Impact of Foreign Direct Investment on Economic Growth: Comparative Analysis in Ecuador, Peru and Colombia 1996-2016

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ABSTRACT

The present investigation has the purpose of evaluating whether there is a Granger causality relationship in the 1996-2016 historical trajectory between the study variables, Foreign Direct Investment (FDI) and economic growth of Ecuador, with its commercial partners Colombia and Peru; considering the importance that its implications could contribute to political-economic decisions. The analysis was performed taking data from Ecuador, Peru and Colombia with a temporal sample in the period 1996-2016 on a quarterly basis applying autoregressive vectors to determine the relationship between the mentioned variables. The results indicate that GDP does not cause FDI in any of the countries analyzed. However, in Ecuador and Peru FDI has a significant Granger-causality effect on GDP. A possible explanation for this last result may be that FDI has a non-linear effect on production. Both Ecuador and Peru have a low level of FDI over GDP in relation to Colombia.

Keywords: Foreign Direct Investment, Gross Domestic Product, Economic Growth, Comparative
JEL Classifications: E22, 040, F43, N10

1. INTRODUCTION

Throughout history, governments have been concerned with the generation and increase of Gross Domestic Product as a way of growing the economy of their nations. According to "the capitalist paradigm, Foreign Direct Investment (FDI) is one of the engines of development, especially for receiving economies" (Garay, 2012). Faced with this reality, FDI flows have become a relevant topic to analyze. This research evaluates the relationship that may exist between FDI and economic growth measured through GDP, this analysis was made for Ecuador and its trading partners Colombia and Peru, considering that these three countries have similar characteristics. A temporary sample was used in the 1996-2016 period on a quarterly basis. The methodology to be used is that of Autoregressive Vectors proposed by Sims (1980). This analysis aims to provide information that allows rulers to make suitable

decisions for the proper government of nations. Promoting public policies that promote the productive engine of the economy and therefore can generate growth. Since, as mentioned by (Espin et al., 2016, p. 218) "without sufficient, appropriate and correctly analyzed information, criteria can be generated that would not be well supported and that cannot contribute positively to making adequate decisions."

2. THEORETICAL FRAMEWORK

The proposed variables of the study are: (a) FDI; Economic Growth based on Gross Domestic Product (GDP); Potential determinants of FDI: interest rate, inflation, exchange rate, domestic investment and trade openness. Next, a theoretical analysis will be carried out in greater detail of each of the study variables.

2.1. FDI

For many years, FDI has been studied in the literature concerning economic growth and international trade. Many countries have based their foreign trade policies on the idea that FDI is key to economic development, especially in developing countries (Ozturk and Kalyoncu, 2007; Ozturk and Acaravci, 2010).

FDI reflects the long-term interest of a resident entity in one economy (direct investor) in a resident entity in another economy (direct investment). It covers all transactions between direct investors and direct investment, which means that it covers not only the initial transaction, but also subsequent transactions between the two entities and the rest of the affiliated companies, according to OECD 2011, cited by (Torres, 2012, p.5).

De Vita and Kyaw (2009) mentioned that FDI improves growth in middle- or high-income economies, but not low-income economies. Additionally, according to Steiner and Salazar (2001), the economic literature has highlighted the positive effect that (FDI) can have on economic growth.

However, FDI has been the subject of various theoretical controversies, given that it brings not only advantages but also disadvantages for the destination country, but this controversy takes on a different nuance under the new conditions of the process of internationalization of the economies.

Conditions that under certain circumstances can enhance the benefits derived from FDI (Bonnett, 2006). In order to determine the effect that FDI has on economic growth, this research is carried out and thus be able to generate guidelines for economic policy makers, since, as it can be seen, it cannot be said categorically that FDI implies economic growth it is necessary to determine what circumstances arise in the environment of these nations.

Ramírez (2010) also evaluates the factors that drive FDI during the years 1980-2001 in nine Latin American countries, concluding that the size of the market, the real exchange rate, credit, and education drive the flow of FDI, but not the uncertainty whose effect is opposite.

On the other hand, Espin et al., 2016 cite that according to ECLAC data (2013, p.20) global FDI exceeded expectations in 2013, mainly in developing countries. Throughout the history of FDI, it can be seen that it benefits countries in economic crisis, since it supplies capital that promotes production and therefore the growth of employment rates and therefore the increase in GDP.

2.2. Economic Growth (GDP)

According to Castillo (2011), economic growth is considered as:

Quantitative change or expansion of the economy of a country. According to conventional uses, economic growth is measured as the percentage increase in Gross Domestic Product (GDP) or Gross National Product (GNP) in a year. It can happen in two ways: an economy can grow "extensively" using more resources (such as physical, human or natural capital) or "intensively,"

using the same amount of resources with greater efficiency; more productively (p. 3).

Once it is known what FDI and economic growth is, an analysis of the relationship of both variables will be carried out.

2.3. Relationship between FDI and Economic Growth GDP

Suanes and Roca-Sagalés (2015) analyzed the relationship between FDI, economic growth and income inequality for a group of Latin American countries, through a panel made up of 18 countries, over a period of 30 years, 1980-2009. The study's conclusions were two: the first is the positive effect that FDI has on economic growth, once other factors are controlled for; the second is the non-linear effect of FDI on inequality, for low levels of FDI, however, as FDI crosses a certain threshold, its increase leads to a reduction in income inequality

Li and Liu (2005) analyzed a panel of 84 developed and developing countries during the period 1970-1999, reporting in said research that there is a significant and endogenous relationship between economic growth and FDI; In other words, the effect of FDI on economic growth is positive, because human capital begins to increase, however the effect of FDI on economic growth is decreasing, because the technological gap increases.

