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BRIDGING BORDERS, NOURISHING NATIONS: THE IMPACT OF FOREIGN DIRECT INVESTMENT ON TANZANIA'S CEREAL YIELD

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Abstract

Scholars have shown Foreign Direct Investment (FDI) to play a vital role in enhancing productivity of resources. However, the existing literature is mixed on the effects of FDI particularly in agriculture. This paper examines the effects of agricultural FDI inflows on aggregate cereal yield in Tanzania. World Bank World Development indicators data (1970 – 2016) was used. The bounds test was used to examine the existence of a long-run relationship between FDI and cereal yield, while Autoregressive Distributed lag (ARDL) and Vector error correction model (VECM) were used to determine the existence of short-run and long-run causality between the variables, respectively. Findings show that there is a short-run relationship between FDI and cereal yield in Tanzania. In the long run, when FDI inflow increases by 1%, cereal yield increases marginally by about 0.07% ($p<0.05$). Thus, long-term investments coupled with increased FDI absorptive capacity, are crucial for improving Tanzania's cereal yield.

Keywords: *Effects, Foreign direct investment, Cereal Yield, Tanzania, Granger causality*
JEL Codes: *F13, F20, F21, F30*

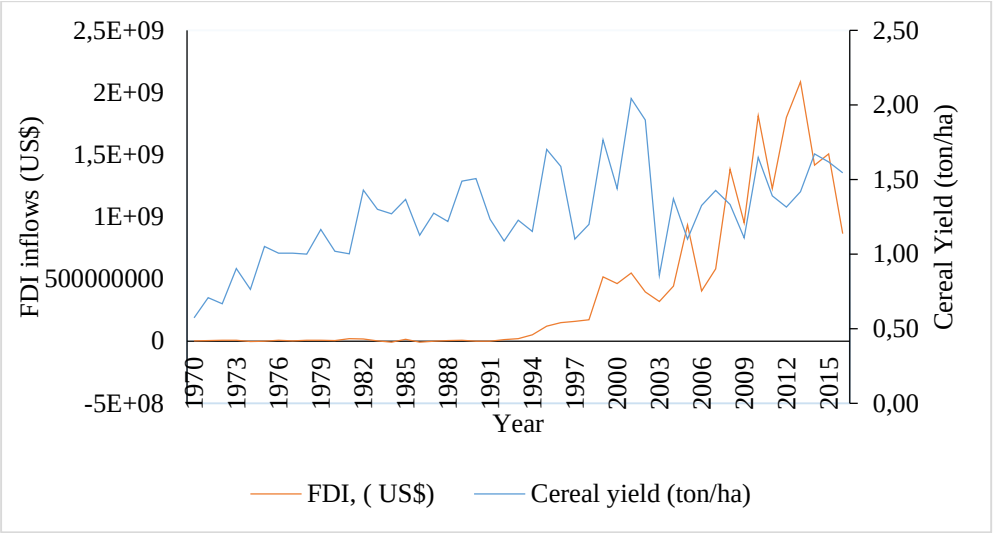
1. Introduction

Agricultural productivity growth has become imperative given the decrease in per capita arable land propelled by an increase in population, urbanisation and a rise in land markets, particularly in Sub-Saharan Africa (FAO, 2019). The agricultural sector is important for development since more than 70% of people in Sub Sahara Africa (SSA) live in rural areas where their main source of livelihood is agriculture (Fasha & Minde, 2020; Jiang and Chen, 2020). Furthermore, growth generated from the sector is urged to be about 2-4 times more effective in reducing poverty than growth in other sectors (Rashid, 2021; World Bank, 2022).

Despite the potential of the agricultural sector in reducing poverty in SSA, productivity growth, particularly in the cereals (maize, rice, wheat, millet and sorghum) sub-sector, has been low at an average of 1.5 tons/ha mainly due to low adoption of improved technology, low input use and low investment in the sector where governments spend less than 10% of their total budgets in Agriculture, and the share has been decreasing (Gunasekera et al., 2015). According to Gunasekera et al. (2015), between the year 1975 to 2007, SSA lagged behind other regions in terms of total factor productivity (TFP) growth, averaging at 0.9% relative to 1.4% in Asia excluding China, whose TFP was 2.1%, and 1% for Latin America. The study also found that a 10% rise in public sector spending in the agricultural sector is estimated to increase agricultural total factor productivity by 0.34%, holding other factors constant. The observed low investment in the sector in SSA has resulted in stagnant growth and a challenge in reducing food insecurity and poverty (FAO, 2019). Given the low investment in the sector due to low internal savings, foreign direct investment (FDI) has become an important lifeline for most developing countries, including Tanzania.

