between poverty and FDI is investigated using the ECM-based approach in a trivariate framework. The intermittent variable that has been selected in this study is the gross domestic product (GDP). This provides a trivariate causality framework consisting of poverty, FDI, and GDP. This approach addresses the weakness of a bivariate framework wherein the results

may suffer from omission-of-variables-bias (among others, see Odhiambo, 2008).

A number of poverty proxies have been used in the literature, including household consumption expenditure, GDP per capita, and poverty indices, income held by the bottom 20% of the population and human development index, among other poverty proxies. Due to limited time-series data and the need to capture the multidimensional aspects of poverty, household consumption expenditure (Pov1), infant mortality rate (Pov2), and life expectancy (Pov3) were employed. Model 1a investigates the causality between FDI and household consumption expenditure (Pov1), Model 1b investigates the causality between FDI and poverty proxied by infant mortality rate, and Model 1c analyses the causality between FDI and poverty proxied by life expectancy (Pov3).

2.1 Cointegration

Following Narayan and Smyth (2008) and Odhiambo (2008), the ARDL-bounds specification for Models 1a-c is presented in Equations 1-9.

ARDL Model Specification for Model 1a (Pov1, FDI, and GDP)

$$\Delta Pov1_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta Pov1_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta GDP_{t-i} + \beta_1 Pov1_{t-1} + \beta_2 FDI_{t-1} + \beta_3 GDP_{t-1} + \mu_{1t} \quad (1)$$

$$\Delta FDI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta Pov1_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta GDP_{t-i} + \beta_1 Pov1_{t-1} + \beta_2 \beta_2 FDI_{t-1} + \beta_3 GDP_{t-1} + \mu_{1t} \quad (2)$$

$$\Delta GDP_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta Pov1_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta GDP_{t-i} + \beta_1 Pov1_{t-1} + \beta_2 FDI_{t-1} + \beta_3 GDP_{t-1} + \mu_{1t} \quad (3)$$

Where α_0 is a constant, α_1 - α_3 and $\theta_1 - \theta_3$are regression coefficients, and μ_{1t} is an error term.

ARDL Model Specification for Model 1b (Pov2, FDI, GDP)

$$\Delta Pov2_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta Pov2_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta FDI_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta GDP_{t-i} + \theta_1 Pov2_{t-1} + \theta_2 FDI_{t-1} + \theta_3 GDP_{t-1} + \mu_{2t} \quad (4)$$

$$\Delta FDI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\, \Delta Pov2_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 Pov2_{t-1} + \theta_2 FDI_{t-1} + \theta_3 GDP_{t-1} + \mu_{2t} \quad (5)$$

$$\Delta GDP_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\, \Delta Pov2_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 Pov2_{t-1} + \theta_2 FDI_{t-1} + \theta_3 GDP_{t-1} + \mu_{2t} \quad (6)$$

Where α_0 is a constant, α_1 - α_3 and $\theta_1 - \theta_3$are regression coefficients, and μ_{2t} is an error term.

ARDL Model Specification for Model 1c (Pov3, FDI, GDP)

$$\Delta Pov3_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov3_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 Pov3_{t-1} + \theta_2 FDI_{t-1} + \theta_3 GDP_{t-1} + \mu_{3t} \quad (7)$$

$$\Delta FDI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\, \Delta Pov3_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 Pov3_{t-1} + \theta_2 FDI_{t-1} + \theta_3 GDP_{t-1} + \mu_{3t} \quad (8)$$

$$\Delta GDP_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\, \Delta Pov3_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 Pov3_{t-1} + \theta_2 FDI_{t-1} + \theta_3 GDP_{t-1} + \mu_{3t} \quad (9)$$

Where α_0 is a constant, α_1 - α_3 and $\theta_1 - \theta_3$are regression coefficients, and μ_{3t} is an error term.

2.2 A Granger-Causality Model Specification

The ECM-based Granger-causality models are specified for Models 1a-c. The inclusion of the lagged error correction term reintroduces the long-run relationship that could have been lost with differencing (see Odhiambo, 2009a). The ECM-based model also enables us to conduct the causality test both in the short run and in the long run. The F-statistics obtained from the Variable Deletion Test or the Wald Test give the short-run causality, while the long-run causality is given by the t-statistic on the lagged error correction term.