Meanwhile, Tan and Tang (2016) analyzed FDI and economic growth under an investment determinants scheme, the variables used in the study were domestic investment, FDI, trade, interest rate and economic growth. Concluding that there is a long-term equilibrium relationship between domestic investment and FDI. On the other hand, Álvarez et al. (2009) pointed out that economic models give different roles to FDI with respect to economic growth, such that neoclassical models indicate that FDI does not impact economic growth in the long term contrary to endogenous models that indicate that there is such an effect. They also mentioned that "in general terms, the literature indicates that the effects of FDI are produced through the externalities it produces, such as technology transfer and spillovers" (p. 117).

Additionally, the results of the research carried out by Álvarez et al. (2009) stated that Institutional Quality is also relevant in Growth. In addition to this, the protection of property rights and a greater degree of freedom in the country are good mechanisms to boost FDI and, as a consequence, growth and greater accumulation of private capital are generated.

De Vita and Kyaw (2015) also investigated the impact of FDI and portfolio investment flows on the economic growth of low, middle, low and medium-high income countries, using a dynamic panel model, from a set of 126 developing countries, for the period 1985 to 2002. The findings suggest that only countries that have reached a minimum level of economic development are capturing the growth effects of both forms of portfolio investment flows.

Additionally, Herzer's (2012) research contributes to the literature on FDI and economic growth mainly in two ways.

First, the effect of FDI on the economic growth of 44 developing countries is examined, including eight Latin American countries: Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru and Venezuela; during the period 1970 to 2005, using heterogeneous panel cointegration techniques that are robust to omitted variables and endogenous regressors. Second, the study uses a general-to-specific model selection approach to systematically search for country-specific factors that explain differences between countries in the growth effects of FDI. The conclusions were that the differences between countries in per capita income, human capital, the opening and development of financial markets cannot explain the differences between countries in the effects of FDI growth. Furthermore, specifically for Ecuador, they determine a negative long-term relationship of FDI growth on GDP, while for countries like Peru and Colombia this relationship was positive.

Likewise, Alvarado et al. (2017) examined the effect of FDI on economic growth in 19 Latin American countries. Using panel data methods, strong empirical evidence is found to suggest that the effect of FDI on economic growth is not statistically significant in aggregate. This result varies when incorporating the levels of development reached by the countries of the region. FDI has a positive and significant effect on output in high-income countries, while in upper-middle-income countries the effect is uneven and not significant (includes Ecuador, Peru, and Colombia, among others).

Finally, the effect in lower middle-income countries is negative and statistically significant; These results show that FDI is not an adequate mechanism to accelerate economic growth in Latin America, with the exception of high-income countries.

On the other hand, Villazón (2018) investigated the fact that FDI has been considered a key factor in promoting economic growth in Latin America. The study used data from 18 Latin American countries including Ecuador, Colombia and Peru during the period 1994-2011. Controls that capture the specific characteristics of each country such as openness to international trade, inflation, economic freedom, domestic investment, human capital, government spending and financial development were used to estimate the regressions. The results showed that much of the economic growth in these countries is explained by the inflow of FDI flows; Likewise, the domestic investment measured by the Gross Fixed Capital Formation stands out.

Annotating these previous analyzes, Huayamares (2015) mentioned that there is a certain consensus of the advantages that the flow of FDI implies for the countries; however, he also mentions that there are divergences with respect to the appropriation of them since this is related to the specific characteristics of each receiving country. Precisely this is one of the reasons that suggests the need to carry out this research, since in the literature review it can be observed that although it is estimated that an increase in FDI could in the first instance suggest growth in the economy, this does not necessarily It is a reality that is constant in the same way in all countries, but could be compromised by other factors. In this same aspect, Jordan (2015) indicating that "the development of

the receiving country's financial system is an important condition for FDI to have a positive impact on economic growth.

In general in Latin America, the flow of FDI focuses on services and manufacturing, except for countries such as Brazil, Colombia, Ecuador and Venezuela, which enjoy abundant natural resources and therefore their investors focus on the mining and hydrocarbons sector (Espin et al., 2016).

Below, Table 1 shows a summary of the research carried out:

Also adding to this analysis Loja and Torres (2013) indicated that there are many contributions that have tried to explain the relationship between FDI and economic growth, generating the following summary in Table 2:

2.4. Colombia FDI Path

Since 1991, with the opening of the economy, FDI in Colombia grew significantly due to the good economic performance and capital inflows of developed countries. This growth has been reversed since 1997, and in particular, between 1998 and 1999, when economic growth was negative, considered as totally atypical, a collapse in FDI was observed (Torres, 2012; Bonnett, 2006).

Kalin (2009) investigated the policies used by Colombia to attract FDI, the FDI regime in Colombia has gone through a modernization process in which the entry and protection rules have been improved since the early 1990s. Despite these developments, Kalin (2009) stated that, to maximize the contribution of FDI to economic development, more efforts should be made to attract quality FDI. Several areas need to be upgraded to internationally competitive levels. First, local science and technology capacity needs to be improved, low R&D spending is alarming and should be increased, and transport infrastructure is poor and an obstacle to export-oriented FDI. Likewise, it is important that planned investments be made between public-private associations in road infrastructure, and the promotion of links between local and multinational supplier companies is recommended.