Foreign direct investment is defined as the net inflow of investments acquired for the long-term management interest, usually having 10% or more of the voting right of a firm working in a territory which is different from that of the investor Barkauskaitė & Naraškevičiūtė (2016), play an important role as a source of productivity growth through capital accumulation, technology transfer, skills acquisition and diffusion of innovation, and incorporation of new and improved inputs in a production function of a host country (Almfraj & Almsafir, 2014; Mamba et al., 2020). The FDI can play a vital role in two major specific areas in the agricultural sector by raising productivity in the currently existing cultivated land and developing suitable land in areas where it is currently available but inefficiently cultivated. It is a catalyst for economic growth by facilitating an increase in the stock of human capital, access to foreign markets, technological inputs and research and development, as well as an effective use of local raw materials (Latif et al., 2018; Iamsiraroj, 2015; Miao et al., 2020; Lucas, 1988). For example, a study by Feeny et al. (2014) in the Pacific Islands countries found that a 10% increase in FDI led to an increase in growth rate by 2% on average. Similarly, the results from Barkauskaitė and Naraškevičiūtė, (2016) study on the impacts of FDI on economic indicators in the Baltic countries show revealed that FDI had positive impacts on economic growth through factor productivity growth.

According to UNCTAD (2020), seven of the top 20 FDI recipient countries were developing countries. Tanzania is one of the FDI recipient countries in Africa, showing a positive trend in FDI inflows as depicted in Figure 1, where FDI inflow increased from 3070000 US$ in 1970 to 864040000 US$ in 2016. On the demand side, the observed increase in the level of FDI in the country has been triggered by the need by the host country to finance development projects by filling the deficit gap, particularly in the agricultural sector left by internal sources, an increase in population and market potential. On the supply side (investors), the size of agricultural land in the country relative to other countries, infrastructure development and institutional quality have played a vital role in attracting foreign direct investment. In 2016, the World Bank extended US$ 70 million to support Tanzania's Southern Agricultural growth corridor (SAGCOT) by linking smallholder farmers to large and medium-scale agribusiness firms (World Bank, 2016). This has resulted in an increase in cereal productivity which shows a positive trend (Figure 1) from 0.57 tons/ha in 1970 to about 1.55 tons/ha in 2016. Despite the observed trend in cereal productivity and FDI in Tanzania, the sector has performed poorly, particularly in the last two decades, whereby the average agricultural productivity growth stood at 4% below the recommended growth of 6% (URT, 2016).



Source: World Development Indicators

Figure 1: FDI inflows and Cereal Yield trend in Tanzania from 1970 – 2016

From the extant literature, the level of FDI inflows into the host country may not affect agricultural productivity and economic growth on its own, but it is conditional on the existence of other factors. For FDI to bring about positive impacts, the recipient country should have developed adequate and strong institutions, infrastructure, and a relatively sufficient stock of human capital as an absorptive capacity to tap the advanced technology brought about by FDI (Gunasekera et al., 2015; Benhabib & Spiegel, 1994; Akinlo, 2004; Iamsiraroj, 2016). In addition, several other scholars put forward that the beneficial impacts of FDI can be attained if and only if there is macroeconomic stability, transparency practices, open trade and investment regime and political stability (Balasubramanyam et al., 1996; Basu & Guariglia, 2007; Baltabaev, 2014). Furthermore, a recent study by Miao et al. (2020) on the impacts of China-Africa economic relation on factor productivity of African countries revealed that the impacts are conditional on the domestic institutional quality of African countries backed by the local adaptive capacity to use the transferred technology.