ECM-based Granger-causality for Model 1a (Pov1, FDI, GDP)

The ARDL Granger-causality model specification for Model 1c is given in Equations 10-12.

$$Pov1_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov1_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 ECM_{t-1} + \mu_{1t} \quad (10)$$

$$\Delta FDI_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov1_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_2 ECM_{t-1} + \mu_{2t} \quad (11)$$

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov1_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_3 ECM_{t-1} + \mu_{3t} \quad (12)$$

Where α_0 is a constant, α_1 - α_3 and $\theta_1 - \theta_3$are regression coefficients, and $\mu_{1t} - \mu_{3t}$ are the error terms.

ECM-based Granger-causality for Model 1b (Pov2, FDI, GDP)

The ARDL Granger-causality model specification for Model 1b is given in Equations 13-15.

$$\Delta Pov2_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov2_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 ECM_{t-1} + \mu_{1t} \quad (13)$$

$$\Delta FDI_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov2_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_2 ECM_{t-1} + \mu_{2t} \quad (14)$$

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov2_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_3 ECM_{t-1} + \mu_{3t} \quad (15)$$

Where α_0 is a constant, α_1 - α_3 and $\theta_1 - \theta_3$are regression coefficients, and $\mu_{1t} - \mu_{3t}$ are the error terms.

ECM-based Granger-causality for Model 1c (Pov3, FDI, GDP)

The ARDL Granger-causality model specification for Model 1c is given in Equations 16-18.

$$\Delta Pov3_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov3_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_1 ECM_{t-1} + \mu_{1t} \quad (16)$$

$$\Delta FDI_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov3_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_2 ECM_{t-1} + \mu_{2t} \quad (17)$$

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta Pov3_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta\, FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i}\, \Delta GDP_{t-i} + \theta_3 ECM_{t-1} + \mu_{3t} \quad (18)$$

Where α_0 is a constant, α_1 - α_3 and $\theta_1 - \theta_3$are regression coefficients, and $\mu_{1t} - \mu_{3t}$ are the error terms.

2.3 Data Sources

The study used time series data from 1980 to 2017 to investigate the dynamic causal relationship between poverty and FDI. The data on gross domestic product, household consumption expenditure, life expectancy, and infant mortality rate were obtained from the World Bank development indicators, while the data on FDI data was extracted from UNCTAD database. The data were analysed using Microfit 5.0.

3. Conducting research and results

3.1 Unit Root Tests

In this study, unit root tests were carried out on Pov1, Pov2, Pov3, FDI, and GDP to confirm if the variables were integrated of at most order 1 [I (1)]. The ARDL approach is only applicable if the variables are integrated of order zero [I (0)], order one [I (1)], or fractionally integrated (Pesaran et al., 2001). The results of Dickey-Fuller generalised least squares (DF-GLS), Phillip-Perron (PP root) and Perron unit root tests (PPU root test) are presented in Table 1.

Table 1. Unit Root Test Results

	DF-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	0.0189	-1.0203	-2.0555**	-4.6969***	1.3915	-1.4722	-3.6249**	-3.986**	-3.4651	-3.8583	-5.5122**	-5.8573**
Pov2	0.5891	-3.7760***	-2.6817**	-	-1.2385	-1.6345	-3.0331**	-5.6714***	-3.5099	-3.4544	-5.6275**	-5.6766**
Pov3	1.1425	-3.2953**	-	-2.6589***	-	-0.3147	-	-	-	-	-	-
					9.0027***			5.9811***	5.3438**	6.4219***		
FDI	-2.2226*	-3.1626**	-	-	-	-	-	-	-	-5.3916*	-	-
					4.2889***	4.1358*			5.3789**			
GDP	2.4286**	-1.6609	-	-5.4930***	2.5965	-1.5435	-6.2239***	-7.8998***	-2.7396	-4.2727	-7.6129***	-7.6283***

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

3.2 Bounds Testing Approach to Cointegration

The cointegration results are presented in Table 2.

