Effects of Foreign Direct Investment on Industrial Performance in Sub-Saharan Africa: An Empirical Analysis using Spatial Econometric Methods

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Abstract:- This paper rigorously analyzes the effects of foreign direct investment inflows on the industrial performance in the Sub-Saharan African (SSA) economies. Applying the Durbin spatial method (SDM) on a two-sector model to account for spatial effects, the empirical results show that the higher the capacity of SSA countries to attract foreign investments, the higher is the job-inducing effect and value-added created in the industrial sector, while no technology transfer was induced. This finding highlights the importance for the countries of sub-Saharan Africa to direct foreign direct investment towards strategic sectors where they benefit from comparative advantages and improve the business climate to attract more FDI, a pledge of any industrial development.

***Keywords**:- Foreign Direct Investment, Industrial Performance, Spatial Econometrics, Sub-Saharan Africa.*

JEL Codes: C21; F30; O14.

I. INTRODUCTION

The rapid expansion of foreign direct investment (FDI) flows from the 1980s onwards has fueled the debates on the consequences of economic openness in developing countries. Indeed, these countries had a negative perception of the entry of FDI for political and economic reasons. Most of the leaders of these countries were suspicious of the massive entry of FDI that was considered a threat to national sovereignty due to the loss of economic and political autonomy. Moreover, FDI was seen as direct competition to local enterprises and a source of social instability.

However, from the 1980s onwards, this perception of FDI entry has positively shifted. Indeed, the entry of FDI is more and more perceived as a determining factor in the development process of contemporary economies in an increasingly globalizing world. Nowadays, it is recognized by all that the FDI plays a capital role in the strategy of economic development of the nations and for proof, the majority of the countries undertake policies of incentive to the attraction of the FDI in their economy. Several studies including that of You and Solomon (2015) show that the example of Asian countries such as China, India, Singapore has confirmed the importance of the massive entry of FDI in the process of industrialization although the success of this process depends heavily on the policies implemented.

However, Sub-Saharan African countries have long been blamed for their low capacity to attract FDI. Indeed, the share of FDI in SSA in total global FDI flows has fallen from 6.3% to 2.1% in 1970 and 2017, respectively against a rise of 5.5% to 31.5% in South and South-East Asia over the same period according (UNCTAD, 2018). In addition, African countries still record in this early 21st century, significant challenges, especially in human capital and infrastructure. The African productive activity is essentially based on a few primary products, agricultural or mining giving a specialization of the continent's economies in the exploitation of raw materials. This poses the problem of structural changes within these economies that can lay a solid foundation for industrialization through capital accumulation, increased productivity, and competitiveness.

Therefore, structural transformation, industrialization, and the search for competitiveness have been at the heart of literature focusing on Africa's development in recent years. Therefore, it appears crucial to understand how FDI inflows influence the industrial development process of SSA countries. This paper analyses the spatial effects of FDI on the industrial performance of SSA economies.

The paper significantly contributes to the existing literature by bridging the gap in empirical studies in SSA economies on the relationship between FDI inflows and industrial performance. Indeed, only a few empirical studies have paid particular attention to the topic and covering SSA economies and most of the existing studies are outdated in terms of data periods in line with the new policy directions of the International Conference on African Emergence in 2015. The existing works in the literature focused on the period before 2010 even though these countries have started to undertake structural transformation strategies of their economies from 2015. Moreover, most of these studies did not find positive effects of FDI inflows on the industrial performance of the economies in this zone. This legitimates the relevance of a new study to empirically highlight the nature of the relationship between the two indicators especially in a context where Africa has now embarked on a new development paradigm by inscribing structural transformation as an imperative and a unique path for its economic emergence. This transformation of the productive structure of SSA economies necessarily requires structural reforms that can facilitate the massive inflow of FDI to support the productive apparatus of these economies. Consequently, an empirical study on the issue should make it possible to update the data but especially to guide and encourage the public decision-makers of the economies of this zone in their decision-making.

An additional important aspect supporting this study consists in using different econometric specifications than previous studies. Indeed, unlike all previous studies focussing on SSA countries, this paper relies on spatial models to unpack the effects of FDI entry on the industrial performance of SSA economies. Industrial development is multidimensional and a multifaced concept requiring to take into account taking into account spatial dependence and heterogeneity when exploring the nexus between FDI and industrial performance. Indeed, the advent of globalization suggests that a country's economic activity can influence its trading partners or close neighbors through trade and factor mobility. Hence, drawing on spatial econometrics would lead to more reliable results and thus allow for the formulation of more optimal economic policy orientations.