Table 1: Summary of literature on FDI and economic growth involving the study countries (Ecuador, Colombia and Peru)

Author	FDI impact on economic growth or related variables
Bengoa and Sanchez-Robles (2003)	+
Trojette (2016)	+
Herzer (2012)	−, +
Alvarado et al. (2017)	Null
Loja and Torres (2013)	+
Hansen and Rand (2006)	+
Moyano and Gil (2014)	+
Kalin (2009)	+
Barajas et al. (2000)	+
Bengoa and Sanchez-Robles (2003)	+
Sosa (2018)	+
Parra (2019)	+
Espin et al. (2016)	Null
Ortiz et al. (1991)	+

(+) positive impacts, (−) negative impacts (null) there is no impact

Table 2: Research on the effects of FDI on economic growth

Authors	Sample	Estimate	Period	Effects of FDI on economic growth
Alfaro et al. (2004)	47 countries	Cross Country	1981-1999	Primary sector: negative Sector Manufacturing: positive Sector. Services: ambiguous
Baracaldo, Garzón and Vásquez (2001)	92 countries	Panel data	1990-2001	Positive and significant influence
Borensztein et al. (1998)	69 Developing countries	SUR Cross-country Panel data	1970-1989	Positive and significant influence in countries with higher per capita income
Carkovic and Levine (2002)	72 countries	Ordinary least squares (OLS) and dynamic panel with average data	1960-1995	Negative impact between FDI and economic growth
De Mello (1999)	15 developed countries (OCDE) y 17 developing countries (non-OECD)	Time series and panel data	1970-1990	FDI drives growth as long as there is complementarity between domestic investment and FDI
Elías et al. (1998)	93 countries classified by income level	Panel data	1960-2002	Positive except in lower middle-income countries
Gaviria and Gutiérrez (1993)	10 Latin American countries	Time series and cross section	1965-1990	Positive correlation between FDI flows and GDP growth per capita
Zhang (2001)	East Asian countries and four Latin American countries	Granger causality test	1960-1997	FDI influences the growth of five economies

Source: Taken from Foreign direct investment in Ecuador during the period 1979-2011: analysis of its impact on economic growth. Cuenca: University of Cuenca by Loja and Torres (2013)

Gil et al. (2013) mentioned that Colombia, in order to attract FDI, eliminated article 58 of the Constitution, which is related to expropriation without compensation for foreign investment, although this has never led to the practice is a positive measure to attract FDI; however, there are still certain deficiencies that must be corrected, such as high transaction costs, excessive regulations, extensive procedures, insecurity and information problems.

2.5. Ecuador FDI Path
FDI in Ecuador is considered one of the lowest compared to the rest of the South American economies, focusing on GDP growth. Even when there are large multinationals that have invested in Ecuador and despite harsh criticism for aspects such as inadequate infrastructure, high costs of public services, rigid legal regulations in the workplace and under development of open policies (Espin et al., 2016).

Following the historical trajectory of Ecuador, Loja and Torres (2013) mentioned another relevant aspect, which is the serious political, economic and social crisis that Ecuador experienced in the late 1990s, in which 100% inflation was mentioned in 1998, a reduction GDP by 7% in 1999, but despite this situation, there was no considerable reduction in FDI, maintaining a slight growth in 2000; year in which the Economic Transformation Law (ETL) was enacted, which highlights official dollarization and fiscal, financial and labor reforms, which generates investors' confidence. This reality was reflected in an increase in FDI balances in 2001-2004. This increase was basically in the mining sector related to oil exploitation and pipeline construction. Subsequently, in the 2005-2006 period, FDI decreased, basically related to the termination of the contract with the Occidental oil company, but in 2008, a rebound in FDI values was seen again, which is attributed to concessions in the cell phone sector. Following the historical trajectory of the Ecuadorian economy during 2009-2010, there is again a 68% decline in FDI, which is attributed to the fact that during this period, the government of President Correa completed the redesign of contracts with major oil companies operating in the countries such as the Brazilian Petrobras, Canada Grande of the Republic of Korea, also EDC of the United States and part of the CNPC of China (CEPAL, 2010). In 2011, growth in FDI was again noted, which is related to mining and construction activity. For the year 2012, FDI had a small decrease of -9.16% and for 2013 an increase of 24.02% (Banco Central del Ecuador [BCE], 2012). Considering that the main reason for this growing trend is due to the Production, Trade and Investment code that entered into force since 2010.

2.6. Peru FDI Path
According to Bustamante (2016), the Peruvian economy has reflected sustained growth in recent years, although with some slowdown in certain years due to crises in international financial markets. One of the relevant factors in said growth is the flow of FDI, such is the case that in 2012, this figure represented just over 6% of GDP. The behavior of FDI in Peru came to represent almost 1.5% of GDP in 2000 to exceed 6% in 2011. Much of this could be related to the fact that Peru is perceived as a low-risk country.

It should also be noted that, with the result achieved in 2012, the Peruvian economy positioned itself as the sixth largest recipient of FIED in Latin America and the Caribbean (CEPAL, 2012). "Likewise, Peru recorded a record FIED in the first half of 2012, exceeding 31% over the same period in 2011" as mentioned (Bustamante, 2016). Also outstanding is the outstanding performance of Peru, which, even though it is a country with an emerging economy, has managed to be an attractive country with an appreciable capture of FDI flows, standing out among the countries of the region. It is necessary to mention that Bustamante (2016), concluded in his research that an increase in FDI of 1% increases the growth rate of GDP by 1.4%, however, he suggests

including other control variables for future research, the same that can be country risk, debt ratio, evolution of wages and labor productivity.

Álvarez et al. (2009) also studied the impact of FDI on economic growth in 14 Latin American countries. during the period between 1996 and 2003. Concluding that FDI drives both the accumulation of private capital per capita and the increase in income per capita, however, there is a close relationship with the quality of institutions, and mainly the protection of private property and the freedom of individuals.

In short, the results in each case depend on the type of investment, country of destination of the investment, commercial openness and characteristics of the companies (Espin et al., 2016).

3. METHODOLOGY

The methodology used in the present investigation is that of Vector Autoregression (VAR), applied to a sample of data from the countries Ecuador, Colombia and Peru in the period 1996-2016, allowing the comparison and analysis of the impact of the variables proposed in these countries.

