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Etude économétrique des IDE Intra-africains via un modèle gravitationnel

Empirical study of the determinants of African FDI in Morocco using the gravity model

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Résumé

Malgré la croissance économique rapide de certains pays africains, les échanges commerciaux de ces pays restent limités en partie à cause des contraintes structurelles qui bloquent la mise en œuvre effective des accords commerciaux signés entre les Etats africains dans le cadre des communautés économiques régionales (CER).

Dans ce contexte, cet article propose une analyse empirique via un modèle économétrique gravitationnel pour spécifier les déterminants impactant les flux des IDE intra-africains au Maroc et étudier l'impact de ces déterminants sur les flux entrants et sortants du Maroc. A travers une étude menée sur des données de panel de 51 pays africains sur une période de 20 ans, en utilisant le modèle de gravité, les résultats montrent que les flux intra-africains sont positivement impactés par le PIB, les accords, les frontières et la langue des pays, alors qu'ils sont négativement impactés par la distance entre les pays. Ce travail nous génère aussi la réflexion de rendre du Maroc un hub africain pour le développement économique du continent africain via « le hub marocain ».

Mots clés : Déterminants des IDE; Investissement direct étranger; Modèle économétrique gravitationnel; IDE Intra Africain; Données panels

Abstract

Despite rapid economic growth in some African countries, trade between these countries remains limited, partly due to structural constraints that block the effective implementation of trade agreements signed between African states within the framework of regional economic communities (RECs).

In this context, this article proposes an empirical analysis using an econometric gravity model to specify the determinants impacting intra-African FDI flows to Morocco, and to study the impact of these determinants on inward and outward flows from Morocco. Through a study carried out on panel data from 51 African countries over a 20-year period, using the gravity model, the results show that intra-African flows are positively impacted by GDP, agreements, borders and country language, while they are negatively impacted by the distance between countries. This analysis also generates the reflection of making Morocco an African hub for the economic development of the African continent via "the Moroccan hub".

Keywords : FDI determinants; Foreign Direct Investment; Gravitational econometric model; Intra African FDI; Panel data

Introduction

Because of their effects on country economies, the determinants of FDI have been the subject of several research studies because of their importance in the location decisions of foreign firms in the host territories.

In this context, it can be estimated that a better integration of trade between African countries can contribute to a potential growth opportunity that can amplify trade flows between African countries and contribute greatly to the continent's ability to be more competitive in the global economy (Mamoudou & Mezui, 2017).

In this context, this paper presents an analysis based on the gravity model in order to highlight the determinants of intra-African trade and assess the extent to which the comparative advantages of the product space allow for an expansion of African trade in the global arena.

To address this issue, the following questions arise:

- What are the determinants of intra-African FDI flows to Morocco?
- To what extent is the intra-African attractiveness of FDI in Morocco enabling the expansion of intra-African trade in the global sphere?

To address this issue, an econometric study was carried out using a gravity model to examine the determinants of intra-African FDI flows, based on panel data from 51 African countries over a 20-year period from 1998 to 2018. We firstly provide a summary of literature review on the gravity model. Then, we presente our econometric model, estimated by the gravity model, and conclude with the analysis, interpretation and discussion of our result.

1. GRAVITY MODEL IN ECONOMETRICS: LITERATURE REVIEW

Throughout the centuries, the gravity law inspired firstly spatial economics, which transposed the principles of gravity for studying the areas of influence of modern economies. Subsequently, it was the turn of international economics to adhere to gravitational principles for the analysis of bilateral trade flows between countries, notably with the work of Tinbergen (1962), who applied Newton's gravitational law to international trade.

Thus, this transposition gave rise to the following expression:

$$F_{ij} = G\frac{m_i^{\alpha} m_j^{\beta}}{D_{ij}^{\vartheta}} \quad (1)$$

With

F_{ij}: The flow from origin country i to host country j, these flows are expressed in monetary values and represented by the value of the exportations.

m_i: The gross domestic product of the origin country

m_j: The gross domestic product of the host country

D_{ij}: The geographical distance between the origin and the host country, measured from centre to centre.

Similarly, Linneman (1966) provides a more robust gravity model empirically applied to international trade. Indeed, the author succeeds in obtaining his model by replacing in the initial equation the three explanatory factors by the variables that determine them: national income, population, geographical distance and the existence of a preferential trade agreement.

