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RELATIONSHIPS BETWEEN ECONOMIC GROWTH, FOREIGN DIRECT INVESTMENT AND INFLATION: ARDL MODELS APPROACH FOR THE CASE OF GHANA

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ABSTRACT

The study applies Autoregressive Distributed Lags models and the Toda and Yamamoto (1995) causality test to analyze the relationships as well as the causality properties among various pairs of Ghana's inflow of Foreign Direct Investment (FDI), Inflation and Economic growth for the period 1980 to 2017. The study finds that Inflation relates inversely with both Economic growth and inflows of Foreign Direct Investment. However, Ghana's Economic growth and its inflows of FDI are positively related. Finally, the study finds a bidirectional causal effect between inflation and FDI. In addition, a unidirectional causal effect moving from Economic growth to Inflation was established and the causal effect is non-existent between Economic growth and inflow of FDI.

Key Words: ARDL, Causality test, Economic growth, FDI, Inflation, Ghana.

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INTRODUCTION

In both developed and developing countries, the principal goal of policy formulators towards reducing poverty is to attain high sustainable economic growth induced by low inflation (Pesaran et al. 2001). High economic growth has the potential to raise living standards of poor societies. Empirical and theoretical studies present varied views on the relationship between economic growth and inflation. Nonetheless, a significant number of studies still confirm that high inflation has a negative impact on economic growth. The distortion and uncertainty caused by high inflation in an economy subsequently retard sustainable economic growth through that economy's spending and its investments. Moreover, the international competitiveness of a country is greatly reduced by high price levels; this makes exports more expensive thereby creating balance of payment problems.

Foreign Direct Investment (FDI) serves as an essential path through which inflation indirectly affects economic growth for the improvement of society (Pesaran et al. 2001). A country experiencing low inflation is a sign of economic stability - this implies increases in the returns on FDI and signifies the ability of the central bank carrying out fitting monetary policies as well as the government's readiness to balance the country's budget. Hence low inflation level in a country boosts FDI.

According to World Bank data, the world's FDI inflows hit a record high in 2007 of $3.1 trillion but has fallen to about $2 trillion in the next decade (2017). In developing economies FDI contribute immensely to economic growth as it increases total investment, productivity gains through improved managerial skills and technology adoptions and implementations. However, (Herzer et al. 2008) argue that FDI also has the potential to hurt the host country by reducing investment opportunities for local investors. These ambiguous results have triggered more empirical studies on the FDI-economic growth nexus in both developed and developing countries.

Just like most developing countries, in Ghana, one of the obstinate problems of the economy is high inflation. This has been persistent for a long time and tends to confirm the belief that high and volatile inflation has the potential of hampering economic growth. In Ghana, the 1983 Economic Recovery Program (ERP) was used as a measure to control inflation in order to attract FDI and thereby triggering economic growth. Recently, the central bank (Bank of Ghana) in 2007 adopted inflation targeting as another measure to combat high inflation and subsequently to achieve more rapid economic growth. Since the adaptation of price stability as a major measure by the Bank of Ghana, there has been a fall in inflation from 80.76% in 2006 to 13.40% in 2017. Net FDI inflows rising from $63.6 million in 2006 to $3.3 billion in 2017 and real Gross Domestic Product growth increasing from 6.4% in 2006 to 8.5% in 2017. These trends would suggest the existence of a correlation between FDI, inflation and economic growth, this, however, does not necessarily translate into causation. Thus, it cannot be said with certainty that falling inflation drives upwards the trends in FDI and economic growth in Ghana. Seemingly, the studies on the causal links of the relationship among FDI, economic growth and inflation are still of interest to macroeconomist due to

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the mixed results provided by empirical studies on different economies. Hence, the nature of a specific economy greatly helps in deciding the relationship between these three macroeconomic variables.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The literature on the relationship between FDI, inflation and economic growth has still not been generalized with certainty in empirical studies. The question of what the relationship is between these variables still requires an empirical study to answer because the individual country-specific economic peculiarities also indirectly affect the interactions of the trio.