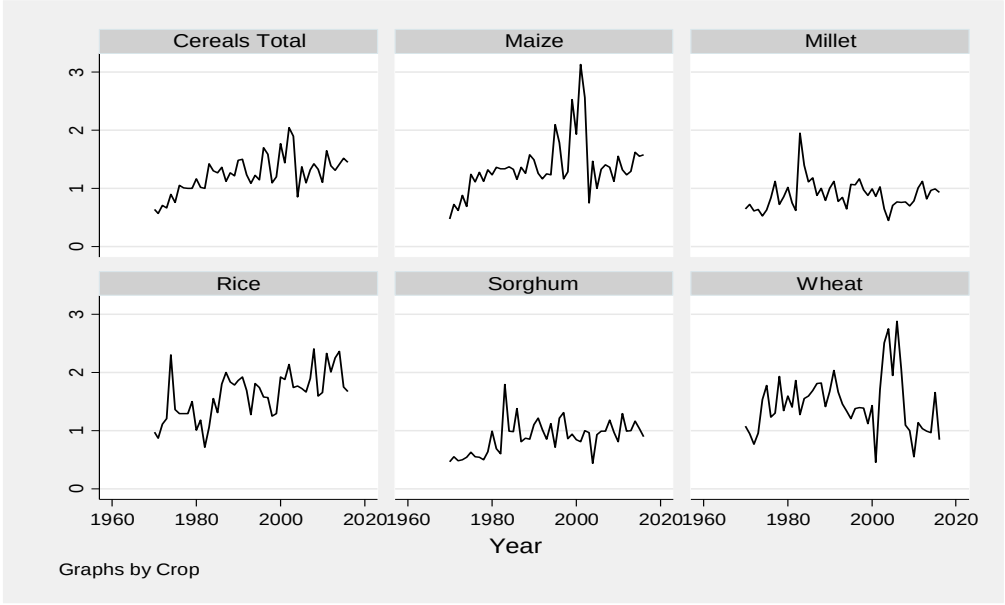
While previous studies have shown the importance of FDI in enhancing capital and technical inflows, the results from the existing literature on the effect of FDI on agricultural productivity still need to be clarified. Some studies (Mamba et al., 2020; Muhlen & Escobar, 2020; De Mello, 1999; Elkanj et al., 2013; Chong et al., 2010) found a positive impact of FDI on agricultural sector performance and economic growth whereas others (Frey, 1992; Iddrisu et al., 2015; Barkauskaitė & Naraškevičiūtė,, 2016; Bayar & Gavriletea, 2018) found negative impacts including displacement of local businesses and elite capture, unfair competition and loss of market position by local producers and even a decrease in productivity while the study by Carkovic and Levine (2002) did not find any significant relationship between FDI and agricultural productivity and economic growth. It can also lead to increased Unemployment brought about by using new and modern technologies by foreign companies (Forte & Moura, 2010). According to Gerschewski (2013), FDI inflows into the country do not always lead to technology transfer since investors may prevent technology leakage to domestic competitors through intellectual property rights. Only two studies have been conducted in Tanzania on this topic. Msuya (2007) examined the impacts of FDI on agricultural productivity and poverty reduction in Tanzania, where he found a positive impact. However, the study observations were based on the review of existing literature as opposed to empirical modelling, which is the concern

of this study. Similarly, a study by Epaphra and Mwakalasya (2017) focused on the analysis of foreign direct investment, economic growth and the agricultural sector in Tanzania using time series data spanning from 1990 – 2015, where no significant effect of FDI on agricultural value-added to GDP ratio was found. The current study differs from this study in terms of time frame, whereby the current study uses more observations spanning from 1970 to 2016.

Thus, the objective of this study is twofold. First, the study examines whether there is a short-run and long-run relationship between FDI and cereal productivity in Tanzania. Second, to determine the effect of FDI on cereal productivity and establish the direction of causality. The study is guided by two hypotheses: (i) there is no significant short and long-run relationship between FDI and cereal productivity, and (ii) there is no significant effect of FDI on cereal productivity. This study will contribute to the existing literature by informing policy on the nature of the relationship and effect of FDI on cereal productivity in Tanzania. The next sections are arranged as follows: section 1.1 presents the cereal sub-sector in Tanzania, section 1.2 presents the theoretical framework, section two the methodology, section three presents the results and discussion, and Section Four presents the conclusion and policy recommendations.

1.1 Cereal Sub-sector in Tanzania

Cereal grains (Maize, rice, sorghum, millet and wheat) are major food staples in Africa and Tanzania. Due to their potential to enhance food security, their production has been increasing from 1015200 tonnes in 1970 to 9594725 tonnes in 2016, with a total area expanding from 1260100 hectares to 6145826 hectares in the same period, mainly cultivated by smallholder farmers (FAOSTAT, 2020). Their demand has also been increasing in the country as a major source of food security and energy in the human diet, given the rise in population and urbanisation (Raheem et al., 2021).



Source: Author computation from FAOSTAT data

Figure 2. Trend of Cereals Yield in Tanzania from 1970 – 2016

However, cereal production has not kept pace with the ever increase in demand mainly due to low productivity caused by several factors, including climate variability, high incidences of

pests and diseases, low investment in mechanisation and low use of fertiliser which currently averages at 11 – 16kg/ha which is about one-sixth of the World average of 98.2 kg/ha (Rashid, 2020; Macauley & Ramadjita, 2015). Figure 2 shows that generally, total cereal yield has been increasing from about 0.81 tons/ha in 1970 to 1.56 tons/ha in 2016, with individual cereals showing little variation over the years.

Table 1. Cereal Productivity in Tanzania for the Period 1970 - 2016

Crop	Mean	Std. Deviation	Minimum	Maximum
Cereals Total	1.2385	0.31823	0.57 (1971)	2.04 (2002)
Maize	1.3702	0.47939	0.48 (1970)	3.14 (2001)
Millet	0.8933	0.25307	0.45 (2004)	1.95 (1983)
Rice	1.6237	0.40833	0.71 (1982)	2.4 (2008)
Sorghum	0.8969	0.28096	0.44 (2004)	1.8 (1983)
Wheat	1.4612	0.50071	0.46 (2001)	2.88 (2006)

Source: Author computation from FAOSTAT data
Note: Figures in parentheses are years

Similarly, from Table 1, the average cereal yield over the time under consideration in this study is about 1.2 tons/ha with minimum and minimum values experienced in 1971 and 2002, respectively. Among the cereal crops, rice has the highest average yield of about 1.6 tons/ha, preferably due to its position as a priority crop in the national agricultural development programmes (URT, 2016). Millet had the lowest average yield among the cereals during the time under study, mainly due to weather vagaries in the dryland areas of central Tanzania, where millet is largely grown. With the observed low cereal yield relative to demand, improving the yield of these staples, particularly to smallholder farmers, through the provision of appropriate inputs coupled with improved technology and training on good agronomic practices will help in solving this problem of low yield in the cereal sub-sector in the country.