Thus, if the previous works are in the form of regression in instantaneous section, Festoc(1997) proposes as for him, an estimation in panel data on a temporal series. This has for effect the obtainment of more powerful result by avoiding collinearity problems.

We can therefore conclude that this model has achieved undeniable empirical success and it emerges from several theoretical models of international trade (Evenett et Keller,2002). As a result, the Gao et al. (2003) model is now considered as an essential tool for estimating FDI location determinants.

2. ECONOMETRIC MODEL PRESENTATION

The model adopted in this paper represents an extension of the original theoretical model. Our gravitational study is inspired from the new generation empirical model of (Ortega & Peri, 2014), (Coulibaly & al., 2018) and (Gnimasoun, 2018). This model allows explaining on the one hand intra-African trade in general and on the other hand intra-African trade by product type.

Thus, since we have been working with panel data, it makes more practical to consider the individualities between the elements of our sample and the relationships they have with each other. In this way, we have introduced additional variables expressing all the disparities in our panel.

In this same context, it should also be noted that in order to set up an equation following a panel method, it is necessary to choose the individual effects that we have used, namely the fixed or variable effects.

2.1. Equations and description of different variables in our model

In order to overcome the limitations of the fixed effect specification which ignores time-stable variables, we have been inspired by the work of (Coulibaly, 2004) et de (Cheng & Wall, 2004) by first estimating the two-sided fixed effects **αij** and then incorporating them into the equation as the dependent value i.

Thus, we obtained the following augmented equation:

$$X_{ijt} = e^{\beta_0+\alpha_{ij}+\delta_t}(Y_{it}^{\beta_1}Y_{jt}^{\beta_2})(YT_{it}^{\beta_3}YT_{jt}^{\beta_4})D_{ij}^{\beta_5}e^{w_{ij}+\Omega_{it}+\varepsilon_{ijt}} \quad (2)$$

Such as:

Y_{it} andY_{jt}**:** Countries i and j's GDP in t

$YT_{it}$and YT_{jt} : GDP per capita of i and j in t

D_{ij} : The geographical distance between the two countries i and j

w_{ij} : A vector of time-invariant variables reflecting the strengthening or friction of bilateral trade between i and j

Ω_{it} : A vector of time-varying variables reflecting the strengthening or friction of bilateral trade between i and j

α_{ij} : The individual effect of the country pair ij where α_{ij} is different from α_{ji}

δ_t : The temporal effect

Σ_{ijt} with $N(0,\sigma^2)$: The random error

i = 1,….. N

j=1,……N-1 as we cannot take into account a country's trade with itself.

With also β_1 ,β_2 ,β_3,β_4 are positives and $\beta_5 < 0$.

After logarithmic transformation and as some data may be unavailable we chose to undertake a regression using **logXij+1** as explanatory variable. Thus by modifying the variable to be explained and determining the other variables, we obtained the final augmented gravity model as follows:

$$\log(X_{ijt} + 1) = \beta_0 + \alpha_{ij} + \delta t + \beta_1 logY_{it} + \beta_2 logY_{jt} + \beta_3 logYT_{it} + \beta_4 logYT_{jt} + \beta_5 logD_{ij} + \beta_6 AC_{it} + \beta_7 Langc_{ij} + \beta_8 front_{ij} + \varepsilon_{ijt} \quad (3)$$

2.2. Data sources

- For **GDP and GDP per capita**: these data are taken from the World Bank database;
- For **Flows:** we used the World Trade Organisation (WTO, WTD) website;
- For **distance**, **languages** and **borders** data, these are taken from the Centre for Prospective Studies and International Information (CEPII);
- For **trade agreements**: taken from the Office d'Echange du Maroc

3. ECONOMETRIC ESTIMATION AND RESULTS INTERPRETATION

The estimation of our gravity model is done on a sample of 54 African countries over a 20-year period from 1998 to 2018 (Appendix A). For this estimation, we have employed the Eviews 10 software.

3.1 Stationarity evaluation of the variables in our model

The stationarity of the model's variables is verified by the Augmented Dickey Fuller (ADF) test. The results of this test allow us to conclude that the GDP and GDP per capita variables are stationary in first difference, while the flows variable is stationary at Level. As for the variables Language, Border and Agreement, they are estimated as dummy variables according to the sources.

