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The Influence of Foreign Direct Investment (FDI) on the Productivity of the Industrial Sector in Ghana

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Abstract *Foreign Direct Investment (FDI) and its impact on the growth of host economies has been widely researched but yet to produce a conclusive empirical result. A number of researchers have therefore moved the analysis to sectoral level in terms of the heterogeneity in the way FDI affects the various sectors of the host countries' economies. The industrial sector is one of the sectors that have received considerable attention in the sectoral paradigm. In the case of Ghana however, the studies on the impact of FDI on the industrial sector are limited and the only study available is restricted to the exporting manufacturing firms in Ghana. We therefore studied the impact of FDI on the performance of the entire industrial sector in Ghana. More importantly, our study of the industrial sector in Ghana which includes the mining & quarrying as well as the oil & gas sub-sectors makes our study more meaningful since FDI to Africa has been argued in the literature to be driven by extractive minerals. Our time series data cover the period 1980 – 2013 and we used the Johansen cointegration test for the estimation of our model. We found FDI, trade openness and gross fixed capital formation to have significant long run positive effects on the performance of the industrial sector in Ghana. We also found that exchange rage exerts significant negative effect on industrial sector performance in the long run. We recommend that policy makers should make foreign ownership of enterprises in Ghana in the industrial sector more appealing to potential and existing investors. The government should work at strengthening the Cedi against the major trading partners as the continuous depreciation of the currency hurts businesses in the planning of payments and receipts denominated in foreign currency. Companies should invest in high quality plants and machines to enhance productivity. Trade relations with other countries should also be improved and fortified as trade openness contributes to the growth of the industrial sector.*

Key words Industrial sector, FDI, Johansen cointegration test, gross fixed capital formation, exchange rate, trade openness

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1. Introduction

The role that foreign direct investment (FDI) plays in the growth fortunes of economies has largely been underscored in the theoretical literature. FDI benefits developing economies in a number of ways including the transfer of technology and knowledge, creation of employment for the host economies, productivity growth, the growth of exports and enhanced capital investments (Fauzel, 2015; Saqib, 2013; and Walfure and Nurudeen, 2010). Empirically however, the results are mixed and inconclusive. While authors such as Elkanj *et al.* (2013), Chong *et al.* (2010) and Samimi *et al.* (2010) found FDI to have positive effect on economic growth, Hassan (2004) and Carkovic and Levine (2002) found no such positive impact of FDI on economic growth. Moreover, Frey (1992) rather found FDI to have a negative relationship with growth.

These conflicting results made Alfaro (2003) to contend that FDI might not affect all sectors in the same way and so a critical look at the heterogeneity in the way FDI affects different sectors could provide useful insights. In this respect, a number of sectoral studies have been done particularly for the emerging economies. One of the sectors that have received such empirical attention is the industrial sector (Lean, 2008; and Chandran and Krishnan, 2008). The results on the impact of FDI on the industrial sector are

mixed and sensitive to the countries and the sample period considered. Masron et al (2012) argue that FDI's impact on growth of the manufacturing sector in terms of technology transfer and other spillovers is far from certain.

For Ghana, although a number of empirical studies in respect of the impact of FDI on the growth of the Ghanaian economy as a whole exist, there are limited studies on the impact of FDI on the industrial sector. There is only one study by Faruq (2012), to the best of our knowledge, which has looked at the impact of FDI on the industrial sector in Ghana, but that study is limited only to the exporting firms in the manufacturing sub-sector in Ghana. This study differs in many respects from the work of Faruq (2012). First of all, the work of Faruq (2012) focuses only on the manufacturing firms but the industrial sector in Ghana also comprises of other sub-sectors. Our study looked beyond just the manufacturing sub-sector to consider performance of the entire industrial sector in Ghana that comprises of manufacturing, oil & gas, mining & quarrying and construction. Secondly, even within the manufacturing sub-sector, Faruq (2012) considered only the exporting firms thereby making his study rather restrictive. Thirdly, Faruq (2012) considered sub-sectors such as food, garment, wood, furniture, machinery and metal and textiles for his study. Meanwhile, FDI to Africa has been argued in the literature to be driven by extractive minerals which represents the stock-in-trade of the mining & quarrying sub-sector in Ghana but which Faruq (2012) did not consider (See Morisset, 2001; Kolstad and Tondel, 2002; Basu and Srinivasan, 2002; Asiedu, 2006; and Sichei and Kinyondo, 2012). In line with this argument in the literature, we argue that our consideration of industrial sector which includes these two sub-sectors in Ghana makes our study more meaningful. We also used a more expansive data covering the period 1980 and 2013 compared to the work of Faruq (2012) which used data from 1991 to 2004.