1.2 Theoretical Framework

The theoretical background of this study can be grouped into three viewpoints; positive view, negative view and dependent impact view. The basis for the positive view is that of neoclassical economic growth theory. It seeks to establish the relationship between FDI and growth through two channels (direct and indirect channel). The direct channel stems from the neoclassical proposition whereby capital is assumed to be the main driver of economic growth while technological progress is assumed to be exogenously determined (El-Wassal, 2002; Iamsiraroj, 2016). The indirect channel emanates from the endogenous growth model developed by Romar (1994), in which technology and human capital are included in the production function in economic growth.

From the negative viewpoint, FDI could negatively impact the host country's growth through widening income inequality, monopolies leading to inefficient allocation of productive resources, and deviating demand away to the international markets, leaving the domestic market crowded out (Reis, 2001). Most of the FDI flowing into developing countries is channelled in industrial areas, which currently employ few people relative to the agricultural sector and absorbs much of the available capital leading to the reduction of capital available for other potential sectors like agriculture (Bornschier, 1980; Miao, 2020). Similarly, from the dependent impact view, FDI cannot solely impact growth, but a country can benefit from FDI depending on its ability to absorb the benefits, particularly through domestic investments in infrastructure, strong institutions and the stock of human capital, which helps in absorbing tech-knowhow and FDI

spill-overs (Blomstromet et al., 1994; Borensztein et al., 1998; Lautier & Moreaub, 2012). These theoretical viewpoints guided this study.

2. Methodology

2.1 Data source and description of variables

The data used in this study were extracted from the World development indicators (WDI) consisting of annual time series data for Tanzania from 1970 to 2016. The period considered in this study was based on data availability. The dependent variable is aggregate cereal crop yield expressed in tons/ha. The key independent variable constituted the foreign direct investment expressed in terms of the balance of payment inflows in US dollars. In addition, following empirical studies examining the impacts of foreign direct investment (Basu & Guariglia, 2007; Li & Liu, 2005), which includes measures of economic stability and availability of natural resources, three variables (inflation expressed as consumer price index and broad money supply annual growth expressed as a percentage as measures of economic stability and farm size expressed in hectares as a measure of natural resource availability) were included as control variables. The description of these variables is shown in Table 2. Foreign direct investment is expected to positively impact cereal yield since it is the source of capital investment accumulation, skill acquisition and diffusion of innovation, which play a large role in enhancing cereal productivity (Msuya, 2007). Area under cereal production is expected to negatively impact cereal yield due to the inverse farm size relationship, where small farms are hypothesised to be more productive than large farms, given the use of family labour and management (Rashid, 2020; Jayne et al., 2016). Broad money supply is expected to positively impact cereal yield since an increase in money supply leads to a decrease in interest rate which in turn leads to an increase in investment in yield-enhancing inputs.

Table 2. Description of Variables

Variable Name	Code	Measure	Source
Cereal Yield	YIELD	tons/ha	WDI
Foreign Direct Investment	FDI	current US$	WDI
Area under cereal production	FSIZ	Ha	WDI
Inflation (consumer price)	INFL	%	WDI
Broad money annual growth	M3	%	WDI

Note: WDI = World Development Indicators

2.2 Analytical Framework

In constructing a dynamic economic model, it is often helpful to first analyse the characteristics of individual time series variables to avoid the possibility of the predicted model being spurious, of which no sensible inference can be made. Therefore, if the series are co-integrated, the co-integration relationship among variables rules out the possibility of spurious results (Engle & Granger, 1987). Most of the co-integration tests, including the Johansen co-integration test (Johansen & Juselius, 1990; Philips & Hansen, 1990), are based strictly on I(1) stationary variables given that if all the hypothesised variables are I(1) stationary, there is a special case resulting into a linear combination of I(0) and hence co-integration.