Empirical studies on the link between FDI and inflation provides mixed findings. Whereas some studies conclude a positive relationship between FDI and inflation, other studies suggest a negative relationship. Udoh and Egwaikhide (2008) employ a GARCH model for the estimation of the uncertainty in inflation and exchange rate volatility to find the impact on FDI in Nigeria. The findings suggested a statistically significant inverse effect on FDI. This goes to affirm that for developing countries, a low and stable inflation level attracts FDI inflows. This then incentivizes economic growth. Udoh and Egwaikhide, however, could not establish any directional causal link between FDI and inflation using the Granger causality test. Djokoto (2012) also discovered a negative relationship between FDI and inflation in Ghana for the period 1970-2009. On the contrary, findings from Gul et al. (2012) and Nazir et al. (2012) on how domestic inflation impacts FDI and trade in Pakistan were positive but statistically insignificant for the periods 1990-2008 and 1970-2010 respectively. Whereas the former used Simple Least Square Method, the latter adopted the co-integration test and error correction model. Both studies found a positive and insignificant relationship. These findings disagree with Djokoto (2012) results likely due to the different estimation techniques employed.

Assessing the relation between FDI and economic growth, numerous empirical studies conclude on a positive relationship between FDI and economic growth. Balasubramanyam et al. (1996) establish that FDI affects economic growth with a strongly positive effect than it does on domestic investment. Just as Balasubramanyam et al. (1996) and Borensztein et al. (1998) failed to also check for the direction of causality between FDI and economic growth and concluded a positive relationship between FDI and economic growth. They concluded that the effect of FDI on economic growth is positive if only the education level is above a given threshold. Other studies that confirm the positive relationship hypothesis between FDI and economic growth, as well as identified causal link from FDI to economic growth, include (Zhang, 2001; Hansen and Rand, 2006, and Esso, 2010). These studies find that FDI spurs economic growth in developing countries. However, Herzer et al. (2008) revisited the FDI-led economic growth in developing countries hypothesis using 28 developing countries and found that there is no causal link between FDI and economic growth.

On the Ghanaian scene, Asafu-Adjaye (2005) concluded a bidirectional

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causality between FDI and economic growth in Ghana when he examined time series data from 1970-2007 and adopting multivariate maximum likelihood method developed by Johansen and Juselius (1990). He , however, established a significant positive relationship between inflow of FDI and economic growth. Frimpong and Oteng-Abayie (2006) contend with Asafu-Adjaye when their study revealed no directional causal link between the two variables for the sample period of 1970-2002 as well as for the pre-Structural Adjustment Program period. They however determined a unidirectional causal link from FDI to economic growth during post-Structural Adjustment Program in Ghana. The contradiction in finding emanates from the usage of varying estimation techniques. While the former used multivariate maximum likelihood method by Johansen and Juselius (1990), the latter established the causal link between FDI inflows and economic growth using the Toda and Yamamoto (1995) method. Other studies on Ghana like Antwi et al. (2013) by employing Vector Autoregression and Johansen co-integration and ordinary least square regressions also confirm that there is a statistically significant positive relationship between FDI and economic growth in Ghana.

Empirical literature on the link between inflation and economic growth provide huge support to confirm that inflation affects economic growth negatively. Such studies include (Bruno and Easterly, 1998; Sarel, 1996; Ghosh and Phillips, 1998; Khan and Senhadji, 2001; Hossain, 2005; Erbaykal and Okuyan, 2008; Risso and Sánchez, 2009; Marbuah, 2010; Quartey, 2010; Hossain et al. 2012; and Olaiya et al. 2011). Whereas all these studies confirm a negative relationship between inflation and economic growth, there seem to be mixed findings on the causality link between the two macroeconomic indicators. For instance, the results of Sarel (1996) and Bruno and Easterly (1998) only confirm the view that economic growth is negatively affected only at high levels of inflation with Sarel (1996) establishing an inflation threshold of 8% above which the negative impact manifests. Some researchers find a unidirectional causation that runs from inflation to economic growth (Hossain, 2005; Erbaykal and Okuyan, 2008; Adrián and Sánchez, 2009; Marbuah, 2010; Olaiya et al. 2011; and Er et al. 2014). However, Ghosh and Philips (1998) discovers that economic growth is positively impacted at low levels of inflation and that the inflation-economic growth relationship is a convex one when examined in a nonlinear model. It is obvious from the above that, inflation and economic growth generally has an inverse relation. However, we cannot make a general conclusion on the causality link between them.