II. LITERATURE REVIEW

Theoretical studies identify two main channels through which FDI flows affect the industrial performance of countries including direct effects and indirect effects. The direct effects are analyzed in terms of job creation or in terms of competition on local companies and on the demand for local inputs as well as their contribution to industrial value added (*e.g*., see Rodríguez-Clare 1996 and Markusen & Venables 1999). Indirect effects, on the other hand, are analyzed in terms of the transfer of technology and knowledge from the host country to the host country, which increases the productivity and value-added of local firms through horizontal and vertical spillovers (*e.g*., see MacDougall 1960; Caves 1971 and Görg & Greenaway 2004).

We first present the works that have studied the direct effects of FDI entry on the industrial development process and then those that have analyzed the indirect effects through technology transfers before focusing on the specific case of African countries.

A. The direct effects of FDI entry on industrial performance

One of the first studies to have empirically analyzed the effects of FDI entry on industrial performance is that of Blomström (1986). Indeed, the author analyses the effects of the presence of foreign firms on the performance of Mexican manufacturing industries over the period 1970 to 1975, focusing on the structure of the manufacturing sector. Using the ordinary least squares (OLS) model, the author finds that the efficiency of the Mexican manufacturing sector is positively correlated with the presence of multinational firms. In other words, industries dominated by foreign firms tend to be more efficient than other industries because local firms acquire better practices. This industry is dominated by multinational firms, therefore, tends to have a concentration of local firms and is found to be in the modern sector.

In the same vein, several other authors have arrived at similar results by analyzing other economies. As an illustration, Barrios *et al*. (2005) explored the impact of FDI on the development of local Irish firms over the period 1972 to 2000 using OLS and semi-parametric regression techniques. They conclude that although the competition effect initially discourages local firms, spillover effects, notably positive externalities, will emerge and lead to a largely positive overall impact for local firms. Local producers need some time to adapt and improve their capabilities. Also, Zhang (2014) using the OLS estimation method highlighted that over the period 2005-2010 FDI entry has positively affected Chinese industrial competitiveness. More interestingly, the study showed that these effects are stronger on low-tech manufacturing industries than on medium- and high-tech industries.

However, other studies have found contradictory results. Indeed, Alfaro *et al*. (2004) used the theoretical model of Rodríguez-Clare (1996) to study firm-level data from Brazil (over the period 1997-2000), Chile (over the period 1987 to 2000), and Venezuela (over the period 1995 to 1999). The results obtained using the OLS method show that the entry of multinational firms has no significant effect on horizontal spillovers. In the same vein, Kang & Lee (2011) use the generalized method of moments (GMM) on panel data to analyze the relationship between FDI and deindustrialization in OECD countries. Their results show not only that there are major internal and external drivers of deindustrialization, but that FDI flows are also a positive impact on employment and manufacturing value-added.

B. Indirect effects of FDI entry on industrial performance

The empirical literature shows that FDI entry indirectly influences industrialization through the technology transfer channel under the assumption that technology transfers can influence the productivity, value-added, and profit of local firms. Indeed, Fosfuri *et al*. (2001) analyzed the technological spillovers of FDI on local firms through the technology *spillover* effect. They find that a multinational firm can transfer superior technology to its foreign subsidiary only after training workers in the host countries. Also, worker mobility contributes to technology *spillovers*.

The spillovers of technology transfer can be vertical or horizontal as demonstrated in the theoretical review. On this point, the vertical spillovers of technological *spillovers* have been analyzed empirically by several authors in various regions of the world. Indeed, Sjöholm (1999) analyzed the effects of regional integration and FDI entry on the productivity of local Indonesian industrial branches over the period 1980-1991 using OLS. Its results show that the presence of FDI has led to a strong increase in productivity in the intra-industry through vertical spillovers of technology transfers. However, the study did not find results showing the possibility that geographical proximity increases vertical spillovers.

In the same vein, subsequent studies highlight a positive connection between FDI inflows and the increase in the productivity of local firms. We can cite the work of Javorcik (2004) who analyzed the case of Lithuania over the period 1996-2000 using OLS and *Olley-Pakes Regression*. His results show positive vertical spillovers of FDI entry on the intra-industry productivity of local firms, especially those of input suppliers. Liu (2008) reached the same conclusion by analyzing the horizontal and vertical spillovers of FDI entry on domestic firms in China using a fixed-effects model on panel data of 17,675 firms over the period 1995-1999. The results show that despite some negative effects in the short run, there are higher positive effects on the productivity of local firms in the long run. Furthermore, Javorcik & Spatareanu (2008) analyzed the case of Romania using the OLS and *Levinsohn-Petrin approach* over the period 1998-2003. The results suggest that vertical spillovers are noticeable among local firms subcontracting with foreign affiliates and that the negative horizontal competitive effect of entry is mitigated by the knowledge transfer that increases the productivity of the industry. Finally, Xu & Sheng (2012) analyzed the spillover effects of FDI entry on domestic firms in the Chinese manufacturing sector between 2000 and 2003 using a battery of models such as OLS, GMM, etc. The results show positive effects of FDI entry on the productivity of intra-industry firms through the interconnection between domestic firms and FDI, especially through the purchase of high-quality intermediate goods or equipment from foreign firms.