Moreover, authors like Romer (1994) and Moran *et al.* (2005), have indicated that FDI impacts economic growth indirectly through the transfer of technology and knowledge capital which is important in developing the technical and managerial capabilities of local enterprises. The spillover effect of FDI to the host economy is argued to take place when skilled and well-trained workers move from multinational companies to the local companies. The spillover also occurs through linkages between the multinationals and the local companies thereby providing the platform for the local companies to learn from the multinationals and also when the multinationals provide stiff competition that pushes the local companies to enhance their technology and production processes to weather the competition (Bwalya, 2006).

Putting together the argument that FDI to Africa is driven by extractive minerals which are at the heart of the industrial sector in Ghana and the argument of FDI's spillover effect of technology to sectors such as manufacturing, the study of the impact of FDI on the industrial sector of Ghana could not be more imperative.

The industrial sector plays an important role in the composition of the Ghana's gross domestic product (GDP) as well as the provision of jobs to the active working population. In 2011 for instance, the sector contributed more than a quarter (25.6%) of Ghana's GDP and by the end of 2014 the sector contributed 28.4% of the country's GDP as per Ghana Statistical Service's revised 2014 figures (GSS, 2015). The industrial sector in Ghana, according to the composition by Ghana Statistical Service (GSS), is made up of the mining & quarrying, oil & gas, manufacturing, electricity, water & sewerage and construction sub sectors (GSS, 2015). The available data from the GSS'S revised 2014 GDP figures indicates that the industrial sector's contribution to GDP from 2011 onwards is driven by the mining & quarrying and the construction sub-sectors.

2. Literature Review

There are three theoretical perspectives, according to El-Wassal (2012), on the relationship between FDI and growth. The first perspective is the 'positive view' which is built on the economic growth theory of the neoclassicals. The benefits of FDI to the growth of the economy, according to this view, rest on two channels namely the direct channel and the indirect channel. On the direct channel, FDI is believed to augment domestic capital as per the neoclassical view that growth is capital-driven. The indirect channel is based on the endogenous growth models which see FDI to benefit growth by way of transfer of technology and knowledge to the domestic enterprises as per the works of Moran et al (2005) and Kumar and Pradham (2002).

The 'negative' view is on the premise that income inequality tend to widen with increase in the inflows of FDI and the growth of the host economy would be impacted negatively as per the works of Nolan (1983) and Bomschier *et al.* (1978). Resource utilization would be less optimal as FDI creates monopolies in a number of industries (Chase-Dunn, 1975). It is also argued that most of these multinationals tend to be too large for the domestic firms to compete with thereby crowding out these domestic firms and killing local initiatives. The repatriation of profits by the multinational enterprises derails the growth efforts of the host economies (Reis, 2001).

Turning to the 'dependent impact' view, FDI is argued to impact on the host economies but the extent of the impact depends on the host economy's ability to annex and absorb these growth-related benefits of FDI. On this score, a number of such pre-conditions have been outlined. While Lautier and Moreaub (2012) identified the level of domestic investment as a pre-condition, Alfaro and Charlton (2007) suggested the composition of the host country's economic sectors. Moreover, Mody and Murshid (2005) identified strong macroeconomic policies, Alfaro *et al.* (2004) identified strong financial markets in the host economy, Antras (2003) suggested strong institutions in the host economy, Borensztein et al. (1998) suggested quality stock of the workforce, Balasubramanyam *et al.* (1996) identified the export orientation and the trade openness of the host economy and then Blomstrom *et al.* (1994) suggested the level of wealth of the host economy. According to these authors, the host economies would only be able to benefit from FDI when these conditions prevail.