3.1. Vectors Autoregressive (VAR)

When you want to analyze the relationship and independence between economic variables, the vectors autoregressive (VAR) are quite appropriate econometric models that allow you to understand this relationship. Therefore, one means of conducting causality testing, or more specifically Granger causality testing, is the VAR.

Granger's causality requires that the lagged values of the "X" variables be related to subsequent values in the "Y" variable, keeping the delay values of the "Y" variable and any other explanatory variable constant. In relation to Granger's causality, the VAR model provides a natural context to demonstrate causality between each set of variables. The VAR model estimates and characterizes the relationships and dynamics of a set of endogenous variables.

For a set "n" of time series

$y_t = (y_{1t}, y_{2t,\ldots} y_{nt,})'$ a VAR model of order p can be written as:

$$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + \varepsilon_t \qquad (1)$$

Where,
p = the number of lags to consider in the system.
n = the number of variables to consider in the system.
y_t is a vector (n × 1) of intercept terms.is a vector (n × 1) that contains each of the "n" variables included in the VAR.
A_0 is a vector (n × 1) of intercept terms.
A_t is a matrix of coefficients (n × n).
ε_t is a vector (n × 1) of the error terms.

Consider a VAR of four variables for the case of Ecuador, Peru and Colombia:

Ecuador

$$FDI_{ec2t} = a_0 + \sum_{i=1}^{P} a_{1i} FDI_{ec2t-j} + \sum_{i=1}^{P} a_{2i} log\left(GDP_{ec}\right)_{t-j}$$
$$+ \sum_{i=1}^{P} a_{3i} EMBIG_{ect-j} + \sum_{i=1}^{P} a_{4i} Opening_{ect-j} + \varepsilon_t \qquad (1.1)$$

Perú

$$\begin{bmatrix} FDI_{ec2t-j} \\ EMBIG_{pert} \\ Opening_{pert} \\ log\left(GDP_{per}\right)_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$
$$\begin{bmatrix} FDI_{per2t-j} \\ EMBIG_{pert-j} \\ Opening_{pert-j} \\ log\left(GDP_{per}\right)_{t-j} \end{bmatrix} + \qquad (2)$$

Colombia

$$FDI_{col2t} = a_0 + \sum_{i=1}^{P} a_{1i} FDI_{col2t-j} + \sum_{i=1}^{P} a_{2i} log\left(GDP_{col}\right)_{t-j}$$
$$+ \sum_{i=1}^{P} a_{3i} EMBIG_{colt-j} + \sum_{i=1}^{P} a_{4i} Opening_{colt-j} + \varepsilon_t \qquad (3)$$

In matrix form, a VAR of four variables can be written as:
Ecuador

$$\begin{bmatrix} FDI_{ec2t-j} \\ EMBIG_{ect} \\ Opening_{ect} \\ log\left(PIB_{ec}\right)_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$
$$\begin{bmatrix} FDI_{ec2t-j} \\ EMBIG_{ect-j} \\ Opening_{ect-j} \\ log\left(GDP_{ec}\right)_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix} \qquad (4)$$

Perú

$$\begin{bmatrix} FDI_{ec2t-j} \\ EMBIG_{pert} \\ Opening_{pert} \\ log\left(GDP_{per}\right)_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$
$$\begin{bmatrix} FDI_{per2t-j} \\ EMBIG_{pert-j} \\ Opening_{pert-j} \\ log\left(GDP_{per}\right)_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix} \qquad (5)$$

Colombia

$$\begin{bmatrix} FDI_{col2t-j} \\ EMBIG_{colt} \\ Opening_{colt} \\ log(GDP_{col})_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \\ a_{30} \\ a_{40} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$
$$\begin{bmatrix} FDI_{col2t-j} \\ EMBIG_{colt-j} \\ Opening_{colt-j} \\ log(GDP_{col})_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix} \quad (6)$$

3.2. Determination of Lag Length for the VAR Model

A relevant component in the explanation of VAR models is the determination of the VAR lag length. Different lag length selection criteria are pointed out by authors who have been part of the literature review. Mention may be made of the Akaike Information Criterion (AIC) by Akaike (1974), Schwarz Criterion (SIC) (1978) and Hannan -Quinn Information Criterion (HQ) (1979). Basically, these criteria determine the goodness of fit of the alternatives (models), so they should be used as a complement to the likelihood ratio (LR) test. When you want to determine how many lags to include, the LR test becomes a main tool.

Likelihood Ratio Test (LR)

$$LR = (T - m)\left(\ln|\Sigma_r| - \ln|\Sigma_u|\right) \sim X^2(q) \quad (7)$$

Where,
T = Number of observations.
m = Number of parameters estimated in each equation of the system, including the constant.
$ln|\Sigma_r|$= Natural logarithm of the determinant of the covariance matrix of the residuals of the restricted system.

$ln|\Sigma_u|$= Natural logarithm of the determinant of the covariance matrix of the residuals of the system without restrictions.

The LR test statistic is compared to making a Chi-Square distribution with q degrees of freedom, where q is the total number of constraints in the system (equal to the number of lags multiplied by n^2) where n is the number of variables (or equations of the system). It is concluded to reject the null hypothesis of the restricted system when: The LR statistic <Critical value.

However, when the samples are small, the likelihood ratio test may not be very useful. In such a case the multivariate generalizations of the AIC and SC statisticians are the alternative test criteria.

3.3. Information Criteria

$$AIC = T \ln|\Sigma| + 2N$$

$$SC = T \ln|\Sigma| + N \ln T$$

$$HQIC = T \ln|\Sigma| + 2N \ln(\ln T) \quad (8)$$

Where,
$|\Sigma|$ = determinant of the variance/covariance matrix of the residuals.
N = total number of parameters estimated in all equations.
T = number of observations.