Nevertheless, there are empirical studies that have invalidated the positive effects of FDI entry by finding negative effects on productivity. For example, Kugler (2006) analyzed the effects of FDI entry on the intra-industry productivity of Colombian firms through the channel of technology transfer. Using the structural *vector autoregressive* (VAR) model over the period 1974-1998, the results reveal the absence of spillovers from FDI entry on intra-industry firms.

C. Empirical work on the specific case of African countries

The empirical literature on the effects of FDI on industrial performance in developing countries and particularly focusing on SSA countries remains controversial. Indeed Managi & Bwalya (2010) analyzed the vertical and horizontal spillovers of FDI entry on intra-industry and inter-sectoral productivity of local firms in three SSA countries namely Zimbabwe, Tanzania, and Kenya over the period 1994-1995 using the system-GMM method. Their results show the existence of positive vertical and horizontal effects of FDI entry on extra and intra-industry productivity in Kenya and Zimbabwe but a negative effect for Tanzania. The authors find that the negative result in Tanzania could be explained by the fact that some tax favors are granted to foreign firms at the expense of local firms, thus creating competition effects.

On the other hand, Nkoa (2016) used the GMM method to analyze the effects of FDI on the industrial performance on a panel of 53 African countries over the period 1975-2014. The results show that FDI contributes to the industrialization of African countries through direct and indirect effects of FDI inflows.

However, Bwalya (2006) analyses the nature and extent of positive externalities of FDI on the productivity of 125 local manufacturing firms in Zimbabwe over 1993-1995. Relying on a combination of OLS, fixed-effect model, and the system-GMM method, the results show no positive effect of FDI entry on intra-industry productivity through the knowledge transfer channel. In the same vein, Kaya (2010) analyzes the effects of globalization on industrialization in 64 developing countries using a five-effect and random-effect model on panel data covering the period 1980 to 2003 finds that FDI inflows did not have a significant impact on industrialization in most of the 64 developing countries and that exports of raw materials do not significantly influence manufacturing employment.

In addition, Waldkirch & Ofosu (2010) analyzed the case of Ghana using OLS, Levinsohn-Petrin, and system-GMM models over the period 1991-1997. Their analysis shows that the effects of FDI presence on the productivity of Ghanaian manufacturing firms are negative for domestic firms but positive for most foreign firms. These finding thus indicates that the positive effect on productivity growth of domestic firms does not seem to offset the negative effect of competition from FDI.

On the other hand, Gui-Diby & Renard (2015) examined the relationship between FDI and the industrialization process in Africa over the period 1980-2009 using panel data from 49 countries using the feasible generalized least squares method (FGLS). Their results indicate that FDI inflows have not had a significant impact on industrialization in African countries.

III. EMPIRICAL METHODOLOGY

A. Presentation of the analysis model

To analyze the relationship between FDI and industrial performance, we adopted the two-country model of the "leader-follower" by Sala-i-Martin & Barro (1995) in a theoretical framework of endogenous growth driven by technological diffusion. The leader country creates and develops new technologies for its production of goods while the follower country adapts the new technologies discovered in the leader country by taking into account its environment. The leader country holds the monopoly of the production of intermediate goods and the follower country can only produce them by adapting its environment[1]0.

Thus, we start from the basic model proposed by Gui-Diby & Renard, (2015) to use two proxies of industrial performance. These are the industrial value added (IVA) and the level of employment in the industrial sector. Indeed, the basic model is as follows:

$$INDUS = \alpha X_{it} + \beta FDI_{it} + région + \varepsilon_{it} \quad (1.a)$$
$$Emploi = \alpha X_{it} + \beta FDI_{it} + région + \varepsilon_{it} \quad (1.b)$$

[1] For more details on the model, see Sala-i-Martin & Barro (1995) page 1 to 14 DOI : http://hdl.handle.net/10419/160652

With $INDUS$ = industrial value-added and $Emploi$ = the level of employment in the industrial sector; both capture the measured industrial performance.

X = The matrix of explanatory variables for industrial performance proposed by Zhang (2014) and Gui-Diby & Renard (2015) includes the GDP per capita, private investment captured by gross fixed capital formation to GDP, human capital measured by gross secondary school enrollment, trade openness, infrastructure is captured by the number of telephone lines per 100 inhabitants.

IDE_{it} = Net foreign direct investment inflow as a percentage of GDP.

$région$ = The dummy variable that allows for the highly heterogeneous nature of the countries. ε measures the error term and α and β represent the parameters of the respective variables.