The need for I(1) variables in these co-integration tests leads to biased estimates because the order of integration often depends on the chosen optimal lag length, unit root tests used, and whether the constant/ drift or trend term is incorporated in the unit root tests. This study employed both the Augmented Dickey-Fuller (ADF) and Philips-Peron unit root tests to

determine the series' co-integration order. Following Iddrisu et al. (2015), the ADF unit root test was estimated as follows-

$$\Delta Y_t = \alpha_0 + \omega Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-1} + \mu_{1t} \quad (1)$$

H_0: $\omega = 0$, implying that the series are not stationary

H_0: $\omega \neq 0$, implying that the series are stationary

Since the series was integrated of I (0) and I (1), as shown in Table 1, a bounds test to integration was used to test the existence of long-run co-integration between the variables. The approach involves the estimation of F-statistic following Pesaran and Pesaran (2009). We reject the null hypothesis of no co-integration if the computed F-statistic exceeds the upper bound critical value. When the value of the F-statistic is less than the lower bound critical value, we fail to reject the null of no co-integration. If the computed F-statistic falls between the lower and upper bound, then the results become inconclusive and thus, further information will be needed. After testing for co-integration, the long-run and short-run model parameters were estimated using the autoregressive distributed lag (ARDL) of the conditional error correction model. The following model presented in Equation (1) was estimated for the long run.

$$lnYIELD_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1t}\ lnYIELD_{t-1} + \sum_{i=0}^{n} \alpha_{2t}\ lnFDI_{t-1} + \sum_{i=0}^{n} \alpha_{3t}\ lnFSIZ_{t-1} + \sum_{i=0}^{n} \alpha_{4t}\ lnINFL_{t-1} + \sum_{i=0}^{n} \alpha_{3t}\ lnM3_{t-1} + \mu_{1t} \quad (2)$$

For the short-run, the model parameters were estimated as presented in equation 3;-

$$\Delta lnYIELD_t = \beta_0 + \sum_{i=1}^{n} \beta_{1t} \Delta\ lnYIELD_{t-1} + \sum_{i=0}^{n} \beta_{2t}\ \Delta lnFDI_{t-1} + \sum_{i=0}^{n} \beta_{3t} \Delta\ lnFSIZ_{t-1} + \sum_{i=0}^{n} \beta_{4t} \Delta lnINFL_{t-1} + \sum_{i=0}^{n} \beta_{3t} \Delta\ lnM3_{t-1} + \phi ECT_{t-1} \quad (3)$$

Where α and β are long-run and short run impact multipliers respectively while are ϕ denotes the degree of adjustment toward the equilibrium. In addition, a multivariate Granger causality was used to examine the direction of causality using equations specified below;-

$$\Delta lnYIELD_t = \beta_0 + \sum_{k=1}^{n} \beta_{1t} \Delta\ lnYIELD_{t-k} + \sum_{k=1}^{n} \beta_{2t}\ \Delta lnFDI_{t-k} + \sum_{k=1}^{n} \beta_{3t} \Delta\ lnFSIZ_{t-k} + \sum_{k=1}^{n} \beta_{4t} \Delta lnINFL_{t-k} + \sum_{k=1}^{n} \beta_{5t} \Delta\ lnM3_{t-1} + \phi ECT_{t-k} \quad (4)$$

$$\Delta lnFDI_t = \beta_0 + \sum_{k=1}^{n} \beta_{1t} \Delta\ lnFDI_{t-k} + \sum_{k=1}^{n} \beta_{2t}\ \Delta lnYIELD_{t-k} + \sum_{k=1}^{n} \beta_{3t} \Delta\ lnFSIZ_{t-k} + \sum_{k=1}^{n} \beta_{4t} \Delta lnINFL_{t-k} + \sum_{k=1}^{n} \beta_{5t} \Delta \ln M3 + \phi ECT_{t-k} \quad (5)$$

$$\Delta lnFSIZ_t = \beta_0 + \sum_{k=1}^{n} \beta_{1t} \Delta\ lnFSIZ_{t-k} + \sum_{k=1}^{n} \beta_{2t}\ \Delta lnYIELD_{t-k} + \sum_{k=1}^{n} \beta_{3t} \Delta\ lnFDI_{t-k} + \sum_{k=1}^{n} \beta_{4t} \Delta lnINFL_{t-k} + \sum_{k=1}^{n} \beta_{5t} \Delta \ln M3 + \phi ECT_{t-k} \quad (6)$$

$$\Delta lnINFL_t = \beta_0 + \sum_{k=1}^{n} \beta_{1t} \Delta lnINFL_{t-k} + \sum_{k=1}^{n} \beta_{2t}\ \Delta lnYIELD_{t-k} + \sum_{k=1}^{n} \beta_{3t} \Delta\ lnFDI_{t-k} + + \sum_{k=1}^{n} \beta_{4t} \Delta\ lnFSIZ_{t-k} + + \sum_{k=1}^{n} \beta_{5t} \Delta \ln M3 + \phi ECT_{t-k} \quad (7)$$

$$\Delta lnM3_t = \beta_0 + \sum_{k=1}^{n} \beta_{1t} \Delta lnM3_{t-k} + \sum_{k=1}^{n} \beta_{2t}\ \Delta lnYIELD_{t-k} + \sum_{k=1}^{n} \beta_{3t} \Delta\ lnFDI_{t-k} + \sum_{k=1}^{n} \beta_{4t} \Delta\ lnFSIZ_{t-k} + \sum_{k=1}^{n} \beta_{5t} \Delta lnINFL_{t-k} + \phi ECT_{t-k} \quad (8)$$

Where β_0 is the intercept, $\beta_{1-}\ \beta_5$ are the coefficients of the lagged dependent variables and the estimated parameters of the independent variables while Δ is the difference operator.