4. RESULTS

According to Sims and Zha (1999), the VAR model was estimated in levels, despite the possible existence of unit roots in some of the variables. The results of the selection of lags are shown in Table 3. There is divergence in the number of optimal lags depending on the information criteria used. In the case of Ecuador, the Akaike information criterion (AIC) and the likelihood ratio test (LR) suggest that the optimal number of lags is 3. In the case of Colombia, three of the four decision criteria suggest that two lags are enough to capture short-term dynamics. In the case of Peru,

Table 3: Selection criteria for optimal lags in the VAR model

	LAGS	LR	AIC	SC	HQ
Ecuador	1	3.943.268	−3.771.803	−2.962222*	−3.452.868
	2	5.040.403	−4.205.211	−2.855.909	−3.673653*
	3	32.52700*	−4.355751*	−2.466.728	−3.611.569
	4	2.285.390	−4.352.575	−1.923.831	−339.577
	5	2.047.216	−4.340.007	−1.371.543	−3.170.579
	6	1.658.156	−4.276.364	−0.768179	−2.894.313
Colombia	1	2.045.514	−9.117.394	−8.199.622	−8.767.901
	2	51.58545*	−976.703	−8.237411*	−9.184542*
	3	2.049.397	−9.696.307	−7.554.841	−8.880.824
	4	233.421	−9.785747*	−7.032.434	−873.727
	5	144.996	−966.359	−629.843	−8.382.118
	6	1.692.697	−9.728.881	−5.751.873	−8.214.414
Peru	1	2.274.574	−2.266.575	−1.530.554	−1.972.425
	2	1.023.385	−3.396.105	−2.169.403	−2.905.856
	3	5.459.142	−3.855.559	−2.138.177	−316.921
	4	925.836	−5.030.776	−2.822713*	−4.148327*
	5	2.921.051	−5.150.659	−2.451.915	−407.211
	6	33.36189*	−5.396844*	−2.207.419	−4.122.195

*Number of optimal lags selected under the information criteria

the information criteria of Schwartz (SC) and Hannan Quinn (HQ) indicate 4 lags as the optimal value, while the LR and AIC tests suggest 6 lags. Consequently, the VAR was estimated with 3 lags for the case of Ecuador, 2 lags for the case of Colombia, and 4 lags for Peru. With this number of lags, the model residuals do not show the presence of autocorrelation. The Breusch-Godfrey Lagrange multiplier test was used to test this hypothesis in the three models.

The Granger causality tests for FDI and GDP are presented in Table 4. In the case of Ecuador, it is evident that trade openness and country risk Granger-cause FDI, at 10% significance. GDP does not have a significant predictive power over the size of FDI. All the variables together, Granger-cause FDI at 10% significance.

The Granger causality test for the Colombian model suggests that only trade openness has predictive power over FDI, at 5%

Table 4: Granger causality test for foreign direct investment

	Causalities	Chi-square	P-value
Ecuador	GDP -> FDI	2.503.128	0.4747
	Opening -> FDI	6.685.686	0.0826*
	EMBI -> FDI	7.056.063	0.0701*
	FDI -> GDP	6.446.574	0.0918*
	Opening -> GDP	1.063.883	0.0138**
	EMBI -> GDP	5.372.904	0.1464
Colombia	GDP -> FDI	138.842	0.4995
	Opening -> FDI	6.037.762	0.0489**
	EMBI -> FDI	0.108201	0.9473
	FDI -> GDP	0.359551	0.8355
	Opening -> GDP	1.152.331	0.562
	EMBI -> GDP	9.775.319	0.0075***
Perú	GDP -> FDI	4.211.034	0.3782
	Opening -> FDI	1.256.837	0.0136**
	EMBI -> FDI	429.783	0.3672
	FDI -> GDP	3.440.842	0***
	Opening -> GDP	1.015.304	0.0379**
	EMBI -> GDP	2.171.156	0.0002***

*Significant at 10%, ** Significant at 5%, *** Significant at 1%

significance. The other variables are not useful in predicting the size of FDI.

Like Colombia, in the case of Peru, only trade openness has a causal Granger effect on FDI, at 5% significance. Taken together, however, all the Granger-variables cause FDI to 5% significance.

Additionally, it is necessary to note that the results show that for Ecuador, FDI Granger causes GDP to 10% significance. In other words, future economic growth is impacted by FDI, at least in the short term. The level of trade openness also causes Granger-GDP to 5% significance.

In the case of Colombia, FDI does not have a Granger-causality effect on GDP. Only the country risk Granger-causes the GDP at 1% significance.

In the case of Peru, trade openness, country risk and FDI Granger-cause GDP to 5%, 1%, and 1% significance, respectively. In other words, only in Ecuador and Peru is FDI an important variable to predict in the future economic performance of the economy.

According to what Pesaran and Shin (1998) proposed, impulse response functions were constructed to obtain a broader view of Granger's causality relationships. Cholesky decomposition of the covariance matrix was used to calculate the structural shocks. A disadvantage of this method is that it is necessary to impose an order of exogeneity on the variables. However, when the correlation of the residuals is relatively low, the order does not have a significant impact on the impulse-response functions. The order chosen for the three models was country risk, FDI, GDP and trade openness.