In a nutshell, while the examined literature reveals a negative relationship between FDI and inflation, positive or negative relationship between inflation and economic growth and a positive relationship between FDI inflows and economic growth, empirical studies do not give us that liberty to conclude strongly on the direction of causal links between these three variables. This implies the threesome relationship is influenced by the specific nature of an economy being studied.

As shown above, the FDI-inflation-economic growth nexus literature offers mixed conclusions on the relationship that exist among the trio. Majority of these empirical studies used panel and cross-sectional data. This does not make it possible to study the actual relationship between the

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three variables due to the fact that cross-sectional and panel data averages the data for the sample used and applies it across countries from non-related regions. Hence, the country-specific relationship between these variables is missed.

Theories on Inflation and Growth

The relationship between inflation and growth have theoretical models in the Keynesian school of thought and the Neo-classical school of thought. The Keynesian model focuses on Aggregate Demand and Aggregate Supply analysis. In this model, aggregate supply curve slopes upwards instead being vertical in the short-run. Due to the upwards sloping nature of the aggregate supply curve, any changes in demand is able to result in changes in prices and output. Hence, in the short-run equilibria of aggregate demand and aggregate supply curves, a positive adjustment path is formed between inflation and growth. However, this adjustment later turns negative. In the neo-classical school of thought, Solow (1956); Tobin (1965); and Stockman (1981). Firstly, Solow's model postulates that technological changes is exogenously determined and is the main explanation for long-term growth. Therefore, Solow believed that, inflation and growth exhibits no relationship since it is assumed to be exogenously determined (Ray, 1998). Secondly, Tobin (1965) followed Solow (1956) and included the assumption of money being the store of value in an economy. Therefore, according to Tobin's model, a rise in the rates of inflation in an economy motivates people to keep money instead of interest bearing assets, thereby stimulating economic growth. Thus, a positive relationship between inflation and growth is suggested by Tobin's model. Thirdly, Stockman (1981) postulates a model that assumes that, money is a complement to capital. Therefore, when there is an increase in inflation, purchasing power of money declines, and this leads to low capital accumulation, which then leads to decline in output growth. This provides a significant justification for an inverse relationship between inflation and economic growth.

Theories on Inflation and Foreign Direct Investment

The Fisher equation postulates that, nominal interest rate is made up of real interest rate plus inflation rate. From this relationship, it implies that low inflation rates lead to low nominal interest rates. Consequently, cost of capital and financial cost of new investment will be low. Thus, the availability of capital at lower nominal interest rate in the host country will attract investors from foreign countries. Fisher's equation provides a base for the conclusion that inflation and foreign direct investment relates inversely.

Theories of Foreign Direct Investment and Growth

According to the endogenous growth theory, the main determinants of economic growth include factors such as economies of scale, increas-

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ing returns or induced technological changes in the production process. Romer (1990) and Grossman and Helpman (1991) developed a growth model explaining the relationship between FDI and economic growth within the endogenous growth theory. In this model, technological advancement is assumed to be the main driving force of economic growth. The creation of technological knowledge, the transfer of this knowledge and innovation are major engines for growth in these theories. New growth theories finds a bidirectional causality between FDI and growth. Factors that could explain this are as follows: the incorporation of new inputs and foreign technologies in the production function of host country, the increase in host country's existing knowledge through training and development (Borensztein et al., 1998 and De Mello, 1999). Nonetheless, Dowling and Hiemenz (1982) contends that inflow of FDI is stimulated when there is rapid economic growth in the host country. This rapid growth creates an enabling environment and a self-assurance to foreign investors to invest in the host country. Additionally, high levels of capital requirements created as a result of sustainable growth coupled with the host country's need for FDI gives birth to a macroeconomic climate that attracts foreign investors. Hence, foreign direct investment and economic growth has a positive and bidirectional causality relationship.