3. Results and Discussion

3.1 Descriptive Statistics

The descriptive statistics of the variables used in this study are presented in Table 3. This was undertaken since it is important to take into account the measures of central tendency and dispersion over the period 1970 – 2016 to get a general overview of the data before undertaking the inferential measures. The results show that over the period under investigation, the average aggregate cereal yield in Tanzania was 1.22 tons/ha with a minimum of 0.57 tons/ha and a maximum of 2.03 tons/ha. Foreign direct investment averaged at 54.73 million US $ over the period under consideration with a minimum of 9996.6 US$ and a maximum of 2.1 billion US$. The area under cereal production averaged at 3.2 million hectares with a minimum of 1.7 million hectares and a maximum of 6.58 million hectares. Inflation rate averaged at 13.1% and that of broad money annual growth averaged at 20.3%.

Table 3. Descriptive statistics

	Yield	Cereal Area	INFL	FDI	M3
Mean	1.22	3.20	13.1	54.73	20.3
Median	1,27	3.10	12.8	148.3	19.85
Std. Dev	1.31	1.49	2.06	20.51	1.64
Minimum	0.57	1.70	3.49	9996.6	3.67
Maximum	2.03	6.58	36.2	2.1	46.9
Skewness	0.49	1.38	0.914	0.371	0.417
Kurtosis	2.07	0.40	0.224	3.037	5.618

Source: Author computations from WDI

Table 4. Correlation Analysis

	LN (YIELD)	LN(Cereal Area)	LN (INFL)	LN (FDI)	LN (M3)
LN (YIELD)	1				
LN (Cereal Area)	0.446**	1			
LN (INFL)	0.08	-0.270	1		
LN (FDI)	0.390*	0.646**	-0.470**	1	
LN (M3)	0.078	0.023	0.201	-0.261	1

Source: Author computations from WDI

Note: **, * represents rejection of the null hypotheses at 0.01 and 0.05 sig. level respectively.

In addition to the presented summary of descriptive statistics, a correlation analysis was conducted to examine the relationship between the variables under consideration. Results in Table 4 show that there is significant weak positive relationship between foreign direct investment and cereal yield in the study area. The observed weak correlation between FDI and aggregate cereal yield could be attributed by low absorptive capacity of the transferred technologies due to underdeveloped human capital. This can be supported by the results found by Wang et al. (2014) who showed that technological spill-over from Chinese foreign direct investment into Africa to be limited due to skill mismatch and low absorptive capacity. Furthermore, the results show the existence of positive and significant correlation between farm size and cereal yield as well as a significant and relatively strong positive relationship between foreign direct investment inflows and farm size. However, the degree of association between inflation and foreign direct investment was found to be negative and significant. It is important to note that correlation analysis coefficient is not enough on its own to make the outcome valid

and hence this study conducted an econometric estimations to supplement the results obtained through correlation analysis.

Table 5 presents stationarity test of the series used in the analysis. The results show that almost all the variables were stationary at first difference ($p<0.01$) with the exception of yield and money supply variables which were stationary at both level I (0) and first difference I (1) as indicated by both the Augmented Dickey-fuller (ADF) and Philips-Peron (PP) unit root tests. The results imply that all the observed series are mixed with different order of integration which necessitates the use of an autoregressive distributed lag model bound's test to test the existence of long-run relationship between the dependent and the independent variables.

Table 5. Unit Root Tests

	ADF		PP	
	Level	First difference	Level	First difference
LNYIELD	-3.156***	-7.547***	-4.039***	-12.461***
LNFSIZ	-1.094	-4.811***	-0.991	-7.407***
LN INFL	-2.004	-5.524***	-2.096	-8.526***
LN FDI	-1.693	-8.258***	-1.711	-5.647***
LN M3	-3.775***	-6.642***	-5.044***	-10.319***

Source: Author computation

Note: ***, ** represents rejection of the null hypotheses at 1% and 5% sig. level respectively, Δ is first difference

Table 6. Bounds test of Co-integration

Dep. Variable	SBIC Lags	F-statistic	Lower bound critical value (1%)	Upper bound critical value (1%)	Decision
Fy(LNYIELD)	1	3.132	3.74	5.06	No co-integration

Note: H_0: No co-integration, H_1: There is co-integration

From the results of the bounds test in Table 6, we fail to reject the null hypothesis of no co-integration since value of the calculated F-statistic is below the lower bound critical value. This implies that, there is no long –run relationship between cereal yield and the hypothesized variables used in the model. Since the study finds no long-run relationship, an autoregressive distributed lag model was applied to ascertain the effect of foreign direct investment on cereal yield as shown in Table 7.

