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IMPACT OF FOREIGN DIRECT INVESTMENT ON THE ECONOMIC GROWTH OF SENEGAL

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ABSTRACT
Since the local market liberalization in the late 1980s and early 1990s, Senegal has been striving to attract foreign private capital by adopting new economic policies such as the implementation of structural adjustment programs, reduction of the State intervention in the economy, fiscal incentive grants to companies, and privatizations of some of the State-owned companies. The motivation for adopting such measures lies in the expansion of economic growth rates due to the increase in technology. From this context of changes, we set out to study the impact of foreign direct investment on the economic growth of Senegal between the years 1970 and 2013. To this end, we made use of vector models complemented by the Toda and Yamamoto causality test approach. Overall, in the long term, the variables (exports, public expenditures, economic openness and, above all, foreign direct investment) impacted positively on the behavior of the Senegalese aggregate output, results reinforced by the temporal relations. However, and not least, our findings suggest that the local conditions contributed to a large extent to the inflow of foreign productive capital.

Keywords: Economic Growth; Foreign Direct Investment; VAR/VEC and Toda and Yamamoto causality approach.

JEL: F10; C32

1 INTRODUCTION

Foreign direct investment (FDI) is an essential economic component for developing economies, because of its features and effects on economic growth. Among its features and effects, we can mention the rise in the level of private capital stocks, domestic markets competitiveness, jobs creation, and workforce qualification, as well as its positive effects on the balance of payments. As such, the reasoning behind FDI arises from the argument that foreign direct investment produces externalities in the form of technology and know-how transfer, resulting thus in spillover effects on the economy.

However, this rationale, which associates economic growth with FDI is not unanimous in the economic literature. Although evidence has shown that FDI helps raise investment rates, savings and cash availability, and consequently the economic

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growth rhythm, its effects on recipient economies are questioned from a microeconomic viewpoint, since they can result in imperfect competition characterized by market concentration, domestic companies' bankruptcy and denationalization, and country loss of sovereignty (CUTINI, 1981).

Based on this perception, FDI raises a controversy concerning its effects on host economies. One of the questionings is over the fact that multinational companies (MNCs), for enjoying technologies, capital, and management skills that domestic companies do not enjoy, and for being more integrated into the international market, take advantage of this situation, and practice imperfect competition, segment and control the markets. Such a behavior would cause harmful consequences for domestic companies which, for not having the means to compete on an equal footing with (MNCs) in the local market, would be forced to undergo a restructuring or else leave the market (ZHANG, 2001).

The maintenance of this scenario can also result in negative effects on consumers, who can witness a rise in the price of goods, higher than it would have been in competitive markets. Furthermore, FDI can negatively affect the balance of payments of recipient countries, with regard to profit transfers, dividend and royalty payments to parent companies, especially when these, exceed inflows of private capital.

As such, approaches to FDI provide ambiguous arguments over their effects on economic growth. However, despite their negative effects and, because of their contribution to economic growth, associated with loans and financing shortages to developing countries, several economies ended up loosening over the years, the restrictions on this type of investment and even offered incentives and subsidies to attract the foreign capital (AITKEN, HARRISON, 1999; WORLD BANK, 1997a; 1997b). As such, this discussion is complex because, FDI brings along a variety of effects to recipient countries' economies, specifically those effects related to the benefits of such inflows to countries of low economic growth and resource constraints, which is the case of African countries, in particular, the Republic of Senegal. Although Senegal is among the heavily indebted poor countries, it has been receiving over these last forty years, an increasing inflow of foreign investment. Because, according to the United Nations Conference on Trade and Development

(UNCTAD , 2014), throughout the period 1970-2013, the average annual inflow of FDI was 9.97% while that of the last decade (2003-2013), was 19.07%, with an average annual inflow of US $ 258.7 million. This scenario has sparked further discussion about the effects that FDI has generated in Senegal since research approaching the impact of FDI on economic growth are incipient in the country. It is in this perspective that we outline this study, hoping that our results can help policy-makers implement policies to attract foreign direct investment so that the country can enjoy a long-term sustainable economic growth. Therefore, the main objective of this work is, besides contributing to the empirical literature on the relationship between foreign direct investment and economic growth, to study the effects of foreign direct investment on the economic growth of Senegal over the period 1970-2013. And as specific objectives: a) to contextualize the Senegalese economy over the past decades; b) to discuss the determinants and effects of foreign direct investment in Senegal.

The remainder of this work is organized as follows: section 2 presents the econometric framework employed in this study and highlights the empirical model and the source of the data. Section 3 approaches the results and their interpretations. Finally, section 4 makes concluding remarks and recommendations.

2 METHODOLOGY

2.1 Theoretical approach of VAR modeling

The Vector Autoregressive (VAR) model is a set of equations in which all the variables are considered as endogenous, capturing thus the dynamic interactions of a set of K variables with time series characteristics (LÜTKEPOHL; KRÄTZIG, 2004). In this modeling, a particular situation is on the Vector Error Correction Model (VECM), which helps study the economic relationship, (short and long term) that exists between the variables.

Furthermore, by getting the impulse elasticities to k periods, the VAR model helps study the variables´ behavior in response to individual innovations (shocks) in any of the system components. Besides, it helps determine over time the variables´ dynamic behavior, making it thus possible to analyze by simulations the effects of events that are likely to happen (LÜTKEPOHL; KRÄTZIG, 2004).

For Enders (2010), the VAR model is useful for analyzing the interrelations that exist between multiple time series, provided that all the variables are set in a system of equations. Thus, this procedure helps improve the level of time series forecast, since it is assumed that the variables are mutually influenced by one another. The VAR model of order p can be expressed by a vector of n endogenous variables, X_t that are related one another by a matrix A such as:

$$AX_t = \beta_0 + \sum_{i=1}^{p} \beta_i X_{t-1} + \varepsilon_t \qquad (1)$$

where A is an (nxn) matrix that sets the restrictions on the variables that constitute the vector X_t; X_t is an $(nx1)$ vector of macroeconomic variables at the instant t; β_0 is an $(nx1)$ vector of constant terms; β_t is an (nxn) matrix of coefficients, with $i = 0,....., p$; ε_t is an $(nx1)$ vector of random disturbances that are not contemporaneously and temporarily correlated among themselves, that is $\varepsilon_t \sim i.i.d(0, I_n)$.

Equation (1) is an expression of a standard VAR model, as it describes the interactions of endogenous variables of an economic model theoretically structured. The shocks ε_t are called structural shocks because they affect every variable. These elements are considered independent as their interrelationships are indirectly captured by the matrix A. Hence, the independence of the shocks occurs without loss of generality (BUENO, 2008).