The empirical evidence on the FDI-growth relationship is far from certain. Mohamed *et al.* (2013) studied the relationship between FDI, domestic investment and the economic growth of Malaysia by employing causality test. They did not find any long run causal link between FDI and the economic growth of Malaysia. El-Wassal (2012) considered sixteen Arabian countries and found that the impact of FDI on these economies was rather negligible but observed that the sectoral composition of the economies is key to the annexation of the benefits of FDI. Hassan (2004) as well as Carkovic and Levine (2002) also found FDI and economic growth not to have any positive relationship. On the other hand, Elkanj *et al.* (2013), Chong *et al.* (2010), Samimi *et al.* (2010), Lai *et al.* (2006), and Eller (2005) established that FDI has positive effect on economic growth.

Looking at the sectoral front and specifically the industrial sector, the empirical results are also mixed. Caves (1974) studied the industries in Australia to ascertain the existence or otherwise of spillover effects of FDI and found that the increase in the productivity of domestic firms is related to the increase in the ownership of foreigners. The level of foreign ownership, among other factors, was found by Globerman (1979) to account for the differences in productivity among the numerous industries in Canada. Buckley et al (2002) studied the spillover effect of foreign multinationals on domestic firms in China with cross sectional data for 1995. The authors found that domestic firms in China benefited from technological transfer and accessibility to international markets from the foreign multinationals. They found further that Chinese investors overseas provided only accessibility to international markets to the local firms. In the addition, the authors established that the foreign multinationals generated negative spillovers to the local firms that are owned by the State.

The work of Filip *et al.* (2007) on the manufacturing plants in China established that idiosyncratic factors in firms as well as certain institutional factors underpinned the extent of the impact of FDI on the productivity of these firms. Lean (2008) studied the impact of FDI on manufacturing sector in Malaysia and found no long run relationship between the growth of the sector and inward FDI. Having failed to reject the null hypothesis of no cointegration between the variables over the period studied (1980–2005), the author further looked at the granger causality between inward FDI and the growth of the manufacturing sector and found that they are independent.

Zhang *et al.* (2010) studied firms in the manufacturing sector of China with panel data covering the period between 1998 and 2003. The authors found that the productivity of the local firms is positively related with the diversity of the country of origin of the FDI and the intensity of the positive relationship increases with size and the technology gap existing between the local firms and FDI.

Using correlation analysis and data covering the period 1999–2004, Masron *et al*. (2012) found FDI to have positive correlation with the productivity of the manufacturing sector in Malaysia and thus the existence of spillover effect. In addition, using data over a sample period covering 1970 to 2003 and

employing the ARDL approach, Chandran and Krishnan (2008) found inward FDI to have positive and significant impact on the growth of Malaysia's manufacturing sector.

Fauzel *et al.* (2015) studied the spillover effect of FDI on the manufacturing sector of Mauritius using the dynamic error correction model and data from 1980 to 2010. The authors found that FDI made significant contributions to the labour and factor productivity of the manufacturing sector in the long run.

In the context of Ghana, studies on FDI and growth abound. For instance, Karikari (1992) considered the causal link between FDI and growth in Ghana using data over the period 1961 and 1988. The author found that economic growth in Ghana is not granger-caused by FDI but economic growth rather granger-caused FDI. Frimpong and Oteng-Abayie (2006) conducted a similar study on Ghana by focusing on the prior and post Structural Adjustment Programme (SAP) in Ghana. The authors did not find any causal link between FDI and economic growth prior to the SAP but also found that FDI granger-caused economic growth in the post SAP period. Taking the whole sample period (prior and post SAP), the authors did not find causal link between FDI and economic growth in Ghana. Furthermore, Frimpong and Oteng-Abayie (2008) found no causal link between FDI and growth in output in Ghana.

Having used data over the period 1984 and 2007 and employing the autoregressive distributed lag (ARDL) model, Sakyi (2011) found that trade openness, foreign aid and economic growth have a long run relationship in Ghana. Insah (2013) used time series data over the period 1980 and 2010 and found that FDI has a long run positive relationship with economic growth in Ghana. When the FDI values are lagged however, the author finds a negative relationship between growth and FDI. Antwi *et al.* (2013) also found that FDI and economic growth in Ghana have a positive relationship, having used data that covers the period 1980 and 2010 in much the same coverage as Insah (2013) and with similar results.