3.2 Ordinary Least Squares (OLS) estimation

3.2.1 Estimation without effect specification

Based on empirical arguments, the fixed effect methodology is the most advantageous as it not only avoids heterogeneity bias but also explains the lack of trade between two countries in a given sample... (Cheng & Wall, 2004).

For these reasons, we opted firstly for the choice of working with the fixed effect methodology for the specification of our model in order to consider it as a baseline and reference estimation for its next robust estimation (Coulibaly, 2004) and (Cheng & Wall, 2004).

The following results are obtained in **Table 1**:

Table N²1: OLS estimation table

Dependent Variable: FLUXIJ				
Method: Panel Least Squares				
Date: 02/04/21 Time: 23:06				
Sample: 1998 2018				
Periods included: 21				
Cross-sections included: 52				
Total panel (unbalanced) observations: 755				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	**-3890513.**	**9298184.**	**-0.418416**	**0.6758**
PIB	**707.4822**	**46.15448**	**15.32857**	**0.0000**
PIB_PAR_TETE	**2339.395**	**520.3557**	**4.495761**	**0.0000**
DISTANCE	**-4130.254**	**1507.881**	**-2.739111**	**0.0063**
LANGUESC	**15534985**	**6598870.**	**2.354189**	**0.0188**
FRONTIERE	**1.95E+08**	**14833242**	**13.17961**	**0.0000**
R-squared	**0.452212**	**Mean dependent var**		**29792376**
Adjusted R-squared	**0.448555**	**S.D. dependent var**		**1.09E+08**
S.E. of regression	**80716817**	**Akaike info criterion**		**39.25871**
Sum squared resid	**4.88E+18**	**Schwarz criterion**		**39.29548**
Log likelihood	**-14814.16**	**Hannan-Quinn criter.**		**39.27287**
F-statistic	**123.6636**	**Durbin-Watson stat**		**0.202150**
Prob(F-statistic)	**0.000000**			

The results presented in **Table 1** show that all the estimation variables of our model are significant at the 5% level. Similarly, in terms of the coefficients' economic significance, all the variables admit positive signs expected and evoked by the theory with the exception of the distance, which presents a negative sign as claimed.

3.2.2 Estimation with variable effects specification

The fixed effect estimation could not be conclusive due to the existence of a country-specific effect. This specification is random, hence the choice of a variable random effect estimation to have heteroscedasticity in the estimation of our model**.**

Table N²2: Table with specification of variable effects

Dependent Variable: FLUXIJ				
Method: Panel EGLS (Cross-section random effects)				
Date: 02/04/21 Time: 23:07				
Sample: 1998 2018				
Periods included: 21				
Cross-sections included: 52				
Total panel (unbalanced) observations: 755				
Swamy and Arora estimator of component variances				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	**-3082721.**	**25002949**	**-0.123294**	**0.9019**
PIB	**708.3882**	**66.69110**	**10.62193**	**0.0000**
PIB_PAR_TETE	**2302.720**	**870.8887**	**2.644103**	**0.0084**
DISTANCE	**-3998.340**	**4116.901**	**-0.971202**	**0.3318**
LANGUESC	**13901075**	**17644710**	**0.787832**	**0.4310**
FRONTIERE	**1.96E+08**	**43954457**	**4.467045**	**0.0000**
	Effects Specification			
			S.D.	**Rho**
Cross-section random			**55460902**	**0.4452**
Idiosyncratic random			**61913337**	**0.5548**
	Weighted Statistics			
R-squared	**0.195986**	**Mean dependent var**		**7670243.**
Adjusted R-squared	**0.190619**	**S.D. dependent var**		**68294768**
S.E. of regression	**61491149**	**Sum squared resid**		**2.83E+18**
F-statistic	**36.51519**	**Durbin-Watson stat**		**0.348255**
Prob(F-statistic)	**0.000000**			
	Unweighted Statistics			
R-squared	**0.452142**	**Mean dependent var**		**29792376**
Sum squared resid	**4.88E+18**	**Durbin-Watson stat**		**0.202087**

According to Table 2, we can note that after the introduction of the variable effect specification, the GDP, GDP per capita and frontier variables are significant at the 5% level. For the variables of distance, common language and agreements, they are no longer significant.