According to Enders (2010), the assumed hypotheses for the construction of a VAR model are: a) the variables that constitute the vector are stationary; b) the random shocks are white noise disturbances with zero mean and constant variance $(\varepsilon_t \sim N(0,\sigma))$ and; c) the shocks are uncorrelated white noise $Cov(\varepsilon_t, \varepsilon_j)$

It should be noted that if one or more than one time series are non-stationary, and are of the same order of integration; it can be inferred that they are potentially cointegrated, that is to say, they have in the long-run a common trend (ENDERS, 2004). If this relationship is confirmed, the results provided by the VAR model will be

statistically inconsistent, implying therefore that the model that should be used is the vector error correction model (VECM) as advocated by Johnston and Dinardo (2001).

A VEC model is similar to a VAR model. However, the VEC model equations contain a vector of error correction, which has as a purpose to correct the integration relationship. According to Enders (2004), a VEC model with just one cointegration vector, can be expressed as:

$$\Delta x_t = \sum_{i=1}^{k} \beta_i \Delta x_{t-1} + \beta a' x_{t-1} + \varepsilon_t \qquad (2)$$

where x is a vector of variables; $a'x_{t-1}$ is a cointegration vector and, k is the number of lags. A VAR model estimation requires first, testing for series stationarity. In the case of stationarity, some features remain over time. As pointed out by Bueno (2008), in this case, the shocks are necessarily temporary, since their effects dissipate over time and the series become reversible to the long-term average level.

2.2 Analytical Model and Data

The purpose of the empirical model is to capture the effects of the aggregate variables included in the vector X_{t-1} of equation (1) on the Senegalese GDP, specifically foreign direct investment (FDI). The variables of the referred to vector are: gross fixed capital formation (GFCF), the degree of economy openness to international trade (OPEN), public expenditures (PUBEXP), imports of goods and services (IMP), and exports of goods and services (EXP).

Of this set of variables, the variables (GDP, FDI, IMP, EXP) were collected from the report of the United Nations Cooperation on trade and Development (UNCTAD, 2014), while the variables (GFCF) and (PUBEXP) from the data set of *Perspective Monde.* As for (OPEN), it is the ratio of exports and imports to GDP. The series comprise annual observations spanning from 1970 to 2014 and are expressed in millions of dollars.

Operationally, we used the log-log function, in which the variables were transformed into natural logarithms so as the estimated coefficients could straightforwardly be interpreted as elasticities. The analysis assumes the time series are stationary, that is, the mean and variance are constant over time. If the time series are non-stationary, the relationship between them is likely to be spurious; so

the series must be differenced d times to turn them stationary and get their trend removed (ENDERS, 2004).

To this end, we used the Augmented Dickey-Fuller test, to test for the hypothesis of time series stationarity or not, in accordance with Enders´ (2004) procedure as shown in equation (3) in which past values of the endogenous variable y_t are incorporated so as to remove the presence of autocorrelation between the random error terms.

$$\Delta y_t = \alpha + \beta t + \eta y_{t-1} + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-1} + \mu_t \qquad (3)$$

where y denotes the dependent variable; Δ is a difference operator, and α, β and η are parameters to be estimated with the hypothesis $H_0 : \gamma = 0$ presence of unit root and $H_a : \gamma < 0$, absence of unit root.

Besides testing for unit root presence, a VAR estimation requires determining the optimal lag lengths. Therefore, we made use of the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC). Moreover, we tested for series co-integration through Johansen´s test to check for any long-run relationship between the variables, (BUENO, 2008). Mathematically, this test can be represented as shown in equation 4:

$$X_t = \beta_1 X_{t-1} + \beta_2 X_{t-2} + ... + \beta p X_{t-p} + \delta d_t + \varepsilon_t \qquad (4)$$

where d_t is a vector of deterministic variables, and δ is a nxn matrix of coefficients of compatible dimension with d_t.

Along with Johansen´s test, we calculated the maximum eigenvalues and their ranks, as the test distribution and that of the unit root is unconventional. Therefore, we made use of trace test, which assumes as null hypothesis, the existence of r^* vectors of cointegration against the alternative hypothesis of $r > r^*$ vectors. The referred to test is shown in equation 5:

$$\lambda_{tr}(r) = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}_{\hat{i}}) \quad (5)$$

In terms of analysis, vector modeling helps check for impulse response; a procedure that describes the response of a variable to an impulse in the variable itself or in the other endogenous variables of the system. In this way, it is possible to know the behavior of the model variables in response to various observed shocks (GOMES; AIDAR, 2005).

Another way of analyzing VAR models is through variance decomposition, a method that shows the percentage of the forecast error variance that arises from each endogenous variable over the forecast period. In addition, according to Bueno (2008), variance decomposition provides relevant information on the importance of a particular variable in the changes of another variable of the model.

2.3 Causality

As a complement to the tests, we performed the causality test, which aims at analyzing the effects directions or their precedence. The most commonly used method is Granger (1969) causality method, which consists of checking if current and past values of a variable can be forecast from future values of one or more variables. It is about the existence of a temporal precedence statistically significant in the explanation of a particular variable. One of the advantages of this test lays on the fact that it is immune to the problem of endogeneity (KOSHIYAMA, 2008). Specifically, the test proposed by Granger (1969), follows the specifications as those shown in equations (6) and (7):

$$Y_t = \alpha_1 + \sum_{i=1}^{k}\beta_{1i}Y_{t-i} + \sum_{i=1}^{k}\gamma_{1i}X_{t-i} + \mu_{1t} \quad (6)$$

$$X_t = \alpha_2 + \sum_{i=1}^{k}\beta_{2i}Y_{t-i} + \sum_{i=1}^{k}\gamma_{2i}X_{t-i} + \mu_{2t} \quad (7)$$

where Y and X are dependent variables; α is a constant term; μ is the error term; the t subscript refers to the time period and i the lag $(i = 1,...,k)$.

However, the Granger causality test is based on some assumptions (stationarity and time series cointegration), which restrict to some extent its application. Besides, the commonly carried out unit root tests (Dickey-Fuller and

Phillips-Perron) have a low power over the alternative hypothesis and are not reliable for relatively small samples (TODA; YAMAMOTO, 1995). In addition, the cointegration test presents some limitations since its results are sensitive to the different adopted specifications, a feature that increases uncertainty about the results, due to the presence of biased pre-tests (MARQUETTI; KOSHIYAMA; ALENCASTRO, 2009).