These studies focused on FDI and growth of the entire economy. On the sectoral front and specifically the industrial sector, there is only one study (to the best of our knowledge) by Faruq (2012) that has looked at the FDI and manufacturing in Ghana. Faruq (2012) studied how the export of local manufacturing firms in Ghana is affected by the presence of multinational enterprises in the same industry with data covering the period 1991 and 2004. The author found a positive spillover effect from the multinational enterprises to the Ghanaian exporting manufacturing firms. Having controlled for the possible spillover effect on these local exporting firms from other exporters, the author obtains the same results.

3. Methodology of research

3.1. Data used and the sources

We used time series data on Ghana covering the period 1980 and 2013 obtained from the World and African Development Indicators as well as the International Financial Statistics.

3.2. Description of Variables

The regress and in our model is the industrial sector performance while the regressors include the foreign direct investment, exchange rate, gross fixed capital formation, inflation and trade openness. The variables are described as follows:

1. The industrial sector (dependent variable)

The value added to the industrial sector is an aggregation of the value added to the sub-sectors which include manufacturing, mining, oil & gas, water & sewerage, electricity and construction. The data used are based on 2005 prices (real terms). On the basis of the argument that FDI leads to technology and knowledge transfer, we expect to have a positive long run impact of FDI on the industrial sector of Ghana.

2. Foreign Direct Investment (FDI)

The foreign direct investment (FDI) which is the key variable of interest is measured in our model as the net inflows FDI expressed as a share of gross domestic product (GDP). We expect this variable to positively impact the industrial sector

3. Gross Fixed Capital Formation (GFCF)

Gross fixed capital formation (GFCF) expressed as a share of GDP is comprised of purchases of equipment, machinery, industrial buildings, plant, and construction of roads as well as railways. GFCF is expected to have a positive impact on the industrial sector performance.

4. Inflation (INFL)

The percentage change in the Consumer Price Index (CPI) is used in this model to represent inflation. This variable also gauges the level of stability of the macro economy.

5. Trade Openness (TRADE)

The share of export and import in Ghana's GDP is employed as a proxy for trade openness and it is expected that the more Ghana engages in international trade, the growth-related benefits to the industrial sector would increase.

6. Exchange Rate (EXR)

The exchange rate of the Ghanaian cedi against the United States dollars is used to represent exchange rate since the United States dollar is a major trading currency in Ghana.

3.3. Specification of our model

The industrial sector performance represents our dependent variable and the other variables above are the regressors. We formulate our equation with the above variables as follows:

$$INDUS_t = f(FDI_t, INFL_t, GFCF_t, EXR_t, TRADE_t) + \varepsilon_t \quad (1)$$

The variables outside our model are represented by the error term ε_t.

To obtain linearity in equation (1), we adopt a Cobb-Douglas log-linear model of the form in equation 2 below:

$$INDUS_t = \alpha_0 (FDI_t)^{\alpha_1} (INFL_t)^{\alpha_2} (GFCF_t)^{\alpha_3} (EXR_t)^{\alpha_4} (TRADE_t)^{\alpha_5} u_t^{\varepsilon_t} \quad (2)$$

The model in equation 2 is multiplicative in nature. When we take the natural log of equation (2), we get:

$$\ln INDUS_t = \alpha_0 + \alpha_1 \ln FDI_t + \alpha_2 \ln INFL_t + \alpha_3 \ln GFCF_t + \alpha_4 \ln EXR_t + \alpha_5 \ln TRADE_t + \varepsilon_t \quad (3)$$

The coefficients of the regressors in equation (3) represent their respective long run elasticities with respect to the regressand.

2.4. The Test for Unit Root

Since we are using time series data, it is imperative that we test for the stationarity properties of our variables and the order of which they are integrated to avoid spurious results. In this respect we employ the augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests. The ADF approach has a restrictive assumption in respect of the error term by assuming that the error term is homoskedastic. We therefore employ the Phillips-Perron (PP) unit root test to overcome the restrictive assumption of the ADF approach and to cater for any heteroskedasticity in the error term and serial correlation.

We undertake the ADF test as follows;

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (4)$$

The null hypothesis is given as, H_0: δ = 0 (The series are not stationary) and the alternative hypothesis is that H_1: δ < 0 (the series are stationary).