This basic model was further strengthened by Nkoa (2016) to take into account the effect of interaction between some explanatory factors to give the model below:

$$INDUS = \alpha X_{it} + \beta FDI_{it} + \gamma V_{it} + région + \varepsilon_{it} \quad (2.a)$$

$$Emploi = \alpha X_{it} + \beta FDI_{it} + \gamma V_{it} + région + \varepsilon_{it} \quad (2.b)$$

With V measuring the interaction between three variables which are industrialization, FDI and human capital. Indeed, according to Ongo Nkoa (2016), FDI can impact industrial performance through human capital or trade openness.

B. Overview and rationale for the use of spatial panel econometrics

Focusing on FDI, the decision to invest abroad presupposes two pieces of spatial information, namely the location and the attribute on which the choice is made in a given geographical area. Then, the installation of a multinational firm in a country will depend on the preliminary conditions of attractiveness which can be related to comparative advantage or an incentive policy on behalf of the authorities. Overall, the arrival of FDI in a country is likely to influence the industrial performance of the host country but also of its neighboring countries. As a result, two geographical units may affect each other Elhorst (2014).

Therefore, this study uses spatial econometrics to take into account spatial interactions in the analysis of the effects of FDI on industrial performance. Indeed, spatial econometrics makes it possible to apprehend the strategic interactions between the decisions of the actors of the economy and the spatial structures. According to Manski (1993), the probability of an individual behaving in one way or another varies according to the prevalence of the effects of a reference group to which he belongs. These effects can, depending on the context, be called "social norms", "neighbourhood effects", "imitation", "contagion", "herd behaviour", or "social interactions", etc. In other words, Manski (1993) shows that social or spatial interaction occurs when the behavior of individuals is influenced by the average behavior of the group to which they belong.

In the literature, a distinction is made between spatial models, cross-sectional data and panel data. The present study uses panel data. Indeed, let us consider a sample of N individuals i (i=1; 2; ...; N) observed over the period t=1; 2; ...; T. The standard model of spatial econometrics for panel data is :

$$Y_{it} = X_{it}\alpha + Z_{it}\beta + \varepsilon_{it} \quad (2.9)$$

With X_{it} vector of k explanatory variables of dimension (1, k) and assumed to be exogenous;

Z_{it} is a vector of individual-specific and time-invariant variables ; α = is a vector of unknown parameters to be estimated of dimension (k , 1) ; β = vector of the parameters of the individual-specific variables and ε_{it} = the error terms.

This equation allows us to understand two important phenomena in spatial econometric analysis. These are the individual-specific effects or individual heterogeneity and the spatial effects or spatial autocorrelation which are essential in the specifications of spatial models.

C. Formulation of the weight matrix

In fact, there are symmetric and non-symmetric weight matrices. The non-symmetric weight matrix is a matrix of which values w_{ij} of the matrix are not symmetrical with respect to the diagonal as is the case in this study. We use a non-symmetric weight matrix of which components w_{ij} represent the average value of bilateral exports of 36 SSA countries over the period 1998-218. The choice of the export matrix and the 36 countries is justified by the fact that data are not available for some countries, as exports are the best variable to capture trade flows between countries.

As LeSage & Pace (2009) and Elhorst (2014) have shown, it is important to normalize the non-symmetric weight matrix to 1 to have a linear combination between the country i with its partners in order to facilitate the convergence of the estimated models and the possibility of comparing them with each other. This normalization consists of relating each component of the matrix to the sum of the value of the components of the row concerned in order to obtain the sum of each row of the matrix equal to unity. More formally, the normalization equation for the weight matrix is as follows:

$$w_{ij}^S = \frac{w_{ij}}{\sum_j w_{ij}} \text{ ; With } w_{ij}^S = 1 \quad (4)$$

With: w_{ij}^S = the normalized weight of the country i to the country ; $\sum_j w_{ij}$ = the total sum of the country's exports i with SSA partner countries.

Thus, for a sample of 36 SSA countries with inter-country trade flows, the weight matrix A can be represented as follows:

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$$
\begin{array}{cc}
 & \begin{array}{cccccccc} \text{AGO} & \text{BDI} & \text{BEN} & \text{BFA} & \ldots & \text{UGA} & \text{ZAF} & \text{ZMB} \end{array} \\
\begin{array}{c} \text{AGO} \\ \text{BDI} \\ \text{BEN} \\ \text{BFA} \\ \cdot \\ \cdot \\ \cdot \\ \text{UGA} \\ \text{ZAF} \\ \text{ZMB} \end{array} &
\begin{pmatrix}
0 & w_{1.2} & w_{1.3} & w_{1.4} & w_{1.j} & w_{1.34} & w_{1.35} & w_{1.36} \\
w_{2.1} & 0 & w_{2.3} & w_{2.4} & w_{2.j} & w_{2.34} & w_{2.35} & w_{2.36} \\
w_{3.1} & w_{3.2} & 0 & w_{3.4} & w_{3.j} & w_{3.34} & w_{3.35} & w_{3.36} \\
w_{4.2} & w_{4.2} & w_{4.3} & 0 & w_{4.j} & w_{4.34} & w_{4.35} & w_{4.36} \\
 & & & & & & & \\
w_{i.1} & w_{i.2} & w_{i.3} & w_{i.4} & & w_{i.34} & w_{i.35} & w_{i.36} \\
 & & & & 0 & & & \\
w_{34.1} & w_{34.2} & w_{34.3} & w_{34.4} & w_{34.j} & 0 & w_{34.35} & w_{34.36} \\
w_{35.1} & w_{35.2} & w_{35.3} & w_{35.4} & w_{35.j} & w_{35.34} & 0 & w_{35.36} \\
w_{36.1} & w_{36.2} & w_{36.3} & w_{36.4} & w_{36.j} & w_{36.34} & w_{36.35} & 0
\end{pmatrix}
\end{array}
$$

With $w_{ij} =$ the weight of the country's exports $i\,(ligne)$ to the partner country $j\,(colonne)$ and $i = 1\,;2\,;\ldots 36$ and $j = 1\,;2\,;\ldots 36$. By definition, a country cannot be a partner with itself, i.e. it is not contiguous with itself, which justifies that $w_{ij} = 0$; for all $i = j$.

From this matrix, the estimation of the weight matrix is obtained by using the average of bilateral exports between the 36 selected SSA countries and over the period 1998-2018 from the export matrix taken from the UNCTAD 2020 database. We thus adopted the procedure of Drukker (2013) for the formulation of the weight matrix.

Once the weight matrix is defined, it is possible to specify the spatial model to implement. The following point highlights the different tests for specifying the spatial model to be used.

D. Spatial model specification tests

Here we present several tests that allow us to select the most appropriate specific model in taking into account spatial dependence. For this, we use the most commonly used tests including the spatial dependence test developed by Pesaran (2015), the Moran'I test of the Lagrange multiplier of spatial autocorrelation of errors and lagged variables.

➢ *Pesaran's space dependency test (2015)*

Spatial dependence in the series can be checked using the test described by Pesaran (2015). The CD-test statistic of this author is based on the average of the correlation of the coefficients between the different countries taken two by two for each time interval. This test consists of testing the null hypothesis of no spatial dependence against the alternative hypothesis of its presence. The result of the Pesaran test is presented in Table 1 below.

Table 1: Pesaran's (2015) spatial dependence test

Pesaran (2015) test for weak cross-sectional dependence. Residuals calculated using predict, residuals.		
H0: errors are weakly cross-sectional dependent	CD	p-value
Eq(1) : VAI= f(FDI, GFCF, Education, ...)	0.554	0.580
Eq(2): Employment = f(FDI, GFCF, Education, Government...)	-0.968	0.333

Source: Author based on estimates

Table 1 shows a P-value greater than 5%, indicating that the null hypothesis of no spatial dependence between industrial performance and explanatory variables cannot be accepted. Thus, there is a strong spatial dependence between the different variables of the 36 SSA countries. However, the Pesaran test does not provide information on the structure of the spatial dependence, especially if there is an autocorrelation of the errors or autocorrelation of the spatially detected variables. The Lagrange multiplier test allows us to take into account this insufficiency.

➢ *Spatial autocorrelation tests for errors and lagged variables*

There are several tests of spatial autocorrelation of errors or between lagged variables but we retain the Moran *test* $(LM_{err}LM_{LAG})$ to choose the spatial model. The decision rule is based on the Maran statistic following a normal distribution.

H_0No spatial autocorrelation of errors. We accept H_0 if P-value $<$ 0,05.

H_1 Presence of spatial autocorrelation of errors. We accept H_1 if P-value $>$ 0,05. The following table 2 presents the results of this test.

The results show for equation Eq(1) a p-value greater than 5% for all three tests, which means that we cannot accept the null hypothesis of no lagged spatial autocorrelation and no spatial autocorrelation of errors. This result implies that there are autocorrelations of errors between lagged variables. Thus, the SAC model is suitable for estimates of the relationship between industrial value-added and its explanatory variables.