Seeking to overcome these restrictions, Toda and Yamamoto (1995) developed an alternative test procedure characterized by the simplicity of its applicability since it can be carried out on series that are cointegrated or not, or on series of a different order of integration, making the test for unit root presence unnecessary. Moreover, this procedure can provide results usually obtained from more complex and alternative procedures (KOSHIYAMA, 2008). Moreover, the test is more appropriate for relatively small samples (YAMADA; TODA, 1998; MARQUETTI; KOSHIYAMA; ALENCASTRO, 2009).

Specifically, the procedure proposed by Toda and Yamamoto (1995) consists of performing a Modified Wald (MWALD) test to test for restrictions on the parameters of an augmented level VAR model. The test is performed directly on the least squares estimators of the coefficients of the level VAR.

Toda and Yamamoto (1995) showed that the Wald test application to test for restrictions on the parameters of a VAR(z) model, follows an asymptotic Chi-square (χ^2) distribution regardless of the non-stationarity involved in the system when a VAR $(z+e)$ is estimated, with e being the maximum order of integration for the variables in the system.

From this, the Wald test restrictions on the hypothesis of Granger non-causality test are carried out on the first z coefficients, whereas the latter e coefficients are not explicitly taken into account in the Wald test. These extra lags are, however, necessary to ensure that the test statistic has an asymptotic Chi-square (χ^2) distribution (KOSHIYAMA, 2008).

Operationally, the Toda and Yamamoto (1995) procedure involves three steps that consist of determining the optimal lag length z and the maximum order of

integration e of the system. Then, a level VAR model is estimated with $(z+e)$ lag lengths as shown in equations (8) and (9).

$$Y_t = \alpha_1 + \sum_{i=1}^{z} \beta_{1i} Y_{t-i} + \sum_{j=z+1}^{z+e} \beta_{1j} Y_{t-j} + \sum_{i=1}^{z} \gamma_{1i} X_{t-i} + \sum_{j=z+1}^{z+e} \gamma_{1j} X_{t-j} + \varepsilon_{1t} \quad (8)$$

$$X_t = \alpha_2 + \sum_{i=1}^{z} \beta_{2i} Y_{t-i} + \sum_{j=z+1}^{z+e} \beta_{2j} Y_{t-j} + \sum_{i=1}^{z} \gamma_{2i} X_{t-i} + \sum_{j=z+1}^{z+e} \gamma_{2j} X_{t-j} + \varepsilon_{2t} \quad (9)$$

After the estimation has been carried out, Wald test restrictions are put on the first z parameters in order to check for Granger non-causality hypothesis. Therefore, there will be unidirectional causality from X to Y if the hypothesis $H_0 : \gamma_{1i} = 0$ is rejected and the hypothesis $H_0 : \beta_{2i} = 0$ is not. Likewise, there will be unidirectional causality from Y to X if the hypothesis $H_0 : \beta_{2i} = 0$ is rejected and the hypothesis $H_0 : \gamma_{1i} = 0$ is not.

Another relevant fact refers to the number of variables involved in the tests. Because, in bivariate systems non-causality on the horizon of a period implies non-causality in any horizon, which is not the case in multivariable systems, in which causality between X and Y may arise from auxiliary variables even though there is no causality between the variables (Koshiyama, 2008). Therefore, bivariate systems have some advantages over multivariate systems. However, omitting important variables in bivariate systems can overestimate the causality between the variables of interest (AKBAR; NAQVI, 2003). Thus, in addition to the bivariate and multivariate models, we made use of a trivariate model in the causality analysis. The trivariate model can be expressed as in equations (10), (11) and (12):

$$Y_t = \alpha_1 + \sum_{i=1}^{z} \beta_{1i} Y_{t-i} + \sum_{j=z+1}^{z+e} \beta_{1j} Y_{t-j} + \sum_{i=1}^{z} \gamma_{1i} X_{t-i} + \sum_{j=z+1}^{z+e} \gamma_{1j} X_{t-j} + \sum_{i=1}^{z} \varphi_{1i} Z_{t-i} + \sum_{j=z+1}^{z+e} \varphi_{1j} Z_{t-j} + \varepsilon_{1t} \quad (10)$$

$$X_t = \alpha_2 + \sum_{i=1}^{z} \beta_{2i} Y_{t-i} + \sum_{j=z+1}^{z+e} \beta_{2j} Y_{t-j} + \sum_{i=1}^{z} \gamma_{2i} X_{t-i} + \sum_{j=z+1}^{z+e} \gamma_{2j} X_{t-j} + \sum_{i=1}^{z} \varphi_{2i} Z_{t-i} + \sum_{j=z+1}^{z+e} \varphi_{2j} Z_{t-j} + \varepsilon_{2t} \quad (11)$$

$$Z_t = \alpha_3 + \sum_{i=1}^{z} \beta_{3i} Y_{t-i} + \sum_{j=z+1}^{z+e} \beta_{3j} Y_{t-j} + \sum_{i=1}^{z} \gamma_{3i} X_{t-i} + \sum_{j=z+1}^{z+e} \gamma_{3j} X_{t-j} + \sum_{i=1}^{z} \varphi_{3i} Z_{t-i} + \sum_{j=z+1}^{z+e} \varphi_{3j} Z_{t-j} + \varepsilon_{3t} \quad (12)$$

where Z denotes the third variable used in the causality analysis.

In terms of estimation, we first estimated the bivariate models, then the trivariate and multivariate models. We considered in all the three models every possible relationship that may exist between the variables, which resulted in 42 bivariate equations, 21 trivariate equations, and 7 multivariate equations. The multivariate model estimation took into account the seven variables; and for that reason, the multivariate model is not reproduced here, since it is an extended variant of equations (10), (11) and (12).

3 RESULTS

3.1 Stationarity and cointegration

Since VAR models require series testing for stationarity, we first carried out the Augmented Dickey-Fuller (ADF) test, which identifies unit root presence when the error term is not white noise. Table 1 presents the results for the ADF unit root tests in levels and in first differences, with models specification with an intercept and trend τ_t and with just an intercept τ_μ.

Table 1 - ADF unit root tests at levels and first differences

	Levels		**First Differences**	
Variables	τ_μ	τ_t	τ_μ	τ_t
GDP	-1.326042	-2.273719	-5.628207***	-
GFCF	-1.563091	-2.682935	-6.000370***	-
OPEN	-3.322777***	-	-	-
PUBEXP	-1.486554	-2.503141	-4.764831***	-
IMP	-1.551540	-2.294412	-5.713586***	-
EXP	-1.706403	-2.952682	-7.896456***	-
FDI	-1.612549	-5.666721***	-	-

Source: Research results. Developed by the authors.
*, ** and *** denotes significance at 10%, 5% and 1% respectively.