2.5. Test for Cointegration

Having checked for the stationarity properties of our series, we test for cointegration using the Johansen (1988, 1991) cointegration test and the vector error correction model (VECM). This test (Johansen cointegration test) takes a maximum likelihood approach in testing for cointegration in models of multivariate vector autoregression (VAR).

Beginning with VAR (k), a vector integrated of the order one or I(1) variables can be represented by Y_t as in equation (5) that follows:

$$Y_t = A_t Y_{t-1} + A_t Y_{t-2} + \dots\dots\dots + A_k Y_{t-k} + \varepsilon_t \quad (5)$$

The Y_t and ε_t are vectors of the form n × 1.

We can remodel equation (5) to obtain;

$$\Delta Y_t = \sum_{i=1}^{k-1} \Gamma_i Y_{t-i} + \prod Y_{t-1} + \mu_0 + \varepsilon_t \quad (6)$$

$$\text{where } \prod = \sum_{i=1}^{k} A_i - I \quad \text{and} \quad \Gamma_i = -\sum_{j=i+1}^{k} A_j$$

We have n × r matrices and α and β with each having a rank *r* so that the matrix ∏ = $\alpha\beta'$ and $\beta' Y_t$ is said to be stationary. That is however dependent on the fact that the reduced rank *r*<*n*, α and individual columns of β are the adjustment parameters in the VECM and cointegrating vector respectively, where *r* is the number of cointegrating relationships.

Having tested for cointegration, we then adopt a vector error correction model (VECM) to capture the long run and the short run dynamics. To estimate FDI's impact on the industrial performance, we consider a VECM as follows:

$$\begin{aligned} \text{InINDUS}_t = \alpha_0 &+ \sum_{i=1}^{n} \Phi \text{InINDUS}_{t-i} + \sum_{i=1}^{n} \Phi \text{InFDI}_{t-i} \\ &+ \sum_{1=0}^{n} \partial \text{InINFL}_{t-i} + \sum_{i=0}^{n} \Omega \text{InGFCF}_{t-i} + \sum_{i=0}^{n} \varphi \text{InEXR}_{t-i} + \sum_{i=0}^{n} \psi \text{InTRADE}_{t-i} + \varepsilon_t \end{aligned} \quad (7)$$

$$\begin{aligned} \Delta\text{InINDUS}_t = \alpha_0 &+ \sum_{i=1}^{n} \Phi \Delta\text{InINDUS}_{t-i} + \sum_{i=1}^{n} \Phi \Delta\text{InFDI}_{t-i} + \sum_{1=0}^{n} \partial \Delta\text{InINFL}_{t-i} \\ &+ \sum_{i=0}^{n} \Omega \Delta\text{InGFCF}_{t-i} + \sum_{i=0}^{n} \varphi \text{In}\Delta\text{EXR}_{t-i} + \sum_{i=0}^{n} \psi \Delta\text{InTRADE}_{t-i} + \xi \text{ECT}_{t-1} + \varepsilon_t \end{aligned} \quad (8)$$

We represent coefficient of the error term (ECT_{t-1}) by ξ.

We then estimate the impact of FDI on the industrial performance in the short run by considering a VECM of the form:

$$\text{InINDUS}_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \text{InINDUS}_{t-i} + \sum_{i=1}^{n} \beta_2 \text{InFDI}_{t-i} + \sum_{1=0}^{n} \beta_3 \text{InINFL}_{t-i} + \sum_{i=0}^{n} \beta_4 \text{InGFCF}_{t-i} + \sum_{i=0}^{n} \beta_5 \text{InEXR}_{t-i} + \sum_{i=0}^{n} \beta_6 \text{InTRADE}_{t-i} + \varepsilon_t \quad (9)$$

$$\Delta\text{InINDUS}_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta\text{InINDUS}_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta\text{InFDI}_{t-i} + \sum_{1=0}^{n} \beta_3 \Delta\text{InINFL}_{t-i} + \sum_{i=0}^{n} \beta_4 \Delta\text{InGFCF}_{t-i} + \sum_{i=0}^{n} \beta_5 \Delta\text{InEXR}_{t-i} + \sum_{i=0}^{n} \beta_6 \Delta\text{InTRADE}_{t-i} + \chi \text{ECT}_{t-1} + \varepsilon_t \quad (10)$$

Where INDUS_t represents industrial sector performance and the coefficient of the error term is represented by χ.