Table 2: Moran's spatial autocorrelation test I

Tests	Industrial added variable Eq(1)			Jobs in the industrial sector Eq(2)		
	Statistics	**P-value**	**Degree of freedom**	**Statistics**	**P-value**	**Degree of freedom**
Global autocorrelation test (test on θ)						
$GLOBAL\ Moran\ MI$	-0.005	0.743		0.025**	0.027	
$GLOBAL\ Geary\ GC$	1.007	0.594		0.972**	0.045	
$GLOBAL\ Getis-Ords\ GO$	0.085	0.743		-0.405**	0.027	
Spatial autocorrelation test of *errors (test on ρ)*						
LM_{err} *(Burridge)*	0.165	0.685	1	3.754*	0.053	1
LM_{err} *(Robust)*	0.564	0.453	1	7.985***	0.005	1
Spatial autocorrelation test for lagged explanatory variables (test on λ)						
LM_{LAG} *(Anselin)*	0.014	0.904	1	0.009	0.925	1
LM_{LAG} *(Robust)*	0.414	0.520	1	4.240	0.039	1
Global spatial autocorrelation test (test on ρ and θ)						
LM_{SAC} ($LM_{err} + LM_{LAG}$_R)	0.579	0.749	2	7.993**	0.018	2
LM_{SAC} ($LM_{LAG} + LM_{err_R}$)	0.579	0.749	2	7.993**	0.018	2

Source: Author based on estimates. Notes: *** ; ** ; * = significant at the 1%, 5% and 10% level

We first follow Belotti *et al.* (2017) to make the choice between the SDM model and the SAC model which are the most used in the literature. Indeed, the choice between the SAC model and the SDM one is based on a post-estimation test and the selected model is the one that maximizes the Bayesian Information Criteria (BIC).

Table 3: Selection of the appropriate specific model between the SDM and SAC models

Choice between SDM and SAC based on Bayesian and Akaike information criteria		
Test	SDM	SAC
AIC	4050.02	4059.31
BIC	4124.07	4105.59

Source: Author based on estimates

The BIC comparison test shows that the SDM model is more appropriate than the SAC model in estimating Eq(1) because it has the highest BIC and the lowest AIC. Another reason to exclude the SAC model is that it is not econometrically feasible to estimate it in a random-effects model.

As for Eq(2), the results show the existence of spatial autocorrelations between the spatially lagged variables. Therefore, the dynamic SDM model is suitable for estimates of the relationship between the level of industrial sector jobs in total jobs created and the explanatory variables.

➢ *Choice of the specific spatial model to be implemented*

Given all these results, two specific models can be used by making restrictions on the parameters associated with the explanatory variables. Accordingly, the tests of adequacy show that the Durbin spatial model (SDM) with random effect is more adapted for the analysis of the effects of the net entries of the FDI on the industrial performances in sub-Saharan Africa. The estimation by the SDM method can be implemented safely.

The SDM model integrates both a spatially lagged dependent variable and the spatially lagged explanatory variables, i.e. it takes into account not only mimicry and social entrainment effects but also contextual effects. The SDM model is much more complete because there are no a priori restrictions on direct and indirect effects in the specification, which allows certain flexibility in the implementation of the model. This flexibility gives a certain advantage to the SDM model and makes it more popular in empirical studies. To analyze the spatial effects of FDI on the industrial performance of 36 SSA countries, the SDM model can be written as follows:

$$VAI_{it} = \delta.W.VAI_{jt} + \beta.W.IDE_{it} + W.X_{it}\alpha + \beta_i + \mu_{it} \quad (5.a)$$

$$Emploi_{it} = \delta.W.Emploi_{jt} + \beta.W.IDE_{it} + W.X_{it}\alpha + \beta_i + \mu_{it} \quad (5.b)$$

With: VAI = the (N,1) matrix of net FDI in flows
$Emploi$ = the (N,1) matrix of the level of employment in the industrial sector
IDE = the (N,1) matrix of net FDI inflows
W = the square matrix (N, N) of trade weights between countries
X_{it} = the matrix (N, K) of explanatory variables
β_i = the constant and μ_{it} = the error terms

IV. PRESENTATION AND DISCUSSION OF RESULTS

Drawing on the appropriate spatial model identified, the next step is the presentation and discussion of the results of the estimations. We will first focus on the results of the spatial effects of FDI on industrial value-added as the first proxy of industrial performance using an SDM model before turning to the results of the effects of FDI on the level of employment created in the industrial sector of SSA countries and over the period 1998-2018.

A. Effects on industrial value added

Table 4 below presents the results of the analysis of the spatial effects of FDI on the industrial value-added of SSA economies over the period, taking care to separate the direct effects from the indirect effects and the total effect by using a linear fixed effects model (LFE).

Overall, we can say that the results are consistent with the hypothesis that FDI positively influences the industrial performance of SSA countries and that there are no indirect effects. Indeed, the net FDI inflow has a positive and direct effect on the industrial value-added of SSA countries at the 5% threshold. A 10% increase in net FDI inflow to SSA economies increases the total industrial value added by 1.6%. This result is consistent with that found by authors such as Zhang (2014) and Nkoa (2016) but contrary to those found by Gui-Diby & Renard (2015) who did not find a significant effect on the industrial performance of SSA economies. This result could be justified by the difference in the methodology of analysis which confirms the relevance of taking into account the spatial in the analysis of FDI effects on industrial performance. Secondly, the inclusion of certain variables such as natural resource rents and the quality of governance by synthetic index may constitute an important difference in the specification of the model.