The results showed that in levels, only the variables OPEN and FDI were stationary at 1% significance level. OPEN stationarity was reached through an intercept while that of FDI through an intercept and trend. As for the other variables, stationarity or (absence of unit root) was reached after first differencing. Therefore, we concluded that the series were integrated of order one that is I(1).

After determining the order of integration, we tested for the optimal lag length (see Table 2). The Akaike Information Criterion (AIC) indicated that there should be three lags in the model; whereas the Schwarz Information Criterion (SIC) and the Hannan-Quinn Information Criterion (HQ) indicated that there should be one lag in the model. On the other hand, the Final Prediction Error (FPE) and the Likelihood Ratio test (LR) indicated that there should be two lags in the model. Seeking to estimate a more parsimonious model, we selected one lag length as proposed by the Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQ) to include in the model. The choice for the latter criteria is based on the fact they are more robust and parsimonious as stated by Stock (1994).

Table 2 - Results of the lag order selection tests

Lag	LogL	LR	FPE	AIC	SC	HQ
0	312.8818	NA	7.81e-16	-14.92106	-14.62850	-14.81453
1	512.3191	321.0454	5.26e-19	-22.25947	**-19.91898***	**-21.40719***
2	566.5590	**68.79212***	**5.04e-19***	-22.51507	-18.12666	-20.91705
3	627.0488	56.06367	5.40e-19	**-23.07555***	-16.63921	-20.73179

* Indicates lag order selected by the criterion.
Source: Research results. Developed by the authors.

After determining the order of integration and the optimal lag length, the next step consisted in checking through Johansen´s cointegration tests, for the existence of a long-run relationship between the variables. Trace and maximum eigenvalue tests are shown in Table 3. The estimates showed a cointegration rank of one in both trace and maximum eigenvalue tests at 5% significance level, confirming thus the existence of a sustainable long-term equilibrium relationship between the variables.

Table 3 – Johansen cointegração tests

	Max-Eigen Value Test	Critical Value 5%	Trace Test	Critical Value 5%
None	57.89635*	50.59985	173.1794*	150.5585
At most 1	42.27976	44.49720	115.2830	117.7082
At most 2	22.32479	38.33101	73.00329	88.80380
At most 3	17.84933	32.11832	50.67851	63.87610
At most 4	15.46002	25.82321	32.82918	42.91525
At most 5	11.99985	19.38704	17.36916	25.87211
At most 6	5.369305	12.51798	5.369305	12.51798

* Denotes rejection of the null hypothesis at 5% level.
Source: Research results. Developed by the authors.

In summary, the results of the specification tests have shown the required conditions for the estimation of a vector error correction model (VECM), from which it is possible to get the short and long-term estimates.

3.2 Results of long-term estimates

The estimation of the long-term relationships through the VEC model and their normalized forms are shown in Table 4. It is worth mentioning that the variables ordering is based upon Granger Causality/Block Exogeneity Tests, which consider the value of χ^2 statistics, so as the most exogenous (lower values of statistics) variables are put before the most endogenous variables. Therefore, the variables ordering is as follow: gross domestic product (GDP), gross fixed capital formation (GFCF), degree of economic openness (OPEN), public expenditures (PUBEXP), imports of goods and services (IMP), exports of goods and services (EXP) and foreign direct investment (FDI).

The estimates allow us to observe that except for imports (IMP) and to some extent gross fixed capital formation (GFCF), all the variables have shown a positive sign. In terms of relationships (OPEN), (PUBEXP) and (FDI) were statistically significant at 1%, while (IMP) and (EXP) at 5% and 10% respectively. As for (GFCF), it showed no statistical relationship associated with changes in the aggregate output of Senegal.

Table 4 – Results of the estimation of the long-term equation

Normalized Cointegrating Vector – Long-Term						
	GFCF	OPEN	PUBEXP	IMP	EXP	FDI
GDP (-1)	-0.476073	0.954785***	1.208366***	-1.561776**	0.534966*	0.374304***
1.00000	(0.39202)	(0.29738)	(0.35007)	(0.67861)	(0.35181)	(0.04922)
	[1.21440]	[-3.21068]	[-3.45183]	[2.30144]	[-1.52059]	[-7.60498]

*, ** and *** denotes significance at 10%, 5% and 1%, respectively.
Note: *t* Statistics in brackets.
Source: Research results. Developed by the authors.

As shown in Table 4, we can notice that if EXP increases by 1% then there is a long-term growth of the aggregate output of 0.53%. A result that highlights the relevance of exports to the economic growth of the country, and is in line with the hypothesis of economic growth based on exports. A similar result was produced by

PUBEXP when an increase by 1% resulted in GDP growth of 1.20%. This more than proportional relationship denotes the high sensitivity of the Senegalese economic activity to increases in public expenditures.

As a corroborative evidence, is the fact that public expenditures have registered an average annual growth of 7.40% over the period (1970-2003). However if we consider the last decade (2003-20013), growth was more significant and amounted to 13.62% per year, a percentage higher than the aggregate output growth, which was 4.50% per year over the same period. The increase in public expenditures corroborate the results found by Kunietama (2014), who found similar evidence in Angola where public expenditures affected positively economic growth. Moreover, this positive result shows the importance of public expenditures to the African economies, since by injecting more resources into the economy, the governments cause changes in the economic dynamics, especially in countries whose industrial structure is in a developing process, which is the case of Senegal.

As for FDI, an increase of 1% causes an expansion of 0.37% on the aggregate output. A result that reinforces evidence that with market liberalization and privatization of State-owned companies, the influx of private capital contributes positively to the economic growth of Senegal. This positive contribution of FDI to GDP is in accordance with results found in Ndiaye (2007) and Esso (2010), in which FDI impacted positively on the economic growth of some African countries, among which Senegal.

Another variable positively related to GDP refers to economic openness, as a growth of one percentage point in the degree of openness led to a growth of 0.95% in the aggregate output; a result similar to that found in Thioye (2006). This positive relationship was also found in the work of Koshiyama (2008) in his study of some Latin American countries. Therefore, it can be concluded that the process of economic openness was beneficial to the expansion of the aggregate activity, especially in countries with a predominance of natural resources and production of agricultural commodities.

In addition, economic openness generates positive effects on technological changes, labor productivity, and capital efficiency as well as on production. In this perspective, economic openness, characterized by the domestic market liberalization initiated in the late 1980s and early 1990, has also become a vector of economic

growth, in spurring international trade, entry of multinational companies and technology expansion into the country.