2.6. The Impact of Foreign Direct Investment on the Industrial Sector

Selection of VAR Lag Length

To undertake the Johansen cointegration test, we first determined the lag order selection criteria. On the basis of the Schwarz information criterion, we selected a lag length of two (2) to minimize information criteria. The lag lengths as in the table below were suggested by the various information criteria.

Table 1. The Criteria for VAR Lag Order Selection in respect of FDI's impact on the industrial sector

Endogenous variables: LINDUS LFDI LINFL LEXR LTRADE LGFCF

Exogenous variables: C

Lag	LogL	LR	FPE	AIC	SC	HQ
0	78.08444	NA	2.34e-10	-5.148889	-4.863416	-5.061617
1	209.6566	197.3583*	2.71e-13	-11.97547	-9.977166	-11.36457
2	251.0296	44.32821	2.74e-13	-12.35926	-8.648117*	-11.22473
3	309.3834	37.51317	2.06e-13*	-13.95596*	-8.531984	-12.29780*

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

2.7. Johansen Cointegration Test

Table 2. Unrestricted Cointegration Rank Test (Trace)

Series: LINDUS LFDI LINFL LEXR LTRADE LGFCF
Lags interval (in first differences): 1 to 2

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.891540	158.1785	95.75366	0.0000
At most 1 *	0.742053	95.98002	69.81889	0.0001
At most 2 *	0.675680	58.03996	47.85613	0.0042
At most 3	0.478013	26.51131	29.79707	0.1141
At most 4	0.255256	8.308164	15.49471	0.4330
At most 5	0.002003	0.056140	3.841466	0.8127

Trace test indicates 3 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 3. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.891540	62.19845	40.07757	0.0000
At most 1 *	0.742053	37.94006	33.87687	0.0155
At most 2 *	0.675680	31.52865	27.58434	0.0147
At most 3	0.478013	18.20315	21.13162	0.1224
At most 4	0.255256	8.252024	14.26460	0.3537
At most 5	0.002003	0.056140	3.841466	0.8127

Max-eigenvalue test indicates 3 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The results of the Johansen cointegration test based on the trace is presented in table 2 above and that of the maximum-eigenvalue test statistics are presented in table 3. On the basis of both the trace and maximum-eigenvalue, the null hypothesis of no cointegration is rejected. There is therefore cointegration among our variables in model.

2.8. Estimates for Long Run Relationship

With cointegration established between the industrial sector performance and the independent variables, we test the long run impact of FDI and other variables in the model on the industrial sector performance. The results are presented in table 4.

Table 4. Results on the long run Impact of FDI on the Industrial Sector

Dependent Variable: LINDUS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.750272	0.243777	3.077697	0.0050
LFDI	0.121213	0.022418	5.946230	0.0001*
LINFL	-0.036627	0.044916	-0.815466	0.4225
LEXR	-0.124662	0.022937	-5.434972	0.0000*
LTRADE	0.508073	0.129446	3.924970	0.0006*
LGFCF	0.512411	0.164560	3.113824	0.0046*
Diagnostic Tests				
R-squared	0.952279			
Adjusted R-squared	0.942735			
F-statistic	99.77656			
Prob(F-statistic)	0.000000			
Durbin Watson stat	1.243594			
Serial Correlation LM Test (p-value)	5.869305	(0.0531)		
Normality: Jarque-Bera test (p-value)	0.887254	(0.641705)		
Heteroskedasticity: Chi-square (p-value)	2.303311	(0.8058)		

Note: * denotes significance at 1% level. Standard errors are White Heteroskedasticity-Consistent.

According to the diagnostic checks, 94% of the changes in the performance of the industrial sector is explained by the changes in the independent variables included in our model. The *F*-statistic of 99.77656 is highly significant with a *p*-value of 0.0000 indicating that our variables taken as a whole are highly significant. The diagnostic test results also indicate that our model is robust and without defects relating to heteroskedasticity, residual serial correlation and normality.

We find that FDI is positive and highly significant, implying that FDI impacts positively on the performance of the industrial sector in the long run. That is, the performance of the industrial sector improves by 0.12% when FDI inflows increase by 1%. Our finding supports earlier findings by Chandran and Krishnan (2008), Faruq (2012), Masron *et al.* (2012) and Fauzel *et al.* (2015).