DATA AND METHODOLOGY

This paper uses data on real GDP as a measure of economic growth, net inflow of Foreign Direct Investment (FDI) and consumer price index (inflation) for Ghana obtained from World Development Indicators (WDI). The paper uses annual data for the period 1980-2017 for the Ghanaian economy.

This study applies the Autoregressive Distributed Lags (ARDL) model to examine the relationship between FDI, inflation and economic growth in Ghana and goes further to apply the Toda and Yamamoto (1995) causality test to check for the existence of causality between these variables. Additionally, to fill the gap of studies that employed the ordinary least square and bivariate VAR technique that likely suffer from miss specification and omission biases, a tri-variate ARDL model is specified. This is to capture and fit the theoretical and empirical relationships established among these three variables as discussed above. While Keynesian model supports an initial positive relationship between inflation and growth, which turns negative later, the neoclassical framework suggests that growth can be affected positively or negatively by inflation. Moreover, the endogenous growth theory postulates that inflation affects FDI and economic growth negatively. Finally, FDI and economic growth has bidirectional causality and relates positively according to the new growth model. Therefore, the model that will be applicable to the Ghanaian economy becomes an empirical question.

Stationarity Test

The stationarity of the series used in this study is checked using Dickey and Fuller (1979), and Phillips and Perron (1998) tests. The Phillip-Perron

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(PP) test supports and confirms the results of the ADF test, which is not reliable if there is structural breaks in the series. The Augmented Dickey-Fuller (ADF) test uses the following model to check for non-stationarity in variables:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t=1} + \alpha_t \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

where:

Y_t is the variable in question

t is a time trend

Δ is the difference operator

ε_t is a white noise process

From equation 1, the test for stationarity is achieved by testing the following hypothesis:

$$H_0: \delta = 0 (Y_t \; is \; non - stationary)$$

$$H_1: \delta < 0 (Y_t \; is \; stationary)$$

Bounds Co-integration Test

The test for stationarity is followed by Bounds test for co-integration between the three variables. The advantage of this method over other multivariate co-integration techniques such as Johansen and Juselius (1990) its simplicity and allows co-integration relationships to be estimated by OLS once lag order of the model is known. Moreover, Bounds test is applicable regardless of the level of stationarity of the underlying regressors. Using the Bounds approach for the test for co-integrating relationship eliminates the possibility of spurious regression. Bounds approach also simultaneously estimates the long-run and short-run components of the model (Narayan and Narayan, 2006). The Null hypothesis of no level relations between variables. The Wald or F-statistic is compared with the lower and upper critical values at varying levels of significance. If the F-statistic is greater than the critical value of the upper bound I(1), then there is co-integration and consequently a long run relationship between variables. However, if the F-statistic is lower than the critical value of the lower bound I(0), we fail to reject the null hypotheses of no long-run relationship.

Auto-Regressive Distributed Lags (ARDL) Models

This long-run relationships using ARDL (m, n, k) can be specified as follows:

$$INF_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{2i} \Delta INF_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta FDI_{t-i} + \sum_{i=1}^{k} \alpha_{4i} \Delta GDP_{i-1} + \mu_t \; (2)$$

$$FDI_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{2i} \Delta FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=1}^{k} \alpha_{4i} \Delta GDP_{i-1} + \mu_t \; (3)$$

$$GDP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=1}^{k} \alpha_{4i} \Delta FDI_{i-1} + \mu_t \; (4)$$

The short run and the Vector Error Corrections ARDL (m, n, k) models are specified as follows:

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$$\Delta INF_t = \alpha_{01} + \alpha_{1i} EC_{t-1} + \sum_{i=1}^{m} \alpha_{2i} \Delta INF_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta FDI_{t-i} + \sum_{i=1}^{k} \alpha_{4i} \Delta GDP_{i-1} + \mu_t \quad (5)$$

$$\Delta FDI_t = \alpha_{02} + \alpha_{1i} EC_{t-1} + \sum_{i=1}^{m} \alpha_{2i} \Delta FDI_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=1}^{k} \alpha_{4i} \Delta GDP_{i-1} + \mu_t \quad (6)$$

$$\Delta GDP_t = \alpha_{03} + \alpha_{1i} EC_{t-1} + \sum_{i=1}^{m} \alpha_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=1}^{k} \alpha_{4i} FDI_{i-1} + \mu_t \quad (7)$$

where:

INF = first difference of the logarithmic transformation inflation (consumer price index)

FDI = first difference of the logarithmic transformation of net inflows of FDI

GDP = first difference of the logarithmic transformation of real GDP

EC_{t-1} = error correction term of 1-year lag.

α_{2i}, α_{3i}, α_{4i} are coefficients to be estimated.

α_{1i} = the speed of adjustment to equilibrium in the long-run.

μ = the error term.

Optimum lag selection

The study employs the Akaike Information Criteria (AIC) and the Schwartz Bayesian Information Criteria (SIC) in the determination of the optimum lag lengths of the variables. Appropriate lag length selection is crucial in determining the variables to be included in any model. A model with relatively large number of lags will possibly generate residuals that are close to white noise process, but might not be parsimonious. On the other hand, relatively lesser number of lags can result in parsimonious models, but the residuals generated might not be closer to a white noise process. Lag selection criteria is in table 1.

Table 1: *Lag Selection Criteria*

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-110.248				0.156938	6.66167	6.7076	6.79635
1	-25.8476	168.8	9	0.000	.001866*	2.22633*	2.41004*	2.76504*
2	-20.5411	10.613	9	0.303	.002353	2.4436	2.7651	3.38635
3	-16.2568	8.5687	9	0.478	.003218	2.72099	3.18028	4.06778
4	-5.60216	21.309*	9	0.011	.003128	2.62366	3.22074	4.37448

Source: Authors' computation using Stata 13

Endogenous: logINF logGDP logFDI
Exogenous: constant

Tests for Causality

The Toda and Yamamoto (1995) causality test is applied to investigate the directional causality between FDI, inflation and economic growth. This method is preferred over the Granger causality test because the latter is founded on the asymptotic concept which implies the critical values are applicable to only variables that are stationary and their long-run co-integrating relationship are not bound together (Granger, 1988). This implies the results from Granger causality test are to some extent weak and conditional on absence of co-integration between the variables in

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the model. In view of these shortcomings associated with the traditional Granger causality test and without recourse to the stationarity of variables or order of integration of variables, Toda and Yamamoto (1995) causality test is applicable. This test involves using the order of integration of the series to determine the number of extra lags, (dmax) to add to the optimum lag length (k) in order to correctly specify level VARs. This aims to control for potential co-integration. Therefore, the causality between inflation, foreign direct investment and economic growth can be tested using the following VARs:

$$logINF_t = \alpha_0 + \sum_{i=1}^{k+d_{max}} \lambda_{1i} logINF_{t-1} + \sum_{j=k+1}^{k+d_{max}} \beta_{1i} logFDI_{t-1} + \sum_{i=1}^{k+d_{max}} \gamma_{1i} logGDP_{t-1} + \varepsilon_t \quad (8)$$

$$logFDI_t = \alpha_0 + \sum_{i=1}^{k+d_{max}} \lambda_{1i} logINF_{t-1} + \sum_{j=k+1}^{k+d_{max}} \beta_{1i} logFDI_{t-1} + \sum_{i=1}^{k+d_{max}} \gamma_{1i} logGDP_{t-1} + \varepsilon_t \quad (9)$$

$$logGDP_t = \alpha_0 + \sum_{i=1}^{k+d_{max}} \lambda_{1i} logINF_{t-1} + \sum_{j=k+1}^{k+d_{max}} \beta_{1i} logFDI_{t-1} + \sum_{i=1}^{k+d_{max}} \gamma_{1i} logGDP_{t-1} + \varepsilon_t \quad (10)$$

where:

k = optimal lag length in the original VAR system

dmax = the maximum order of integration of the variables in the VAR system

logINF = log of consumer price index expected to have a negative sign

logFDI = log of foreign direct investment inflows expected to have a positive sign