In terms of international trade, OPEN has contributed to reducing the role of the State, as the main economic player, especially with the involvement of the private sector in the economic activities. It should be noted that before the market liberalization, the State was the main player in the activities of imports and exports.

Following the privatizations of the State key companies and the entry of multinational companies especially in the areas of telecommunication and manufacturing industry, the country started improving its competitiveness and efficiency. A competitiveness resulting from the market plurality, and an efficiency translated into barriers removal for the sake of better resources management; the reason why economic openness generated positive results on the aggregate output.

On the other hand, IMP has related negatively to the aggregate output. Quantitatively, a 1% increase in imports resulted in a 1.56% decrease in GDP. This expressive result is due to the fact that the country imports almost everything it consumes, mainly agricultural products, manufactured goods, minerals, and petroleum. The most imported products are petroleum, oil, machinery, rice, wheat, dairy products (ANSD, 2014). Moreover, imports represent 37.4% of GDP over the period of study (UNCTAD, 2014). This result shows the negative effects of imports on the aggregate output, given that imports have almost always exceeded exports, which is why the country´s trade balance has been showing over the years, a chronic deficit. Because, during the period spanning from 1970 to 2013, the country experienced a surplus on its trade balance only on five occasions: 1970, 1972, 1974, 1975 and 1994 (UNCTAD, 2014). The surpluses registered in the 1970s were largely due to the rise in the international price of commodities, while that registered in 1994 was due to the local currency (CFA) devaluation; because with the exchange rate depreciation, local products became more competitive on the international market, which favored the country´s exports.

Although not significant, GFCF showed to hold a negative relationship with the aggregate output. This negative relationship may be attributed to the country´s industrial structure; because besides being underdeveloped, it is confronted with problems associated with external competition (especially the influx of Chinese

products) and power supply shortages. Insecurity regarding legal issues is another problem that affects the industrial sector with regard to setting up industries with only foreign capital.

It should be noted, that due to the scarcity of local resources for domestic investment, foreign capital becomes the only means of investment, which undermines the expansion of gross fixed capital formation.

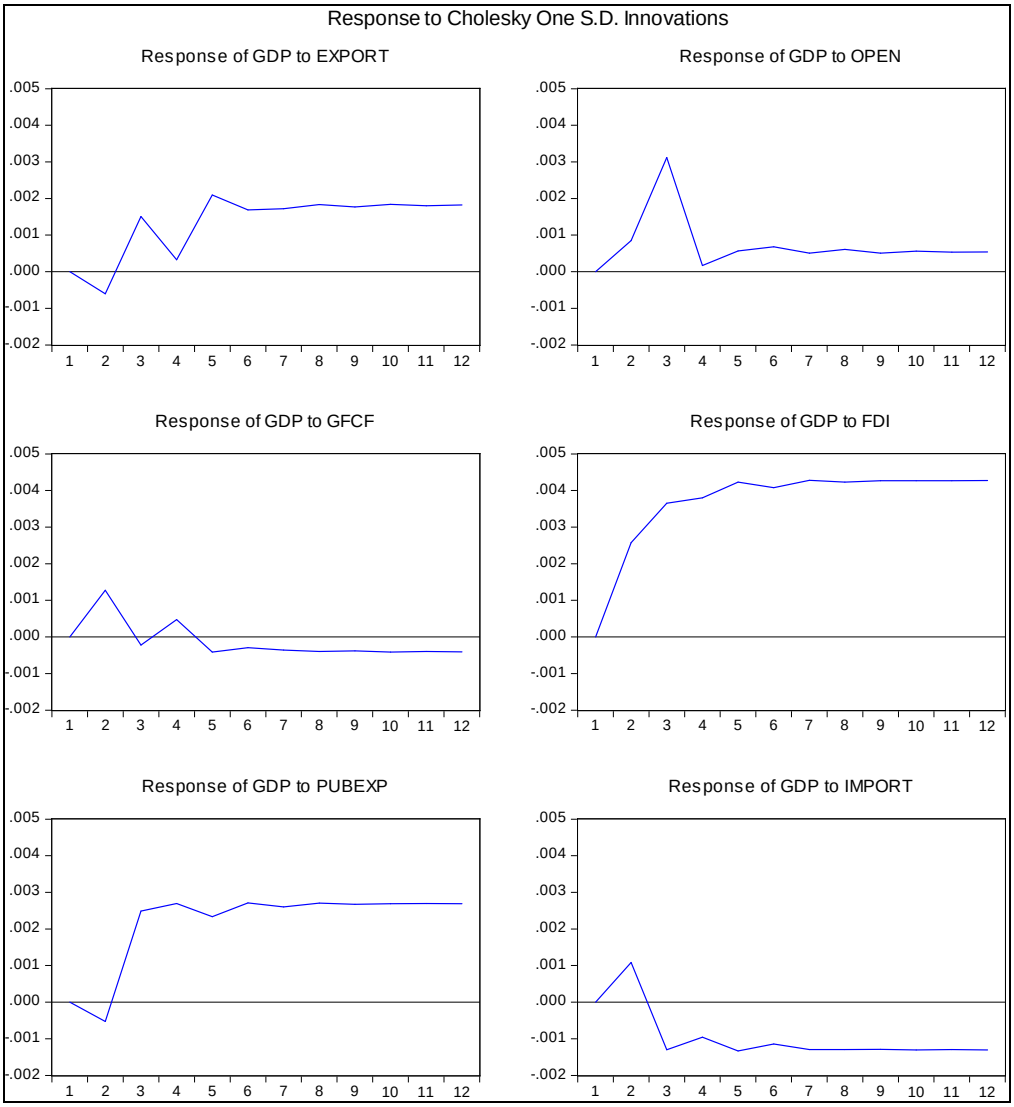
Complementing the analysis by approaching the short-term relationships, we present the estimation of the impulse response functions, which help describe the response of a variable to an impulse in the variable itself or in the other endogenous variables of the system (GOMES; AIDAR, 2005). Specifically, we estimated the response of GDP to an unanticipated shock on the macroeconomic variables of study (See figure 1).

We can observe that shocks on FDI, EXP, and PUBEXP cause positive and lasting effects since GDP stabilizes at levels higher than the level before the shock. Although these variables show to hold a positive relationship, it turns out that the time and magnitude of the changes are different. While exports and public expenditures reach their maximum effects (between 2 and 3 percentage points) in the fifth and sixth periods, FDI reaches its maximum effects (between 4 and 5 percentage points) in the seventh period.