Figures 1-3 show the response of GDP to a shock of one standard deviation in country risk, trade openness and FDI. In the case of Ecuador, trade openness and country risk have a significant effect

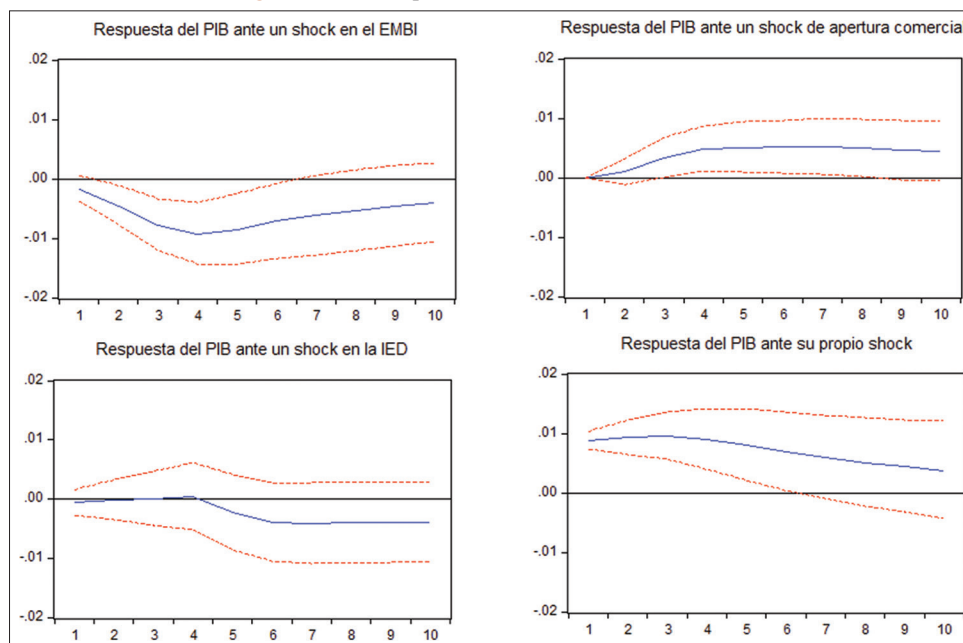**Figure 1:** GDP response to structural shocks, Ecuador

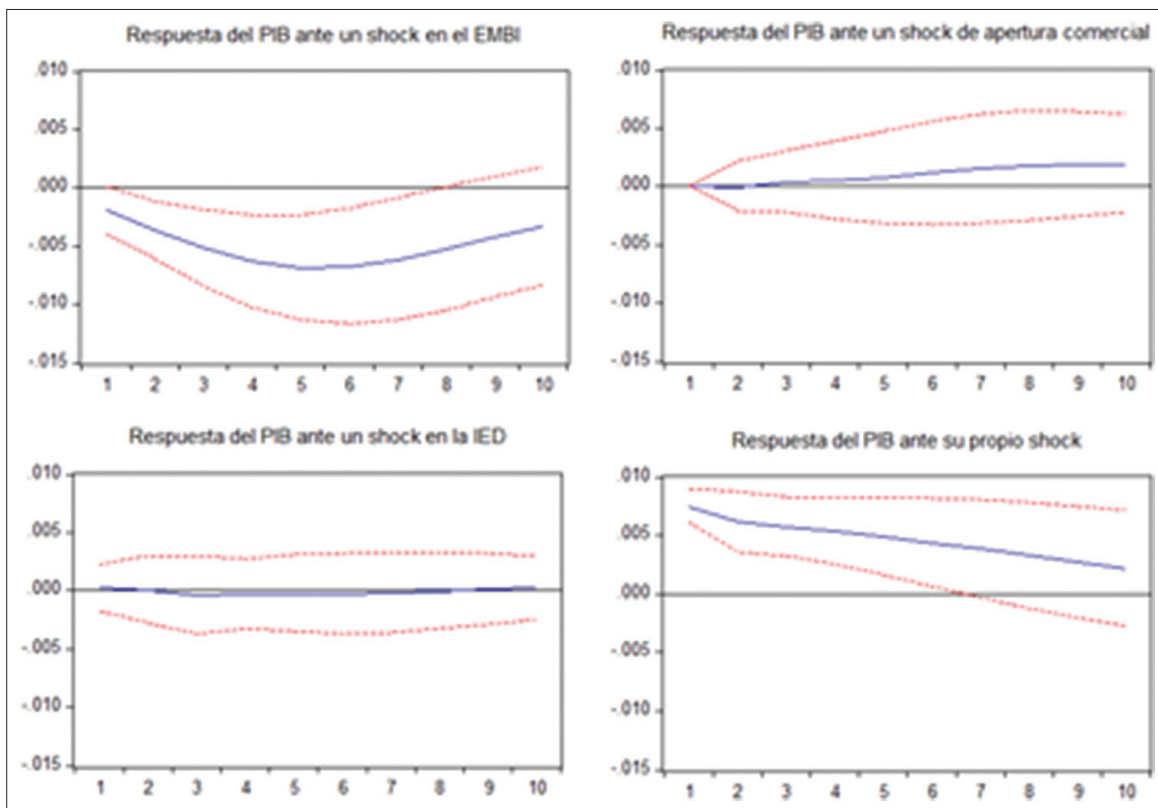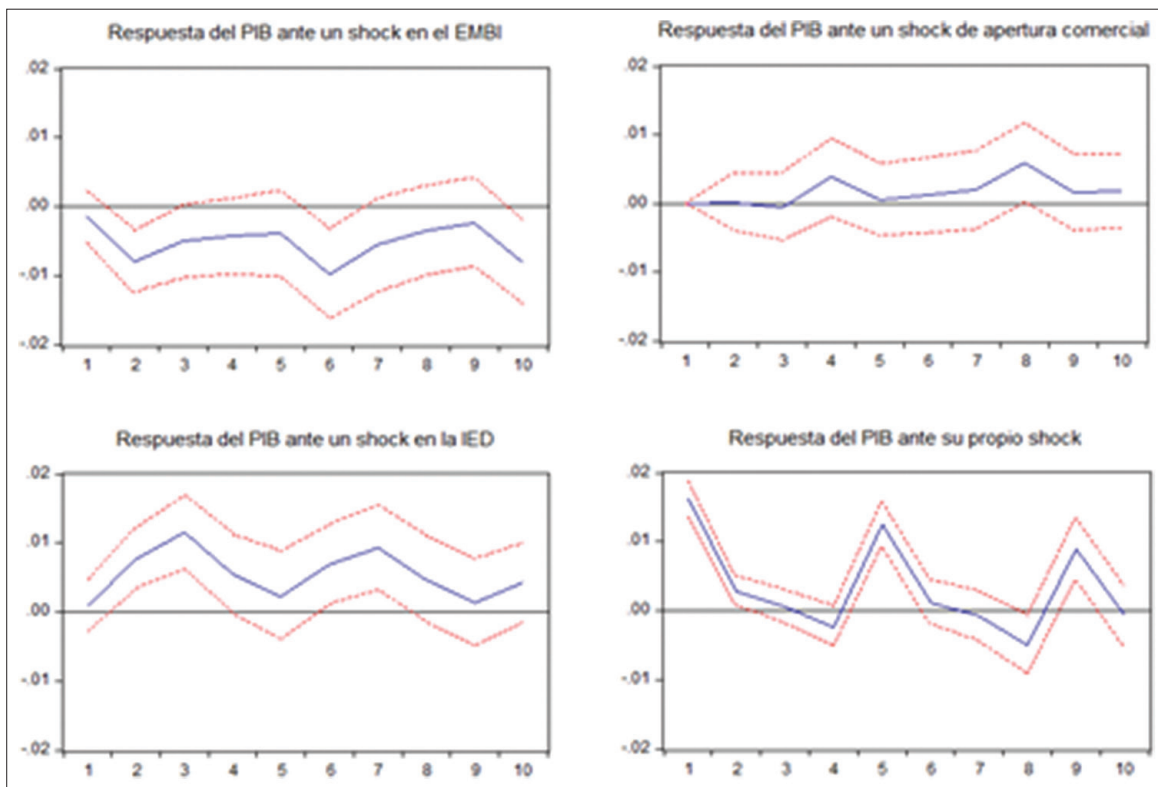**Figure 2:** GDP response to structural shocks, Colombia