Exchange rate is found to be significant with a negative coefficient. That is, a rise in the exchange rate which implies depreciation of the cedi leads a decline in the performance of the industrial sector. When the cedi depreciates by 1% against the dollar, performance in the industrial sector falls by 0.12%. Many of the industrial raw materials and inputs in Ghana are imported from abroad. A depreciation of the cedi therefore pushes up the cost of these inputs thereby affecting the volumes of the imported inputs and productivity of the industrial sector.

At 1% significant level, we find trade openness to be positively significant. The industrial performance improves by 0.51% in the long run when trade openness increases by 1%. The industries in Ghana get access to quality and sophisticated inputs from international markets as Ghana deepens international trade. These inputs help bolster productivity of the industrial sector in the long run.

We also found gross fixed capital formation to be positive and highly significant at 1% significance level. The industrial sector performance improves by 0.51% in the long run when gross fixed capital formation increases by 1%.

2.9. Estimates of the short run impact of FDI on the industrial sector

The short run impact of FDI on the industrial sector based on results from the VECM are presented in table 5 below.

Table 5. VECM Results

Variable	Coefficient	Stand. Error	t-Statistic
C	-0.030062	0.04093	-0.73452
D(LINDUS(-1))	0.406025	0.38740	1.04809
D(LINDUS(-2))	-0.078040	0.39442	-0.19786
D(LFDI(-1))	0.016280	0.07126	0.22846
D(LFDI(-2))	0.083857	0.07444	1.12647
D(LINFL(-1))	-0.161946	0.09189	-1.76240
D(LINFL(-2))	-0.042529	0.05742	-0.74071
D(LEXR(-1))	0.511152	0.23250	2.19850**
D(LEXR(-2))	0.168643	0.25775	0.65429
D(LTRADE(-1))	-0.040386	0.31114	-0.12980
D(LTRADE(-2))	0.121086	0.26849	0.45098
D(LGFCF(-1))	0.388253	0.28286	1.37262
D(LGFCF(-2))	0.273286	0.31455	0.86880
ECT	-0.045325	0.04437	-1.02149
DIAGNOSTIC TESTS			
R-squared	0.693906		
Adjusted R-squared	0.364265		
F-Statistic	2.105039		

Notes: ** denotes 5% significance level.

The results of the short run dynamics above indicate that only the first lag of the exchange rate variable is significant at 5% level of significance. The coefficient of the first lag of exchange rate is positive, implying that an increase in the exchange rate (depreciation of the cedi) helps to improve performance of the industrial sector in the short run. This is particularly true for industrial exports as prices of the exports become relatively cheaper following the depreciation of the cedi. All the other variables do not impact on the industrial sector in the short run as they are insignificant.

3. Conclusion and Policy Recommendations

On the basis of our results, we could conclude that FDI, trade openness and gross fixed capital formation have positive and significant long run impact on the industrial sector performance in Ghana. We also conclude that exchange rate has a negative long run impact on industrial sector performance. Our findings have significant policy implications. As FDI has long run positive impact on the industrial sector performance, policy makers should make foreign ownership of enterprises in Ghana in the industrial sector more appealing to potential and existing investors. The government must create an enabling environment for foreign investors to do business in Ghana, especially in the industrial sector. In respect of the exchange rate, the Ghanaian cedi has plummeted against the US dollar in recent times and that hurts businesses considering the fact that Ghana is a net importer. The government should work at shoring up the value of the Ghana cedi to help businesses to plan and forecast their purchases and receipt of revenues denominated in foreign currencies with reasonable certainty. For the gross fixed capital formation which includes plant and machinery, companies should invest in high quality plants and machines to enhance productivity. As many of these machines are imported, the government should consider exemptions in

import taxes to enable these companies to import them and boost the industrial sector and a possible spillover to the other sectors. Trade with other countries should also be improved and fortified as trade openness contributes to the growth of the industrial sector. Enhancement of the trade relations also provides the Ghanaian businesses the platform to export their products and would help, to a greater extent, in shoring up the value of the Ghanaian cedi and improve exports in general since the country is a net importer currently.

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