Table 2. Bounds F-test for Cointegration: Model 1a-c

Dependent Variable	**Function**		**F-Statistic**		**Cointegration Status**	
Panel A: Model 1a						
Pov1	F(Pov1|FDI, GDP)		1.9014		Not Cointegrated	
FDI	F(FDI|Pov1,GDP)		4.3029*		Cointegrated	
GDP	F(GDP|Pov1, FDI)		0.9004		Not Cointegrated	
Panel B: Model 1b						
Pov2	F(Pov2|FDI, GDP)		2.6884		Not Cointegrated	
FDI	F(FDI|Pov2,GDP)		4.9178**		Cointegrated	
GDP	F(GDP|Pov2, FDI)		0.6228		Not Cointegrated	
Panel C: Model 1c						
Pov3	F(Pov3|FDI, GDP)		5.1705**		Cointegrated	
FDI	F(FDI|Pov3,GDP)		2.9643		Not Cointegrated	
GDP	F(GDP|Pov3, FDI)		0.2247		Not Cointegrated	
Asymptotic Critical Values (unrestricted intercept and no trend)						
Pesaran *et al*. (2001:300)	1%		5%		10%	
critical values (Table	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
CI(iii), Case III)	5.15	6.36	3.79	4.85	3.17	4.14

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

The results reported in Table 2 confirm cointegration between poverty proxies (i.e. Pov1, Pov2 and Pov3), FDI, and GDP, although the results are sensitive to the poverty proxy used. The F-statistics confirm the existence of cointegration between poverty proxies (Pov1, Pov2 and Pov3), FDI, and GDP. The presence of cointegration in any one of the equations in Model 1a, Model 1b, and Model 1c indicates the presence of causality in at least one direction (see Granger, 1988; Narayan and Smyth, 2008). The direction of causality is obtained by running an ECM-based Granger-causality test.

3.3 ECM-Based Causality Testing

After establishing the existence of cointegration between poverty – Pov1, Pov2, Pov3 – FDI, and GDP, an ECM was included as an additional variable in the Granger-causality analysis for those equations where cointegration was confirmed. For those equations where no cointegration was confirmed, the Granger causality test was performed on the variables without an ECM. The short-run causality was determined by the F-statistics on the explanatory variables given by the variables deletion test, and the long-run causality was determined by the significance of the lagged error correction term using the t-statistic (see Narayan and Smyth, 2008; Odhiambo, 2009a). The results of the ECM-based causality test are reported in Table 3.

Table 3. ECM-Based Causality Results

Panel A: Model 1a				
Dependent Variable	**F-Statistics**			**ECM**
	ΔPov1	ΔFDI	ΔGDP	**t-statistics**
ΔPov1	-	0.4488 [0.508]	3.7265* [0.063]	-
ΔFDI	1.8822 [0.181]	-	6.2704*** [0.018]	-0.5414** [-3.388]
ΔGDP	0.3428 [0.563]	3.5025* [0.072]	-	-
Panel B: Mode1 1b				
Dependent Variable	**F-Statistics**			**ECM**
	ΔPov2	ΔFDI	ΔGDP	**t-statistics**
ΔPov2	-	3.0860* [0.045]	3.5059** [0.045]	-0.1169** [-2.099]
ΔFDI	0.0014 [0.972]	-	6.8164*** [0.014]	-
ΔGDP	2.9316* [0.097]	1.8105 [0.188]	-	-
Panel C: Model 1c				
Dependent Variable	**F-Statistics**			**ECM**
	ΔPov3	ΔFDI	ΔGDP	**t-statistics**
ΔPov3	-	3.2740* [0.080]	8.0203** [0.008]	-0.225*** [-3.997]
ΔFDI	0.0082 [0.929]	-	7.1056** [0.012]	-
ΔGDP	1.5730 [0.220]	3.1834* [0.085]	-	-