3.2 Effects of Foreign Direct Investment on Aggregate Cereal Yield

The econometric analysis results on the effect of foreign direct investment on cereal yield are presented on Table 7. The results show that, in the long-run, foreign direct investment (FDI) has positive and significant effect on aggregate cereal yield ($p<0.05$). As the foreign direct investment increases by 1%, aggregate cereal yield increases by about 0.07% holding other factors constant. This can be explained by the reason that FDI inflows enhances yield through transfer and diffusion of technology, improved human capital and an increase in investment in the productive resources (Awunyo-victor et al., 2018; Msuya, 2007; Gunasekera et al., 2015; Miao, 2020). Private investments from foreign firms in the form of different plant varieties, fertilizer, pesticides, capacity building and machinery have been a vital source of improved agricultural technology which in turn enhances cereal yield (Husmann et al., 2019). Furthermore,

FDI improves both social and economic infrastructure as well as creating employment to local community. It also affects local investors through spill-over effect (Zhan et al., 2018). Against this result, other studies found that large scale foreign direct investment particularly those targeting land investment have negative impacts including market dominance, exclusion of smallholder farmers and the rise of limited linkage with the local economy especially when the foreign investment targets export oriented projects which may also hamper food security (Zhan et al., 2018; Karlsson, 2014). The results in this study is similar to the results found by Oyedele (2014) in Nigeria and Msuya (2007) in Tanzania who also found positive impacts of FDI on agricultural productivity. The results further imply that, FDI is crucial in enhancing aggregate cereal yield in Tanzania.

However, in the short run, FDI inflows was found to have no significant effect on cereal yield. This may be explained by the reason that, most of the foreign direct investments channelled to the agricultural sector are long-term investments whose benefits can be achieved in the long-run. There is empirical evidence that investment in research and development in the agricultural sector which are long-run investments yields high returns (Akinwale et al., 2018; Alston et al., 2009). Investment in African agricultural research and development has been argued to have brought return in excess of around 20% (Pauw & Thurlow, 2012).

Among the control variables, inflation and farm size (area under cereal cultivation) were found to be significantly affecting cereal yield. Inflation has positive effect on cereal yield in the long-run. As inflation level increases by 1%, cereal yield increases by about 0.21% ceteris paribus. This is contrary to priori expectation where inflation was expected to negatively affect agricultural sector through an increase in the cost of inputs thereby increasing operational costs. Furthermore, the results show that, there is an inverse relationship between the area under cereal production and cereal yield which supports the long debated inverse farm size –productivity hypothesis.

Table 7. Autoregressive Distributed Lag (ARDL (1, 1, 1, 1)) Model Results

Model: LNYIELD= f(LNFDI, LNFSIZ, LNINFL, LNM3)				
Variable	Coefficient	Std. Error	t-statistic	Prob.
Long run				
LN (FDI)	0.0657**	0.0292	2.25	0.033
LN (Cereal area)	0.0131	0.1947	0.07	0.947
LN (INFL)	0.210*	0.1072	1.96	0.060
LN (M3)	0.0465	0.1907	0.24	0.809
Short run				
ECT(-1)	-0.602***	0.1597	-3.77	0.001
ΔLN (FDI)	-0.0273	0.0232	-1.18	0.249
ΔLN (Cereal area)	-0.416*	0.2395	-1.74	0.094
ΔLN (INFL)	-0.0827	0.0750	-1.1	0.279
ΔLN (M3)	0.0659	0.0934	0.71	0.486
Constant	-1.063	1.6727	-0.64	0.530

Source: Author computation

Note: Log likelihood=14.3405, R^2= 0.3787, N=47, SBIC information criterion was used to determine the maximum lag length of 1, ***, **, * represents rejection of the null hypotheses at 1%, 5% and 10% sig. level respectively.

The small farms are said to be more efficient due to factor market imperfections on labour markets in which problems in existing non-farm employment leads to an increase in the use of family labour on the small farms causing relatively low shadow prices (Woodhouse, 2010; Sen, 1966; Binswanger et al., 1995; Feder, 1985). Again, from the principal –agent problem, large scale farms use hired labour thereby leading to higher cost of supervision which in turn translates into low productivity per unit area (Rashid, 2020; Eswaran and Kotwal, 1986). The result is in conformity with previous studies (Sheng et al., 2019; Larson et al., 2014; Otsuka, Liu & Yamauchi, 2013) which found similar results. However, the recent study by Omotilewa et al. (2021) in Nigeria revealed a u-shapes relationship between farm size and productivity whereby the inverse relationship holds between zero and around 22 hectares and turning positive above that level of farm size.