3.2.3 Logarithmic OLS estimation

Table N² 3: Logarithmic estimation table by OLS

Dependent Variable: LFLUXIJ				
Method: Panel Least Squares				
Date: 02/04/21 Time: 23:15				
Sample: 1998 2018				
Periods included: 21				
Cross-sections included: 52				
Total panel (unbalanced) observations: 755				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LDISTANCE	**-1.805156**	**0.225306**	**-8.012005**	**0.0000**
LANGUESC	**0.960940**	**0.214365**	**4.482728**	**0.0000**
LPIB	**1.245713**	**0.069782**	**17.85157**	**0.0000**
LPIB_PAR_TETE	**0.157458**	**0.111999**	**1.405881**	**0.1602**
FRONTIERE	**-0.931813**	**0.514775**	**-1.810135**	**0.0707**
ACCORDS	**0.882124**	**0.290535**	**3.036206**	**0.0025**
C	**14.90483**	**2.252340**	**6.617488**	**0.0000**
R-squared	**0.430005**	**Mean dependent var**		**13.89601**
Adjusted R-squared	**0.425433**	**S.D. dependent var**		**3.434303**
S.E. of regression	**2.603209**	**Akaike info criterion**		**4.760595**
Sum squared resid	**5068.970**	**Schwarz criterion**		**4.803492**
Log likelihood	**-1790.125**	**Hannan-Quinn criter.**		**4.777119**
F-statistic	**94.04863**	**Durbin-Watson stat**		**0.513371**
Prob(F-statistic)	**0.000000**			

After introducing the logarithm of the independent variables of **distance**, **GDP, GDP per capita** and the **$Flux_{ij}$** dependent variable, we find that **all the variables** become **highly significant (Sig<1%) except the frontier and GDP per capita variables.**

Thus, in this direction, we have re-estimated our model with the robust least square model to overcome this problem.

3.2.4 Estimation with the robust least square method

Table N² 4: Estimation with the robust least square method

Dependent Variable: LFLUXIJ				
Method: Robust Least Squares				
Date: 02/04/21 Time: 23:00				
Sample: 1998 2018				
Included observations: 755				
Method: M-estimation				
M settings: weight=Bisquare	**tuning=4.685**	**scale=MAD (median centered)**		
Huber Type I Standard Errors & Covariance				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	**15.18438**	**1.844733**	**8.231205**	**0.0000**
LPIB	**1.179904**	**0.057153**	**20.64456**	**0.0000**
LPIB_PAR_TETE	**0.009533**	**0.091731**	**0.103922**	**0.9172**
LDISTANCE	**-1.583556**	**0.184533**	**-8.581442**	**0.0000**
FRONTIERE	**-1.138066**	**0.421616**	**-2.699295**	**0.0069**
LANGUESC	**1.438941**	**0.175571**	**8.195766**	**0.0000**
ACCORDS	**0.739904**	**0.237957**	**3.109406**	**0.0019**
	Robust Statistics			
R-squared	**0.352025**	**Adjusted R-squared**		**0.346828**
Rw-squared	**0.578926**	**Adjust Rw-squared**		**0.578926**
Akaike info criterion	**996.0366**	**Schwarz criterion**		**1030.148**
Deviance	**3320.841**	**Scale**		**1.837296**
Rn-squared statistic	**742.8303**	**Prob(Rn-squared stat.)**		**0.000000**
	Non-robust Statistics			
Mean dependent var	**13.89601**	**S.D. dependent var**		**3.434303**
S.E. of regression	**2.676457**	**Sum squared resid**		**5358.240**

The results in **Table 4** show that the estimation with the robust least squares model indicates that all variables are **highly significant at the 1% level excluding GDP per capita** confirming the results of previous studies on this variable.

Similarly, the results in **Table 5** of the covariances between the variables in our model confirm and explain the generated results.