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

The results presented in Table 3, Panel 2 and Panel 3 confirm a unidirectional causality from FDI to Pov2 and from FDI to Pov3 both in the short run and in the long run. The short-run causality is confirmed by a statistically significant F-statistic for DFDI in the Pov2 and Pov3 function, while long-run causality is confirmed by the error correction term in the Pov2 and Pov3 functions. The results imply that FDI Granger-causes poverty in the short run and in the long run in Botswana when the level of poverty is measured by infant mortality rate (Pov2) and life expectancy (Pov3). The results compare favourably with findings from other studies (see, for example, Fauzel *et al*., 2015; Soumare, 2015). The results are in line with the theoretical benefits of FDI (direct and indirect benefits). The direct effects are realised through creation of job opportunities and increase in government tax base, while the indirect effects (spillover effects) are the vertical and horizontal effects associated with FDI. However, when poverty is measured by household consumption expenditure (Pov1) no causality was found in the short run and in the long run. Although this finding was not expected, it is not unique to Botswana alone. Gohou and Somaure (2012) and Ogunniyi and Igberi (2014) found the same results in African countries and Nigeria respectively. The causality between FDI and poverty is sensitive to the poverty proxy employed as revealed by the results presented in Table 2. Nevertheless, there is strong evidence

that FDI has poverty-alleviating effect in Botswana as evidenced by a unidirectional causality from FDI to poverty in two out of the three poverty proxies used in this study.

The results of the study further revealed that when household consumption expenditure (Pov1) is used as a poverty measure, there is (i) a distinct unidirectional causality from GDP to poverty (Pov1) in the short run; and (ii) a bidirectional causality between GDP and FDI in the short run and a unidirectional causality from GDP to FDI in the long run. When infant mortality rate (Pov2) is used as a poverty measure, there is (i) a bidirectional causality between poverty (Pov2) and GDP in the short run and a unidirectional causality from GDP to poverty in the long run; and (ii) a unidirectional causality from GDP to FDI in the short run. In Botswana high economic growth plays a vital role in attracting more FDI according to the findings of this study. Finally, when Pov3 (life expectancy) is used as a poverty proxy, there is (i) a unidirectional causality from GDP to poverty in the short run and in the long run; and (ii) a bidirectional causality between FDI and GDP in the short run and in the long run. Thus, high economic growth tends to attract more foreign investment and in return, the high investment results in high economic growth. A summary of the Granger-causality results between FDI and poverty is presented in Table 4.

Table 4. Summary of Causality Results

	Causality	
	Short run	**Long run**
Model 1a (Pov1)	No causality	No causality
Model 1b (Pov2)	FDI→ Pov2	FDI→ Pov2
Model 1c (Pov3)	FDI→ Pov3	FDI→ Pov3

Notes: Pov1= household consumption expenditure; Pov2 = infant mortality rate; Pov3 = life expectancy

Conclusion

This study investigated the causal relationship between poverty and FDI in Botswana using data from 1980 to 2017. The study differs from previous studies in several ways. Unlike some previous studies that have relied on one poverty proxy, the current study uses three proxies to measure the level of poverty. These include household consumption expenditure (Pov1), infant mortality rate (Pov2), and life expectancy (Pov3). The inclusion of three poverty measures gives another angle on the causal relationship between FDI and poverty and increases the robustness of the results. In addition, the study analyses the causal relationship between FDI and poverty in a trivariate framework. This overcomes the omission-of-variable-bias limitation, which has been found to be associated with a bivariate framework (see Solarin & Shahzab, 2013). Specifically, the study included gross domestic product as a third variable in a bivariate causality model between FDI and different proxies of poverty reduction – thereby leading to a trivariate Granger-causality model. The study employed the autoregressive distributed lag (ARDL) bounds testing approach to cointegration and the ECM-based causality test to examine this linkage. Our empirical results found that when household consumption expenditure was used as a poverty proxy, no causality was found to prevail both in the short run and in the long run. However, when the infant mortality rate and life expectancy were used as proxies, a distinct unidirectional causal flow from FDI to poverty (infant mortality rate and life expectancy) was found. Based on these

findings, it can be concluded that the causal relationship between FDI and poverty is sensitive to the proxy used to measure the level of poverty and to the time considered. The study, therefore, recommends that policies aimed at promoting FDI be intensified in Botswana as a step towards poverty reduction. This is supported by a unidirectional causality from FDI to poverty (infant mortality rate – Model 2 and life expectancy – Model 3).

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