Figure 3: GDP response to structural shocks, Perú

on GDP. In both cases the direction of the response is consistent with the economic theory. A positive shock to trade openness raises GDP from the third to the eighth quarter. A positive country risk shock decreases GDP from the second to the eighth quarter after the shock. GDP does not respond significantly to an FDI shock.

For the Colombian model, only country risk has a significant effect on GDP. The GDP response is negative and disappears after the seventh quarter. The response of GDP to a shock in FDI is null for all quarters.

In the case of Peru, the structural shock to FDI does have a significant effect on GDP. The GDP response is positive during the second, third, sixth and seventh quarter. In the rest of the period the effect is not statistically different from zero. The country risk structural shock also has a significant and negative effect on GDP, in quarters 2, 6 and 10.

A shock in variable X is not very persistent if the response of variable X to its own shock ceases to be significant in a short time. See Giordano et al. (2007).

One factor that explains the low impact of an FDI shock on GDP, in the cases of Ecuador and Colombia, is that the estimated FDI shock is little persistent over time. In Figures 4 and 5 it can be seen that the impact of FDI on itself lasts only a quarter. Then it disappears. However, the low persistence is also observed in the case of Peru. Figure 6.

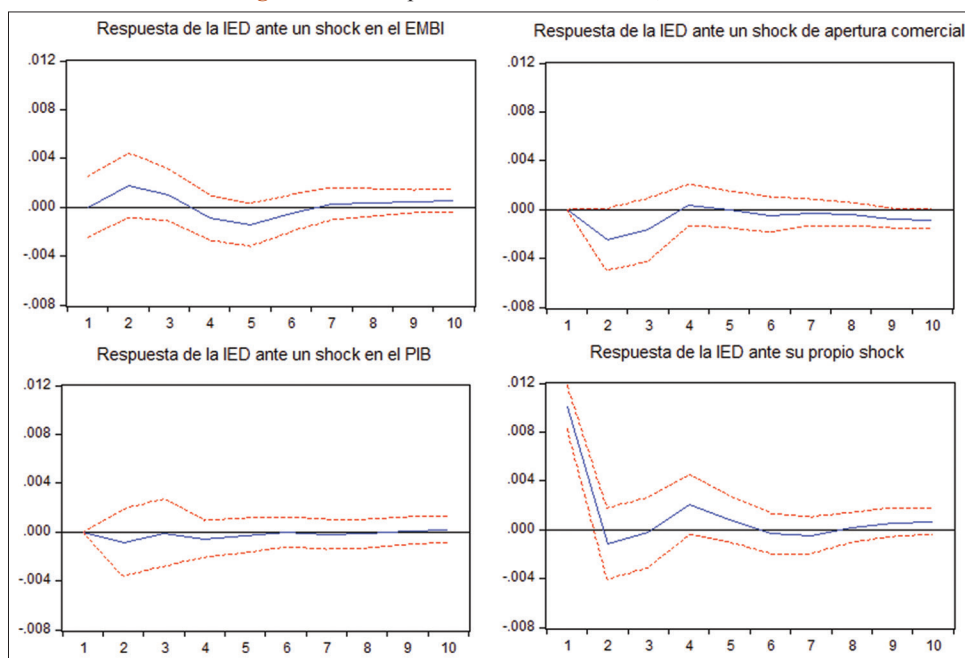**Figure 4:** FDI response to structural shocks, Ecuador