Moreover, while the effects of FDI are growing continuously, GDP response to the two other variables is negative in the first period, possibly, because exports consist of low value-added products, which are the basis of the country´s economic activity. And also due to the fact that PUBEXP requires a longer maturation period given that they involve other activities such as workforce qualification and salaries.

In a different way, GDP response to shocks on OPEN shows that positive effects occur on GDP until the third period when they suddenly dissipate so that from the fourth period onward the aggregate output virtually stabilizes at levels lower than the level before the shock.

Figure 1 – Response of GDP to shocks on the macroeconomic variables



Source: Research results. Developed by the authors.

The two last analyses refer to IMP and GFCF for which it is observed that the response of GDP is positive in the first periods (between the first and the second); however, from the third period, the effects become negative, with the economic activity stabilizing at levels lower than the previous levels.

The positive effects of imports are associated with the fact that some of the imported products such as machinery, tools, and technology are essential to the economic activity and contribute to the country´s growth. However, with the increase in the volume of imports, mainly of manufactured and agricultural products, a fall in

GDP expected. It should be noted that the imported products consist mainly of manufactured and agricultural products and petroleum.

Although the industrial sector has been developing over the years and consists mainly of extractive and food processing industries, it has been contributing positively to the Senegalese economic expansion. However, because of this feature, along with investment shortages and foreign markets threat to the domestic market on account of the increasing volumes of imports, the positive effects of GFCF do not last for long periods. From another perspective, it seems that the investments, namely the local investments are not yet enough to sustain a long-term technological development and economic expansion.

In summary, the long-lasting effects on GDP show how sensitive the Senegalese economy is to unforeseen changes in the economic conjuncture. Besides, the economic activity (income generation) is based on the primary sector that is always subject to exogenous shocks, competition, and climatic factors.

3.3 Forecast Error Variance Decomposition

The results of the forecast error variance decomposition are shown in Table 5. As the purpose was to analyze the behavior of GDP, we showed only the variance decomposition of the aforementioned variable. Analytically, we can observe that the variance decomposition of GDP is wholly explained by its own trajectory in the first period. However, this share is reduced to 91.33% in the sixth period, so that FDI and PUBEXP end up explaining 4.74% and 1.82% respectively. After 24 periods, the share of the macroeconomic variables in the explanation of the variance decomposition of the economic activity reaches approximately 12.35%, especially FDI whose share reached 7.21%, confirming thus, the hypothesis that inflows of foreign productive investment impact on the Senegalese economic activity.

Table 5 - Variance decomposition of the aggregate output (GDP)

Variance decomposition of GDP								
Per.	S.E	*GDP*	*EXP*	*OPEN*	*GFCF*	*FDI*	*PUBEXP*	*IMP*
1	0.018038	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
6	0.038102	91.33829	0.689388	0.774905	0.148677	4.747095	1.829076	0.472572
12	0.052969	88.94846	1.049068	0.464212	0.110043	6.346038	2.477252	0.604926
18	0.064463	88.06377	1.186068	0.355375	0.098255	6.922070	2.720415	0.654048
24	0.074197	87.61239	1.256063	0.299877	0.092279	7.215926	2.844294	0.679167

Source: Research results. Developed by the authors.

Therefore, FDI along with PUBEXP and EXP are the variables that explain most of the variance decomposition of the aggregate output. On the other hand, the shares of IMP, GFCF, and OPEN are not substantial. These results, in particular, those of IMP and GFCF corroborate the results that have already been discussed, since they do not explain the behavior of the aggregate output.

Finally, after analyzing the forecast error variance decomposition, and seeking for information on the direction of the relationship between the variables of study, we proceeded to the analysis of the Granger-causality tests based on Toda and Yamamoto (1995) causality approach.

3.4 Analysis of causal relationships

The last step of the analyses consisted of checking for the existence of any causal relationship between the variables of study, through the Toda and Yamamoto (1995) causality test approach. Empirically, series stationarity was reached after first differencing, which implies that they were integrated of order one. As the tests for first differencing indicated rejection of the null hypothesis on the existence of two unit roots (integration of order 2), we concluded that the maximum order of integration (e) for the variables in the system was equal to one. As for the optimal lag length (z), for which we used the Schwartz Information Criterion (SIC), it turned out to be one, $(z = 1)$. Thus, the causality estimates were obtained through a VAR(2) model, consistent with $(z + e = 2)$.

As the results indicated that the VAR model to be used was a VAR(2) model, we moved on to test for the bivariate, trivariate and multivariate causality relationships. The results of the respective relationships are summarized and reported in Table 6, 7, and 8. It is worth mentioning that due to the high number of estimated relationships, only the causal relationships in which any kind of significance has been found are presented in the Tables.

Thus, the test for the bivariate causal relationships has indicated there to be a causal relationship between EXP and OPEN since the null hypothesis that exports do not Granger-cause economic openness is rejected at 10% significance level, while

the opposite relationship is not found. As it can also be observed, there is a causal relationship between EXP and PUBEXP because the hypothesis that exports do not Granger-cause public expenditures is rejected at 1% significance level. Likewise, the null hypothesis that exports do not Granger-cause gross fixed capital formation is rejected at 5% significance level.

For causing GFCF, PUBEXP, and OPEN, exports tend to precede the variations in the Senegalese GDP, although no direct causal relationship has been found between them. This result is reinforced by the analysis of Bêrni *et al.* (2008), who by simulating the effect of an exogenous increase in exports on employment and income generation, concluded that exports could boost growth, by positively impacting on the other important variables for economic growth. Although exports play a key role and represent the main source of foreign currency inflows into the country, no economic growth based solely on export-led-growth has been found.

The analysis of imports has revealed there to exist a temporal precedence over exports at 1% significance level as well as a causal relationship between imports and gross fixed capital formation with the direction running directly from IMP to GFCF implying that IMP is a good predictor of GFCF. Furthermore, the results indicate the existence of a bidirectional relationship between IMP and FDI at 5% and 10% respectively implying that there is a feedback linkage of predicting each other between these two variables.

The causal relationship between imports and exports with the direction running directly from IMP to EXP may be attributed to the dependence of some exports on imports since some exported products are first imported and then exported (petroleum/ oil). As the economy is underdeveloped, imports become essential, because almost everything that is consumed in the country is imported. As a result, imports end up contributing to gross fixed capital formation and to exports, which to some extent contribute to the expansion of the economic activity.