logGDP = log of real GDP expected to have a positive sign

λ, β, γ = are parameters to be estimated

ε_t = error term

Using the Wald test statistic, the null hypothesis that foreign direct investment and economic growth do not cause inflation is given in equation (8) by testing the hypothesis:

$$H_0: \beta_{1i} = \gamma_{1i} = 0$$

Next, the null hypothesis that inflation and economic growth do not cause foreign direct investment is given in equation (9) by testing the hypothesis:

$$H_0: \lambda_{1i} = \gamma_{1i} = 0$$

Finally, the null hypothesis that inflation and foreign direct investment do no cause economic growth is given in equation (10) by testing the hypothesis:

$$H_0: \lambda_{1i} = \beta_{1i} = 0$$

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ESTIMATION RESULTS

Descriptive Summary Statistics for Variables in table 2.

Table 2: *Descriptive Summary Statistics for Variables from 1980-2017*

Variables	Obser-vations	Mean	Std. Deviation	Minimum	Maximum	Skewness
INFLATION	38	27.480	25.286	7.126	122.875	2.649
GDP(USD)	38	1.54e+10	1.49e+10	4.04e+09	4.78e+10	1.087
FDI (USD)	38	9.12e+08	1.34e+09	2000000	3.49e+09	1.057
log (INFLATION)	38	3.059	0.666	1.964	4.811	0.799
log(GDP)	38	23.048	0.874	22.119	24.590	0.717
log(FDI)	38	18.681	2.412	14.509	21.972	-0.01

Source: Author's computation using Stata 13

The study period saw average inflation at 27% in table 2. This indicates a very high inflation average for the Ghanaian economy. Economic growth measured by real GDP at current prices and net inflows of foreign direct investment averaged a little above $15 billion and $9 million respectively. The economy of Ghana experienced a maximum inflation rate of about 123% and with 7.13% being the minimum inflation over the period of the study. GDP and FDI recorded maximums of $47 billion and $3 billion respectively. The minimum GDP was $4 billion and $2 million was the minimum for net inflows of foreign direct investment.

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, the null hypothesis suggests that the series include unit roots (Non-Stationary). The results of the stationarity tests are given in table 3.

Table 3: *Unit Root Tests*

Unit Root Test Results (ADF)				Unit Root Test Results (PP)		
Level				Level		
Variable	logINF	logFDI	logGDP	logINF	logFDI	logGDP
t-statistic	-3.699	-0.476	0.408	-3.599	-0.470	0.224
Prob.	0.0041***	0.8966	0.9818	0.0058***	0.8977	0.9736
First Difference				First Difference		
Variable	D.logINF	D.logFDI	D.logGDP	D.logINF	D.logFDI	D.logGDP
t-statistic	-9.027	-5.281	-4.801	-10.493	-5.237	-4.776
Prob.	0.0000***	0.0000***	0.0001***	0.0000***	0.0000***	0.0001***

Source: Author's computation using Stata 13
Notes: (***) significant at the 1%, *MacKinnon (1996) one-sided p-values.

According to table 3 The computed t-statistics for logFDI and logGDP are less than the critical values in their level forms for the ADF test. Hence, we fail to reject the null hypothesis, suggesting that logFDI and logGDP are non-stationary in their level. From table 3, according to the (ADF) unit root test and the (PP) unit root test (stationarity), logINF is stationary at level at 1% significance level. However, logGDP and logFDI are non-sta-

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tionary at level. After the first difference of logGDP and logFDI series, they both become stationary at 1% significance level in both ADF test and PP test. With these results, we conclude that the logGDP and logFDI in this study are integrated at I(1) order.

Bounds test for Co-integration is in table 4.

Table 4: *Bounds Test for Co-integration*

Dependent Variable	F- statistic for three variables	1%		5%		10%	
		I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
logINF	11.842***	5.947	7.416	4.123	5.302	3.350	4.396
logGDP	1.200	5.938	7.349	4.132	5.277	3.362	4.383
logFDI	5.467**	5.938	7.349	4.132	5.277	3.362	4.383

Source: Author's computation using Stata 13
**(*) H0: No co-integration is rejected at 5% and 1% respectively.