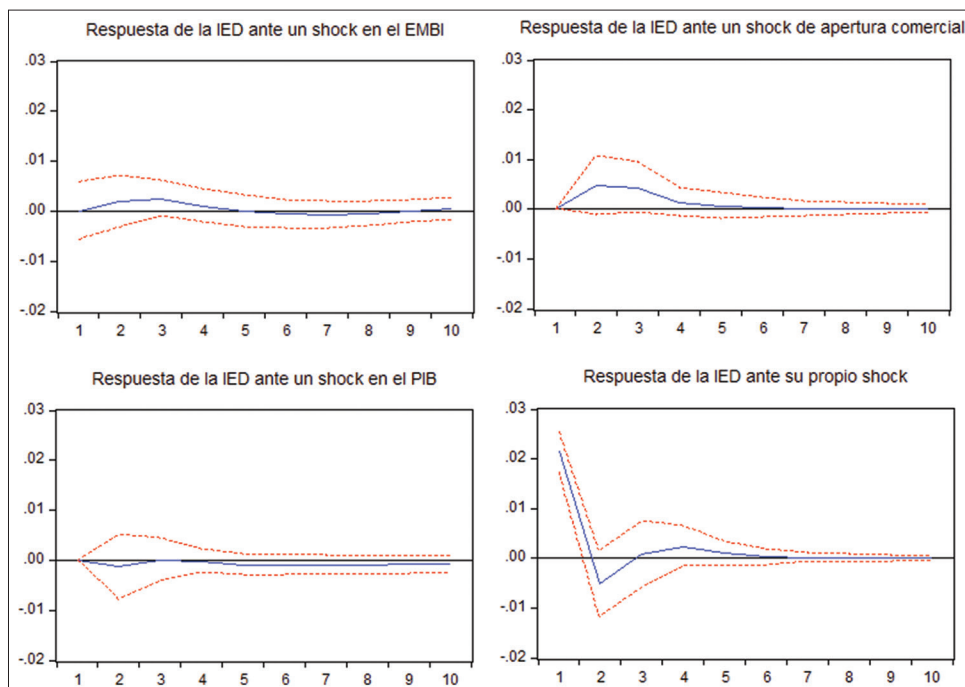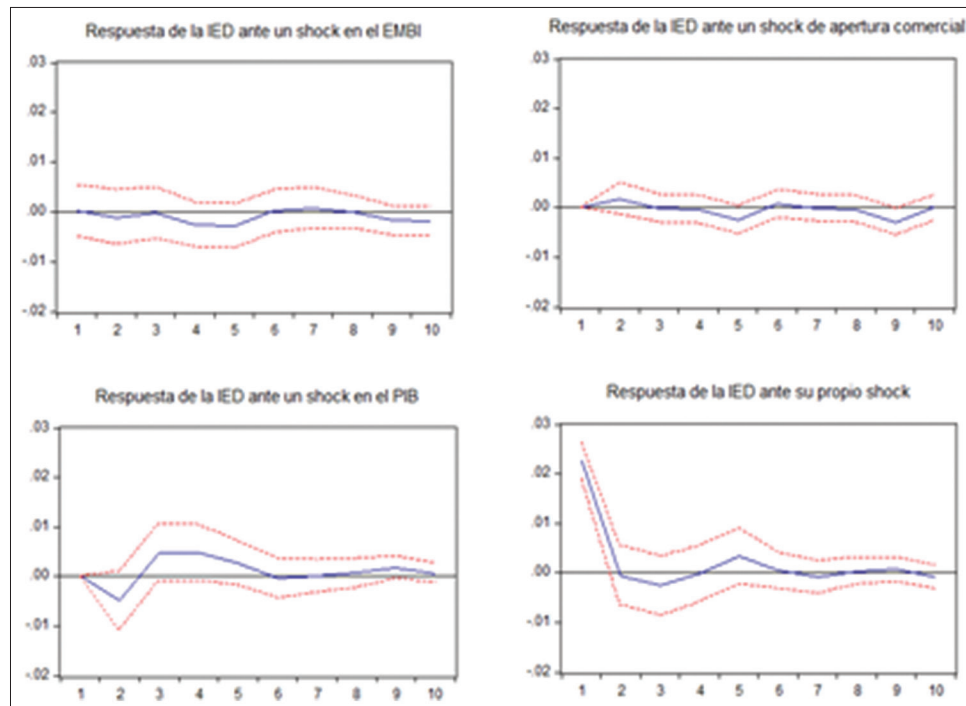**Figure 5:** FDI response to structural shocks, Colombia

Figure 6: FDI response to structural shocks, Perú

5. CONCLUSIONS

This study investigates, through a VAR model, the intertemporal relationships between FDI and economic growth. Three Latin American countries that geographically limit were chosen to analyze the interaction between the variables: Ecuador, Colombia and Peru. The results indicate that GDP does not Granger-cause FDI in any of the countries analyzed. However, in Ecuador and Peru FDI has a significant Granger-causality effect on GDP. A possible explanation for this last result may be that FDI has a non-linear effect on production. Both Ecuador and Peru have a low level of FDI over GDP in relation to Colombia. After exceeding a certain size of FDI, the effect on GDP may be nil.

Additionally, the results of the impulse-response functions do not show significant evidence of any structural effect of GDP on FDI. If a significant increase in GDP is evident in the face of a structural shock in FDI, but only in the case of Peru. Other variables such as country risk do show significant predictive power over GDP, for all the countries analyzed.

This investigation is limited by the number of observations due to the non-comparability of the macroeconomic series for years prior to 2000. This same limitation makes it difficult to include more control variables that, if omitted, could be contaminating the results. This study should be seen as a first approach to public policy decision-making.

It is advisable to analyze the institutional requirements imposed by the recipient country, the country risk, the legal regulations that each country imposes on everything related to property rights that guarantees foreign companies in acts of expropriation arbitration, since these aspects could infer in better capture of FDI flows and in turn related to the economic growth of nations.

6. SPONSORING ORGANIZATIONS

Universidad Católica Santiago de Guayaquil.

7. ACKNOWLEDGMENTS

To Econ. Mauro Toscanini S., PhD., Rector Universidad Católica Santiago de Guayaquil, Ecuador.

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