This peculiar situation raises a question as to the role of imports in the economic growth of the country. Is the Senegalese economic growth based on the hypothesis of import-led-growth? According to Lawrence and Weinstein (2006), imports, especially of manufactured goods (such as capital assets), contribute to the modernization of the industrial park, the absorption of new technologies, the increase in efficiency and competition in the domestic production; serving thus, as important

drivers of growth, especially in countries that manage to maintain an outward-oriented strategy (SARQUIS, 2011).

As for GDP, the results indicate that there is only one temporal relationship with FDI at 5% significance level. This unidirectional relationship in which GDP causes FDI, corroborates the results found in the works of Chowdhury and Mavrotas (2006), Esso (2010), and Mlayah (2012), which support the evidence of a temporal precedence relationship between GDP and FDI in the case of Chile, Liberia, South Africa and Tunisia.

It should be noted that the positive results of the Senegalese economy in recent years are, to a large extent due to the end of the high volatility period observed in the years between 1970 and 1994, as opposed to the steady growth (on average 4.03% per year) period, between 1994 and 2013. The economic stability enjoyed by the country as a result of the implementation of the directives of the World Bank and the International Monetary Fund (IMF), associated with the changes in the economic policies are believed to be the source of foreign private capital attraction.

Table 6 – Summary of results of the Toda and Yamamoto causality test approach for a bivariate VAR(2) system

Null Hypothesis	**MWALD©**	**Causality**
EXP does not Granger-cause OPEN	3.035557*	*EXP* ⇨ *OPEN*
OPEN does not Granger-cause EXP	0.160718	*None*
EXP does not Granger-cause PUBEXP	5.677531***	*EXP* ⇨ *PUBEXP*
PUBEXP does not Granger-cause EXP	0.605389	*None*
GFCF does not Granger-cause EXP	2.121027	*None*
EXP does not Granger-cause GFCF	3.547154**	*EXP* ⇨ *GFCF*
IMP does not Granger-cause EXP	6.087242***	*IMP* ⇨ *EXP*
EXP does not Granger-cause IMP	1.467990	*None*
IMP does not Granger-cause GFCF	6.692551***	*IMP* ⇨ *GFCF*
GFCF does not Granger-cause IMP	1.216095	*None*
GDP does not Granger-cause IDE	4.822901**	*GDP* ⇨ *FDI*
FDI does not Granger-cause GDP	2.026734	*None*
IMP does not Granger-cause FDI	4.127185**	*IMP* ⇨ *FDI*
FDI does not Granger-cause IMP	2.761607*	*FDI* ⇨ *IMP*

© Tests statistics follow a chi-square asymptotic distribution. ***, ** and * denotes rejection of the null hypothesis of non-causality at 1%, 5%, and 10%, respectively.
Source: Research results. Developed by the authors.

As shown in Table 6, our empirical findings suggest that there is a bidirectional relationship between IMP and FDI at 5% and 10% respectively. This bidirectional relationship corroborates the results found in Mlayah (2012) and may be attributed to the need for multinational companies to import, due to the domestic market

incapacity to meet their demand and, also to the need to circumvent any protectionist measures adopted by some countries to protect their local market. As a result, multinational companies end up settling in host countries and produce locally their products. One of the negative consequences that may result from this is the substantial increase in the volume of imported goods and the deterioration of the trade balance.

However, there is no evidence that both situations are present in the case of Senegal, although the first case fits well to the economic context of the country. The bidirectional relationship between imports and foreign direct investment is due to shortages (agricultural products, manufactured goods, machinery etc.) in the local market and to the precarious situation of the country´s industrial park.

Seeking to ratify the results concerning the causal relationships, we incorporated the variables (EXP and GDP) and tested for temporal precedence. The model expansion is always done through the addition of a variable so as to develop the trivariate model. Table 7 presents the respective results of the trivariate model.

Table 7 - Summary of results of the Toda and Yamamoto causality test approach for a trivariate VAR(2) system

Null Hypothesis	**MWALD©**	**Causality**
EXP does not Granger-cause OPEN	4.116535**	*EXP* ⇨ *OPEN*
OPEN does not Granger-cause EXP	0.246852	*None*
EXP does not Granger-cause PUBEXP	2.674753*	*EXP* ⇨ *PUBEXP*
PUBEXP does not Granger-cause EXP	0.191969	*None*
IMP does not Granger-cause EXP	5.256942**	*IMP* ⇨ *EXP*
EXP does not Granger-cause IMP	2.261714	*None*
IMP does not Granger-cause GFCF	5.053673**	*IMP* ⇨ *GFCF*
GFCF does not Granger-cause IMP	0.073775	*None*
GDP does not Granger-cause FDI	6.173223***	*GDP* ⇨ *FDI*
FDI does not Granger-cause GDP	1.934753	*None*
IMP does not Granger-cause FDI	3.263892*	*IMP* ⇨ *FDI*
FDI does not Granger-cause IMP	2.006798	*None*

© Tests statistics follow a chi-square asymptotic distribution. ***, ** and * denote rejection of the null hypothesis of non-causality at 1%, 5%, and 10%, respectively.
Source: Research results. Developed by the authors.

As shown in Table 7, EXP precedes OPEN at 5% significance level. In addition, the null hypothesis that exports do not Granger-cause public expenditures is rejected at 10% significance level. On the other hand, IMP shows to hold a unidirectional relationship with EXP. A similar relationship is found between imports and gross fixed capital formation. Evidence has also shown that there is a

unidirectional relationship between GDP and FDI and between IMP and FDI at 1% and 10% significance level respectively. As for the other variables, no evidence of causation has been found.

The results have also evidenced that, except for the unidirectional relationship from EXP to GFCF, all the temporal precedence relationships found in the bivariate model are confirmed in the trivariate model. It is worth mentioning that the bidirectional relationship between IMP and FDI, found in the bivariate model has turned into a unidirectional relationship in the trivariate model.

As a complement to the causation analyses, we proceeded to the multivariate model analysis, by including in the model the seven variables (*EXP, GDP, GFCF, FDI, PUBEXP* and *IMP*). The results of the referred to model are shown in Table 8.