According to table 4, the F-statistics for the inflation and FDI equations are greater than the upper bound I(1) at 1% and 5% significance levels respectively. Therefore, we reject the null hypothesis of no co-integration between the variables, thus, there exist a long run relationship in the inflation and FDI equations (as dependent variables) through which deviations from equilibrium in the short-run will converge in the long-run. However, the economic growth equation shows no significant evidence of co-integration and/or long-run relationship at any of the standard levels of significance. Once co-integration has been established we estimate the long and short-run relationships in table 5.

Table 5: *Estimated Coefficients for Long and Short-Run Relationships*

Equation	(5)	(6)	(4)
Model	ARDL(1 0 1)	ARDL(1 0 0)	ARDL(1 0 0)
Dependent Variable	Δ logINF	Δ logFDI	logGDP
EC_{t-1}	-0.917***	-0.181**	
	(0.157)	(0.085)	
logINF			-0.079
			(0.052)
logGDP(-1)			0.925***
			(0.078)
logFDI			0.020
			(0.027)
Constant			1.636
			(1.413)
Long-Run estimates			
logGDP	-0.432*	1.552*	
	(0.241)	(0.875)	

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logFDI	0.004 (0.089)		
logINF		-2.863 (1.798)	
Short-Run estimates			
Δ logFDI	-0.387*** (0.130)		
Constant	11.916*** (4.080)	-1.399 (4.932)	
Observations	37	37	37
R-squared	0.561	0.332	0.967
Diagnostics			
Durbin-Watson d-statistic	1.926603	1.82100	1.751857
Br-Godfrey LM test for Autocorrelation (Prob>chi2)	0.681 (0.4092)	0.195 (0.6591)	0.661 (0.4163)
White's test for Homoscedasticity (Prob>chi2)	19.04 (0.1634)	10.17 (0.3369)	5.41 (0.7975)
Jarque-Bera test for normality chi2 (Prob>chi2)	0.2573 (0.8793)	3.097 (0.2126)	18.05 (0.00012)

Source: Author's computation using Stata 13
Standard errors are in parenthesis *** p<0.01, ** p<0.05, * p<0.1.

From the estimated results in table 5 above, equation (5) estimates the error correction for inflation using an ARDL (1 0 1) model. The results indicate that in the long-run economic growth negatively affects inflation at 10% level of significance. Moreover, in the short-run, there is a decrease in inflation by 0.387% for every 1% increase in net inflows of foreign direct investment into the Ghanaian economy, holding all other variables constant. However, the adjustment coefficient of -0.917 implies the speed of correction of deviation from long-run equilibrium inflation. EC has the expected negative sign and statistically significant at 1%. This implies that deviations from the long-run equilibrium inflation is corrected up to 91% by the following year.

Equation (6) estimates the error correction for foreign direct investment using an ARDL (1 0 0) model. The results indicate that in the long-run economic growth positively affects FDI at 10% level of significance. Thus, a 1% increase in economic growth will see foreign direct investment increase by 1.6% ceteris paribus. However, the adjustment coefficient of -0.181 represents the speed of correction of deviation from long-run equilibrium inflows of foreign direct investment. The adjustment factor has the expected negative sign and statistically significant at 5%. This implies that deviations from the long-run equilibrium inflows of FDI is corrected up to 18% by the following year.

Equation (4) estimates an ARDL (1 0 0) model for the economic growth equation. This is because of the absence of co-integration in the logGDP equation from the Bounds test. Ceteris paribus, only the first lag of real GDP significantly affects economic growth at 1% level.