Another important aspect of this result is the lack of long-term indirect effect of FDI inflows on industrial value-added i.e. the absence or embryonic state of technology spillover in the industrial sector. This result could be explained by the fact that most of the FDI entering these economies are invested in the mining sector which has no real effect of technology transfer in the processing sector of locally finished products.

Furthermore, trade openness has positive effects on the industrial value-added of SSA countries at the 5% threshold. A 10% increase in the latter leads to an increase in the industrial value-added of SSA economies by 3%. This result is in contradiction to those found by Nkoa (2016) who found a negative effect on industrial value-added.

Table 4: Presentation and discussion of SDM estimation results

	Model OLS	SDM Model			
		Short term	Long term		
Dependent variable : Industrial value added	Random Effect	Main effect	Direct effects	Indirect effects	Total effect
Foreign direct investment	0.10*** (0.001)	0.09*** (0.004)	0.09*** (0.004)	0.08 (0.208)	0.16** (0.016)
Commercial opening	0.33*** 0.000)	0.21*** (0.000)	0.21*** (0.000)	0.09 (0.250)	0.30*** (0.002)
Human capital	-0.020 (0.11)	0.04 (0.111)	0.00* (0.092)	-0.10*** (0.001)	-0.06*** (0.001)
Imports	-0.18*** (0.000)	-0.20*** (0.000)	-0.20*** (0.000)	0.03 (0.690)	-0.23*** (0.004)
Actual investments	0.06** (0.039)	0.07** (0.017)	0.067** (0.015)	-0.03 (0.543)	0.04 (0.439)
Gross Domestic Product	0.15*** (0.000)	0.15*** (0.000)	0.15*** (0.000)	0.14** (0.037)	0.30*** (0.000)
Natural resource rents	0.22*** (0.000)	0.24*** (0.000)	0.24*** (0.000)	-0.07 (0.164)	0.17*** (0.000)
Constant	20.51*** (0.000)	23.41*** (0.000)			
AIC		4274.33			
BIC		4357.63			
Number of observations	756	756			
$R^2 Ajusté$	0.60	0.60			0.49

Source: Author based on estimates. ***; **; * represent a significant coefficient at the 1%, 5% and 10% level respectively.

Regarding the human capital captured here by the gross secondary school enrolment rate, it has an indirect and negative effect on the industrial value-added of the zone's economies. This counterintuitive result is contrary to those found by Zhang (2014) and Nkoa (2016) and could be justified by the mismatch between the training curricula in schools and the work profiles demanded in industries in Africa. Concerning the other control variables, only import has a reducing effect on industrial value-added at 23% in line with the result of Zhang (2014) as long as natural resource rent and GDP have a contributing effect on industrial value-added of SSA countries at (0.17) and (0.30), respectively.

B. Effects on the level of employment in the industrial sector

To analyze the effects of FDI on the level of employment in the industrial sector, the specification led us to a dynamic fixed-effects SDM model. The short and long-term results are presented in table 5. Overall, FDI influences the level of employment in the industrial sector of SSA countries but the effect is limited to the short run as in the long run there are no significant effects. Indeed, as with industrial value-added, FDI has a positive and direct effect on the level of employment in the industrial sector of SSA countries over the period 1998-2018. An increase in net FDI inflows of 10% leads to an increase in the level of employment in the industrial sector of 0.5% in the short term.

Table 5: Presentation of estimation results by the dynamic SDM model

	Model OLS	**Dynamic SDM model: Short-term effect**			
Dependent variable: Employment in the undue sector.	Fixed effect	*Wx effect*	Direct effects	Indirect effects	Total effect
W. Emlpoi (lag1)		-0.017*** (0.00)			
w. Foreign direct investment	0.01 (0.351)	0.04*** (0.000)	-0.002 (0.431)	0.05*** (0.000)	0.05*** (0.000)
W. Actual investments	-0.01*** (0.737)	-0.03*** (0.000)	-0.003 (0.152)	-0.04*** (0.000)	-0.04*** (0.000)
W. Commercial opening	0.17*** (0.000)	-0.02* (0.064)	-0.03*** (0.000)	-0.03** (0.027)	-0.06*** (0.000)
W. Human capital	-0.003* (0.080)	-0.003* (0.080)	-0.01*** (0.000)	0.02*** (0.000)	0.002 (0.421)
W. Imports	-0.10*** (0.000)	0.04*** (0.000)	0.03*** (0.000)	0.06*** (0.000)	0.08*** (0.000)
W. Gross domestic product	-0.03 (0.115)	-0.04** (0.000)	0.01*** (0.0002)	-0.05*** (0.000)	-0.04*** (0.000)
W. Natural resource rents	-0.02 (0.229)	0.04*** (0.000)	0.01*** (0.000)	0.05*** (0.000)	0.06*** (0.000)
W. Governance	1.42*** (0.002)	0.69*** (0.000)	1.0*** (0.000)	8.5*** (0.000)	9.47*** (0.000)
Spatial rho		0.17 (0.002)			
ρ		0.11*** (0.000)			
AIC	3257.42	424.84			
BIC	3299.08	516.43			
Number of observations	720	720			
Adj. R^2	0.30	0.91			