Table 8 - Summary of results of the Toda and Yamamoto causality tests procedure for a Multivariate VAR(2) system

Null Hypothesis	**MWALD©**	**Causality**
EXP does not Granger-cause *OPEN*	4.075910**	*EXP* ⇨ *OPEN*
OPEN does not Granger-cause *EXP*	0.907333	*None*
FDI does not Granger-cause *OPEN*	0.340810	*None*
OPEN does not Granger-cause *FDI*	10.81584***	*OPEN* ⇨ *FDI*
FDI does not Granger-cause *PUBEXP*	0.375218	*None*
PUBEXP does not Granger-cause *FDI*	9.971791***	*PUBEXP* ⇨ *FDI*
EXP does not Granger-cause *PUBEXP*	2.795800*	*EXP* ⇨ *PUBEXP*
PUBEXP does not Granger-cause *EXP*	0.713485	*None*
FDI does not Granger-cause *EXP*	0.200328	*None*
EXP does not Granger-cause *FDI*	7.703070***	*EXP* ⇨ *FDI*

© Tests statistics follow a chi-square asymptotic distribution. ***, ** and * denotes rejection of the null hypothesis of non-causality at 1%, 5%, and 10%, respectively.
Source: Research results. Developed by the authors.

The results indicate rejection of the null hypothesis that EXP does not Granger-cause OPEN at 5% significance level. The null hypothesis that EXP does not Granger-cause PUBEXP is rejected at 10% significance level. These results corroborate the results found in the bivariate and trivariate models. The null hypothesis that OPEN does not Granger-cause FDI is also rejected at 1% significance level. A similar unidirectional relationship is found between PUBEXP and FDI and between EXP and FDI, both causal relationships at 1% significance level. As for the other variables, no causal relationship has been found between them.

The causal relationships between EXP and OPEN and between EXP and FDI show the relevance of the Senegalese international trade in the attraction of foreign

private capital. Because trade liberalization has provided the economy with a new dynamic that facilitates the influx of foreign capital. As a result, a series of privatizations of State-owned companies started to take place, which led to the entry of new multinational companies. These findings corroborate the results found by Mlayah (2012) in his work on Tunisia. However, they go against those found by Makan (2008) in his work on Côte d´Ivoire. The latter, by using the traditional Granger-Causality test found evidence of a causal relationship between FDI and OPEN with the direction running from FDI to OPEN.

The causal relationship between PUBEXP and FDI may be associated with the entry of companies of the financial sector in the Senegalese market, especially foreign private banks, in consequence of the bankruptcy of a substantial number of public banks and of the inefficiency of public services. It is worth mentioning that the State accounts for almost all of the formal employment in the country.

Moreover, the growing increase in government expenditures on goods and services and the domestic companies' lack of resources to meet such demands, may be the source of foreign direct investment. These multinational companies, in turn, invest in productive capital and increase the inflow of foreign direct investment without, however, transferring technology.

In the light of the analyses, with the exception of the unidirectional relationship from EXP to GFCF in the bivariate model, all the temporal relationships found in the bivariate model were also found in the trivariate model. As for the multivariate model, only two temporal relationships (running from EXP to OPEN and from EXP to PUBEXP) were found in both bivariate and trivariate models.

We conclude from this that the Senegalese international trade activities (imports and exports) constitute the basis for of the country´s economy, as they contribute to enhancing the local economic activities. Moreover, domestic conditions and economic expansion may influence positively on the influx of foreign private capital, although the opposite has not been ascertained.

However, our results are not conclusive as to the temporal relationships found in the multivariate model and not found in the bivariate and trivariate model. Because, according to Koshiyama (2008), in multivariate systems, causality between variables may arise from auxiliary variables even though there is no causality between them.

4 CONCLUSIONS

The effects of foreign direct investment on the economic growth of recipient countries has for long been raising controversies, although most studies find that FDI impacts positively on the expansion of the aggregate output of recipient countries. It is in this debate that this present work is inserted, focusing mainly on the case of Senegal, whose foreign productive investments have been gaining relevance in the local politics.

The Senegalese economic dynamics have for a long time, been focused on exports of agricultural and mineral products and imports of agricultural and manufactured goods. However, imports of these goods have been growing over the years, in such a way, that the deficit in both trade balance and balance of payments is worsening considerably. Along with the increasing population growth rate, there arose the need for measures aiming at balancing the public accounts, among which trade and banking sector liberalization, privatization of State-owned companies etc.

Besides balancing the public accounts, these measures help promote competitiveness and competition and contribute also to attracting foreign private capital. Furthermore, they help reduce the dependence of the country´s economic growth on exports, a hypothesis that has guided this work. Having such aspects as objectives, we made use of vector models (VAR/ VEC) complemented by the Toda and Yamamoto causality approach.

Overall, except for imports and gross fixed capital formation, all the variables of study have, in the long-term, impacted positively on the aggregate output. This variables behavior was also confirmed in the short-term analysis since only imports and gross fixed capital formation impacted negatively on GDP. The effects of imports on the aggregate output were expected, given that, an increase in foreign purchases weakens the domestic market, impacting thus negatively on the country´s economic growth. Unlike imports, gross fixed capital formation usually contributes to economic growth. The negative effects of gross fixed capital formation on the Senegalese economy may be associated with the industrial structure of the country, which is not consolidated since it consists mainly of manufacturing, food and mining industries. On the other hand, it should be mentioned that in addition to being important, the

effects of foreign direct investment, tend to generate short-term results, corroborating thus the thesis that this kind of investment contributes to the expansion of the Senegalese economy.

The temporal precedence relationships reinforce the results by indicating that in both analyses, bivariate and trivariate, economic growth and imports precede foreign direct investment. Thus, it seems that the domestic conditions create to some extent the scenario for the inflow of foreign capital.

In view of these results, we conclude that the Senegalese growth tends to provide the conditions for the expansion of foreign investment. However, there is no conclusive evidence of a reverse relationship between these variables. In addition, international trade activities and economic openness constitute the basis of the country´s economic activity, given that they precede the other variables. Therefore, there is no definite evidence of an economic growth based on the hypothesis of export-led-growth nor on import-led-growth.

From this evidence, we suggest that policies meant for attracting foreign private capital for the investment in the manufacturing sector should be implemented because of the high degree of linkage that this sector has with the dynamic sectors of the economy. And since this kind of investment is likely to increase the volume of imports, policies aimed at controlling this expansion need to be implemented so that the domestic economy does not become even more dependent on foreign markets. In addition, it is necessary that policies aimed at promoting technology transfer be implemented, which will, although in the long-term, expand competitiveness in all of the areas.

It is worth mentioning that our results are not conclusive since our purpose was not that of exhausting the debate over the effects of foreign direct investment in Senegal. In addition, we were faced with limitations that stem from the lack of data set provided by the Senegalese institutions such as APIX and ANSD, and shortages of academic studies that address this issue in the African continent, making it difficult to compare our results. Therefore, it seems desirable that further studies on this issue be undertaken with data set provided by the Senegalese institutions.

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