Foreign Direct Investment and External Vulnerability: An Analysis of the Brazilian Economy With VEC Methodology

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Research on foreign direct investment became one of the main areas of study in the Brazilian economy after the economic stabilization of 1994, a period in which the country began to register an unprecedented flow of investments in its history. In summary, the main research seeks to analyze the importance of FDI for the country's long-term development or to measure its attractiveness factors, and there is still a small literature that focuses on analyzing how external vulnerability affects the flow of foreign capital. In this sense, this research sought to measure how the main external vulnerability indicators affected the FDI flow in the Brazilian economy during the years 1995-2020 using the methodology of Error Correction Vectors (VEC). The explanatory variables selected were the Gross Domestic Product (GDP), Current Transactions, and International Reserves, the explained variable corresponds to the inflow of Foreign Direct Investments. The data suggest that the external vulnerability indicators and their lags are the main factors of attraction of foreign capital.

Keywords: international economics, foreign direct investment, error correction vector, external vulnerability

Introduction

The literature on foreign direct investment (FDI) gained great prominence during the 1990s with the commercial and financial opening, guided by the neoliberal policies of the "Washington Consensus". In summary, the diagnosis of the Latin American crisis, according to the "consensus", was that there was an excess of inefficient state-owned enterprises originating from the import substitution model, which, together with fiscal indiscipline, were incapable of promoting economic growth. From this diagnosis emerged the recommendation of "ten major measures" that Latin American countries should adopt to overcome the crisis of the 1980s according to Williamson's article (1990).

With a context of liberalization and stability from 1994 on, the Brazilian economy began to receive a large FDI flow, unprecedented in its history. According to data from the World Bank, in 1993 the net inflow of investments accounted for US\$ 1,292 billion and in 1996 for US\$ 12,552 billion, resulting in a variation of 871.52% in three years, showing how the internal dynamics was an important factor in attracting new investments.

The boom in foreign investments continued until 2000, registering US\$ 32,995 billion, a level that Brazil only exceeded again in 2007 with US\$ 44,579 billion.

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Not even the global financial crisis of September 2008 reduced the inflow of investments, a period in which the Brazilian economy reached its record in the last 61 years until then, registering US$ 50,716 billion. The effects of the crisis hurt in 2009, when the country registered US$ 31,481 billion, a reduction of 62.07%.

The impact of the global crisis on the inflow of investments was temporary, surprising most analysts when they saw Brazil in 2011 become the fifth country in the world that received the most foreign direct investment according to the World Investment Report (WIR, 2012), besides consolidating its position as the Latin American country that receives the most FDI. From 2011 the behavior of investments has varied steadily, internal factors have proved relevant to explain, given that the performance of the Brazilian economy tends to fluctuate with the inflow of investments.

In addition to internal factors, the global dynamics must be taken into account in any analysis of the determinants of FDI. According to Castro (1979) foreign investment has a double determination: (i) capital exports from developed countries, and (ii) attractiveness of the Brazilian economy in its diversification and growth. For Possas (1983) the bilateral relationship between the two countries is also an important factor, in which this approach differs from the others by introducing the participation of institutions as a conditioning factor of foreign capital inflow.

To meet the research objectives, the paper is divided into four parts: (i) Introduction, (ii) Literature review, (iii) Methodology, and (iv) Conclusion. The structure of the paper was organized to meet the research objectives, so that the empirical analysis is transparent by enabling other researchers to verify the authenticity of the analyses.

The literature review added to the research by identifying the main determinants of foreign direct investment in the Brazilian economy, in addition to deepening the study based on unconventional trade and investment theories, especially the Product Cycle and the Eclectic Paradigm of International Production.

The methodology of the work was developed through the Error Correction Vector model (VEC), which is commonly used in empirical studies on FDI. The main steps of the VEC were demonstrated from the theoretical model, database, model used, unit root test, and cointegration test. At the end it is commented on the main results obtained and the limitations of the study.