Source: Author based on estimates. ***; **; * represent a significant coefficient at the 1%, 5% and 10% level respectively.

Furthermore, as in the analysis of the effects of FDI inflows on industrial value-added, there is no long-run indirect effect of FDI inflows on the level of employment in the industrial sector, i.e., FDI inflows do not lead to a transfer of skills in the industrial sector. Such a result could be explained by the same reason mentioned above which is that FDI entering SSA economies mostly specialize in mining. This mining would not allow for the real transfer of skills to the processing sector of the finished products.

Regarding trade openness, it has a negative effect (-0.06) and in the short term on the level of employment in the industrial sector of countries in the sub-Saharan zone contrary to (Nkoa, 2016) which did not find a significant effect. This result could be justified by the fact of massive imports in SSA countries which could lead to a competition effect on local firms as Nkoa (2016) asserted on the difference in the quality of imported products compared to the products.

Concerning human capital, this variable has an indirect and positive effect in the short run on the level of employment in the industrial sector of the Sub-Saharan economies. This result is consistent with those found by Zhang (2014) and Nkoa (2016).

Focussing on the other control variables, private investment has an indirect and negative impact on the level of employment in SSA economies while natural resource rents and the quality of institutions have both direct and indirect positive effects in the short term on the level of employment in this area. This result is consistent with those found by Gui-Diby & Renard (2015) who found a negative effect of investment on the industrialization of African economies and Nkoa (2016) on the employment level in the industrial sector.

However, the quality of institutions measured here by a synthetic index of governance indicators seems to be the important factor that most influences the level of employment in the industrial sector. Indeed, an increase in the quality of institutions in SSA countries of 1% leads in the short term to a direct increase in the level of employment of 9.5%. Such a result calls for good governance on the part of the governments of SSA countries in order to boost the industrial sector, which is the key to sustainable development.

V. CONCLUSION

.This paper aimed to assess the spatial effects of FDI on the industrial performance of SSA economies over the period 1998-2018 through a respective spatial Durbin model (SDM) and dynamic SDM model for the analysis of the effects on the two industrial performance drivers.

The empirical results showed that net FDI inflows have a contributory effect on both industrial value-added and the level of employment in the industrial sector through direct and short-term effects. The higher the capacity of SSA countries to attract foreign investors to their respective countries, the higher the number of jobs in the industrial sector and the higher the level of industrial value-added.

However, there is no long-term indirect effect of FDI entry on either industrial value-added or the level of employment in this sector. This result implies that the entry of FDI does not lead to a transfer of technology or skills in the industrial sector. Such a result could be explained by the fact that FDI entering SSA economies is mostly specialized in mining. This mining would not allow for a real transfer of technology and skills to the processing sectors of the final products. This result illustrates the importance for SSA countries to direct FDI towards strategic sectors of processing local raw materials into finished products. This may involve a selective investment policy in favor of those industrial sectors deemed most strategic in terms of economic returns. The various value chains of the agricultural and food sectors are important niches to exploit. To achieve such an ambition necessarily requires the reorganization of the more attractive business climate to support a massive entry of FDI in these sectors, which is a guarantee of a real transfer of technology and skills and any industrial development as the Asian countries have done. The governments are encouraged to practice a selective investment policy in favor of the industrial sectors considered the most strategic in terms of economic spin-offs while supporting the existence of the free enterprise and free trade.

In addition, the results also showed that trade openness has a positive effect on the industrial value-added of SSA countries although it tends to reduce the level of employment in the industrial sector. On the other hand, the quality of institutions has contributory effects on the industrial value-added and the level of employment in this sector in the countries of the region. Such a result calls on the governments of the sub-Saharan band to improve the quality of governance to establish an institutional and legal framework favorable to the protection of private rights and investment, all of which contributes to giving more confidence to foreign investors. Finally, human capital through the gross enrolment rate in secondary education has an indirect and negative effect on the industrial value-added and an indirect and positive effect on the level of employment in this sector. This result shows the need to adapt the training curricula to the need for profiles required by the industrial sector.

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