3.3 Short-run Granger Causality test

In order to determine the direction of causality between the dependent and the independent variables, a multivariate Granger causality test was undertaken to investigate whether there is unidirectional, bi-directional or no causality at all. Some variables were found to exhibit unidirectional causality while others exhibited no causality. From Table 8, the results show that, foreign direct investment does not granger cause cereal yield. In addition, the result show a unidirectional causality running from farm size to cereal yield implying that it is farm size that granger cause cereal yield and not vice versa. Similarly, causality also runs from cereal yield to inflation and from broad money growth to inflation. Furthermore, this study found also a bidirectional causality between broad money supply and inflation implying that these variables tend to granger cause each other. Furthermore, to ensure the validity of the results, model stability test was undertaken through the use of a cumulative sum analysis (CUSUM). The CUSUM and CUSUM square plots depicted in Figure 3 show that there was no instability in the data set used in this study since plot runs within the specified 5% parameter critical values.

Table 8. Results of Short run Granger Causality tests

	Sources of Causality (χ^2)						
	ΔLNYIELD	ΔLNFDI	ΔLNFSIZ	ΔLNINFL	ΔLNM3	All	Dir. Causality
ΔLNYIELD	-	1.762	5.117**	1.062	0.031	8.679*	FSIZ→YIELD
ΔLNFDI	1.598	-	0.005	0.153	1.077	3.784	-
ΔLNFSIZ	0.071	1.591	-	0.176	0.870	2.308	-
ΔLNINFL	2.742*	1.404	0.794	-	6.288**	11.886**	YIELD→INFL; M3→INFL
ΔLNM3	0.278	0.222	2.496	6.654***	-	12.077**	INFL→M3

Source: Author computation

Note: ***, **, * represents rejection of the null hypotheses at 0.01, 0.05 and 0.1 sig. level respectively.

This signifies the model for cereal yield and foreign direct investment were stable during the time under consideration by this study. In addition, diagnostic statistics tests were conducted to assess the model adequacy in estimating the outcome variable (Table 9). These included test for serial correlation which is inherent in time series data, normality test, heteroscedasticity, and omitted variable tests. Results show no evidence of these problems in the data implying that the null hypothesis of existence of these problems is rejected.

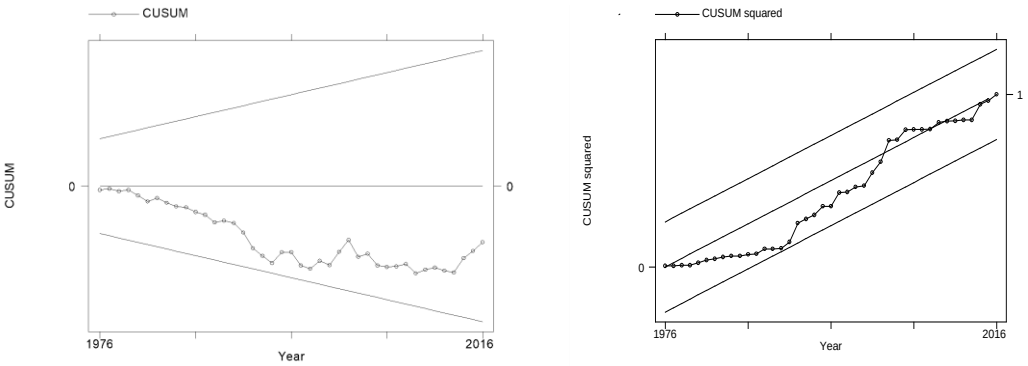


Figure 3. CUSUM and CUSUMSQ stability tests

Table 9. Results of diagnostic tests

Diagnostic test	χ^2/F/mean	Prob.
White test for heteroscedasticity	18.44	0.1873
Breusch-Godfrey test for serial correlation	2.24	0.1344
Ramsey RESET test for model specification	1.05	0.3849
Jarque -Bera test for normality	3.41	0.1821
Mean VIF test for multicollinearity	1.64	

Source: Author computation

4. Conclusion and policy recommendations

Foreign direct investment has long been a subject matter among policy makers and scholars as a source of financing the deficit gap in the domestic economies as well the source of technology transfer, diffusion and innovation particularly to developing countries in Sub-Saharan Africa including Tanzania. This study aimed at examining the effects of foreign direct investment in Tanzania for the period 1970 – 2016 using time series data extracted from the World Bank's World development indicators. Results show that, there is no log-run relationship between FDI and cereal crops yield in Tanzania. However, from the ARDL model, the results show that, foreign direct investments have long-term effect on cereal yield. An increase in FDI by 1% leads to an increase in cereal yield by about 0.07% ceteris paribus. Other factors which affect cereal yield in the long run included the level of inflation that affects cereal yield positively while the area under cereal cultivation was found to exhibit a long-term debated inverse farm size –productivity relationship in the short run.

The policy implications of this paper is that foreign direct investment (FDI) should be directed on long-term investments for sustainability of the expected results from the FDI. This calls for the government of Tanzania and other stakeholders to take a more rigorous actions in improving the legal, infrastructural, human capital stock and good governance coupled with strong institutions to attract more foreign direct investments and be able to tap its benefits in terms of technology transfer, skill acquisition, and diffusion of innovation for productivity improvement and general well-being of the community.

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