Table N²5: The covariance between the variables in our model

	FLUXIJ	FRONTIERE	LANGUESC	DISTANCE	ACCORDS	PIB	PIB_PAR_TETE
FLUXIJ	1.18E+16	11083924	7682073.	-4.76E+10	987466.8	3.48E+12	1.67E+11
FRONTIERE	11083924	0.045409	0.015284	-146.8454	0.007705	1504.780	127.4599
LANGUESC	7682073.	0.015284	0.217790	-170.4977	0.010457	-1044.894	575.3071
DISTANCE	-4.76E+10	-146.8454	-170.4977	4392985.	-278.6479	695313.8	621404.0
ACCORDS	987466.8	0.007705	0.010457	-278.6479	0.135478	-3416.759	-418.8912
PIB	3.48E+12	1504.780	-1044.894	695313.8	-3416.759	4.28E+09	75396833
PIB_PAR_TETE	1.67E+11	127.4599	575.3071	621404.0	-418.8912	75396833	35304622

From **Table 5**, it can be seen that the covariance between **Flux$_{ij}$** and **frontiers is positive**, which is explained by the fact that the existence of frontiers between two countries amplifies the bilateral trade relations;

We can also note that the covariance between **Flux$_{ij}$** and **language is positive**, which means that the existence of a common language between two countries facilitates commercial exchanges.

Regarding the covariance between **Flux$_{ij}$** and **distance**, it represents a negative sign interpreted by the fact that the larger distance between two countries causes the decrease of bilateral trade. This negative covariance is also explained by the increase in the transport cost of the commodities.

Similarly, the results show that the covariance between **flows and trade agreements is positive**, which reflects that the existence of trade agreements between two countries facilitates and amplifies bilateral trade

For the covariance between **GDP** and **GDP per capita,** it has a positive sign, which implies that the increase in gdp and gdp per capita has a **positive impact on trade flows**.

3.3 Results discussion

Through the evaluation of our estimated model by the gravity method, we conclude from the results that the frontier and distance variables have a significant impact on the mass of the $\mathbf{Flux_{ij}}$ insofar as the smaller the distance between African countries and the existence of frontiers with countries, the more important the attractiveness factor. This is attributed to the decrease in transportation costs (Marcias, 2010).

We also notice that the **GDP** impacts significantly on the mass of flows $\mathbf{Flux_{ij}}$, which is reflected by the fact that the potential size of the market strongly impacts bilateral trade (Fontagné,1998).

As for agreements between countries, they also have a positive effect on the mass of trade flows and their presence regulates and facilitates access to inter-country markets according to the recommendations of (Hatem & al, 2004).

Similarly, several theoretical works claim that historical and cultural links, such as a common language, have a positive impact on bilateral exchanges.In our study, we have admitted French, Arabic and English as common languages, to this extent we have obtained results consistent with the theory that supports the idea that language is a significant variable in relation to trade (Avom, 2017).

The results obtained through the estimation of our model, are satisfactory in terms of the chosen variables, excluding the GDP per capita variable, which represents insignificant results in relation to the robust least squares model. This result is justified by a more diversified demand of consumers according to their purchasing power, their living conditions as well as their income in the different countries (Derbal & Kadri, 2015)

CONCLUSION AND PERSPECTIVES

« In a context of accentuated globalization, Morocco has made the opening of its economy a strategic choice» (Radouani, & al. 2020). Through this work, we proposed a gravity econometric model to estimate the determinants of intra-African FDI in Morocco.

This study is based on panel data from 51 African countries over a 20-year period from 1998 to 2018. The results of this study show that intra-African trade flows are positively impacted by frontiers, countries' GDP, agreements and language of communication. While these flows are negatively impacted by the distance between countries.

As for GDP per capita, this factor represents a non-significance, as this factor depends more on subjective human variables.

Thus, the reflection that is required is to make the African continent self-dependent in terms of imports and exports via a Moroccan hub. This could lead first to examine the Revealed Comparative Advantage (RCA) of African countries in order to determine the advantage that each country has in certain areas of activity in relation to a product and to see to what extent the Comparative Advantage of the product area allows the expansion of intra-African trade in the global arena.

Our contribution stands out for its treatment of the subject of the attractiveness of territories and the determinants of FDI flows in Morocco and Intra-Africa. This study allows us to deepen our research work and enrich our empirical analysis, particularly after the fallout of this crisis on the economies of country in general and Morocco in particular. Likewise, this work is part of the context of desire to make the kingdom a strategic African hub with the aim of expanding the Intra-African trade via Morocco's hub in the global sphere.

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