As shown in table 5 above, all three models do not have problems of

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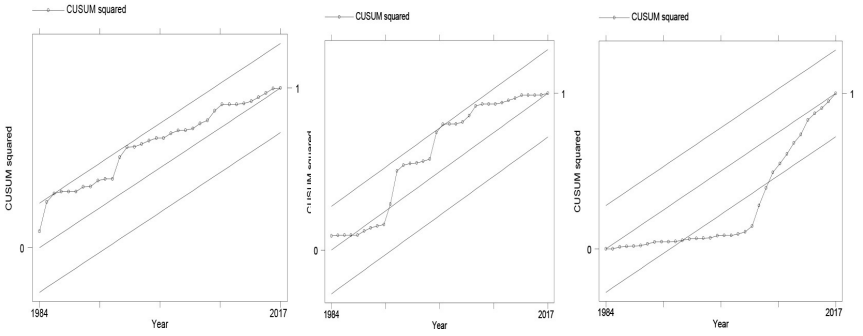
autocorrelation and hetroskedasticity. Most importantly, the models for inflation and FDI are stable within the 5% bound as shown in the CUSUM graph below. However, the model for economic growth in this study is unstable.

Figure 1: *CUSUM graphs*



Inflation model
Equation (5)

Foreign Direct
Investment model
Equation (6)

Economic growth
model
Equation (4)

The result for Toda and Yamamoto Causality Test is in table 6.

Table 6: *Toda and Yamamoto Causality Test*

Null Hypothesis:	Wald test statistic	P-value.
LOGFDI does not Cause LOGINF	474.2629***	0.0000
LOGINF does not Cause LOGFDI	63.74285***	0.0000
LOGGDP does not Cause LOGINF	195.1111***	0.000
LOGINF does not Cause LOGGDP	2.293506	0.9707
LOGGDP does not Cause LOGFDI	12.65651	0.1242
LOGFDI does not Cause LOGGDP	1.42496	0.9939

Source: Author's computation using Stata 13
Note: *** Null Hypothesis is rejected at 5%.

From table 6, we conclude that there is a bidirectional causal effect between Inflation and inflows of Foreign Direct Investment. Thus, at 5% level of significance, inflows of foreign direct investment has a causal effect on Inflation. Likewise, there exist a causal flow running from Inflation to inflows of foreign direct investment. Secondly, the causal relationship between economic growth and inflation is unidirectional which only runs from economic growth to inflation but not vice versa. This means that at 5% significance level, economic growth has a causal effect on Ghana's inflation. Finally, for economic growth and inflows of foreign direct investment, there is an independent causal relationship between them. Thus, neither is there a causal effect flowing from economic growth to inflow of FDI nor is there a causal effect moving from inflow of FDI to economic growth at 5% level of significance.

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CONCLUSION

The study first established empirically that, there is some relationship between inflation, FDI and economic growth. The study finds the causality link between these economic variables using the Toda and Yamamoto causality test. Empirically from this study, there is a bidirectional causality effect between FDI and Inflation, which is contrary to the study by Udoh and Egwaikhide (2008) which could not find a causality link between FDI and Inflation. Economic growth and Inflation showed a unidirectional causality effect running from economic growth to Inflation. These findings are consistent with Marbuah (2010) and Olaiya et al. (2011) but it is different from Hossain (2005) and Erbaykal and Okuyan (2008) who established a bidirectional causal relationship between economic growth and Inflation. Additionally, just as the findings by Frimpong and Oteng-Abayie (2006) our study finds that the causality link between economic growth and net inflows of foreign direct investment is independent. Thus, there is no causal effect between economic growth and FDI.

Firstly, the inverse relationship between inflow of FDI and inflation signifies that high inflation in the Ghanaian economy deters foreign direct investment. Moreover, an effort to stabilize prices will not attract FDI because of the unidirectional causality from FDI to inflation. Therefore, a more laudable policy recommendation is to attract export-oriented FDIs into the industrial and agricultural sectors of the Ghanaian economy. Other ways to attract foreign investors is for government to create an enabling environment in the economy. Provision of sustainable energy and water, improvement in transportation and communication systems, building and expansion of ports and harbors are necessary if government aims to attract foreign direct investment into Ghana. Secondly, the unidirectional causality running from economic growth to inflation indicates that, higher output growth is essential towards the achievement of price stability. As a policy recommendation, real economic factors that inhibit the growth of GDP should be tackled head on as an effort to overcome the inflation problem in Ghana.

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