The last chapter is dedicated to the conclusion of the theoretical and empirical results, so that despite the vast literature on FDI the researches do not tend to be homogeneous, there are spaces for the most varied interpretations.

Literature Review

Between 1980 and 1994 the Brazilian economy was marked by the phenomenon of stagflation, resorting to numerous stabilization plans and monetary reforms that failed to achieve their main objective, monetary stability. Besides the economic difficulties, there was also enormous political instability, marked by the end of the military regime in 1985, the elaboration of a new Constitution in 1988, and the opening of the impeachment process of the first directly elected president, Fernando Collor de Mello in 1992. In summary, the economic and political instability that marked the period between 1980 and 1994 made the Brazilian economy unattractive to foreign direct investment (Curado & Cruz, 2012, p. 282).

The political and economic instabilities during the 1980s kept the countries of the Latin periphery away from the large FDI flows of the period, of which, according to World Bank data, high-income countries and later middle-income countries were the main destinations of new investments. According to Curado and Cruz (2012),

in 1978 and 1979, net FDI flows to the Brazilian economy were US$ 2.18 billion and US$ 2.40 billion, respectively.

Although the debate on foreign investment already existed during the lost decade, specialists focused on external imbalances. Contractionist policies and maximal exchange rate devaluation were adopted to minimize current account deficits, which according to Carneiro and Modiano (1990) resulted in a retraction in economic growth and a change in the inflation level.

With the advance of globalization and neoliberal focus policies, studies on foreign direct investment became one of the main areas of research in the Brazilian economy in the 1990s, in which the change in internal dynamism in 1994 was one of the key factors for the large flow of new investments. According to Laplane and Sarti (1997) the stabilization generated two important factors: elimination of nominal and effective tariffs through the opening of trade and elimination of nontariff barriers through exchange rate appreciation. The two factors together contributed with less protection to the domestic market, thus attracting foreign capital.

The authors Medeiros, Hoffmaister, and Agénor (1997), Cardoso and Goldfanj (1998), and S áand Almeida (2006) emphasize the importance of stabilization and privatization for the entry of foreign resources; the great dilemma consists in analyzing whether these are still key factors for the Brazilian economy and whether they differ according to the sector.

Theories of international trade have also become important for understanding the strategies of multinationals, the "eclectic paradigm of international production" and the "product cycle theory" are frequently found in the literature. By emphasizing market failures, uncertainty, resource constraints, and technologies, the theories have identified the movements of multinational firms.

Product cycle theory was first introduced by economist Raymond Vernon with the publication of "International investment and international trade in the product cycle" in 1966, by suggesting that a given product type has three phases: (i) introduction, (ii) maturation, and (iii) standardization. The first stage is marked by uncertainty, since it is not yet known how and which consumers will accept the product, and its production is directed to the domestic market where the transnational company operates and for export. The second stage refers to maturation, where the number of producers expands in search of product homogenization, in which production starts to take place in foreign countries. Finally, after the introduction and maturation of the product, the scaling of production is optimized and the company transfers its production to the country where costs are minimized.

According to Alencar (2011) the model shows how subsidiaries evolve towards activities with greater added value via technology transfer from headquarters. According to Gomes (2003) the product cycle model is of great use in understanding the initial stages of the subsidiary's evolution, by establishing the dependence of the subsidiary with the corporate level, given that when innovation advantages become scarce, the company transfers part of production to subsidiaries in countries where there are low costs.

Another important theory present in the literature refers to "The Eclectic Paradigm" or simply "OLI (Ownership, Location, Internalization) Model", elaborated by Dunning (1980). The model consists in analyzing the factors of attractiveness in the realization of Foreign Direct Investments (FDI), following three levels: (i) ownership, (ii) location, and (iii) internationalization. The first level refers to the firm's specific ownership advantage in relation to the local companies where it is setting up, so that there will be advantages if these exceed the production costs of the foreign company. According to Dunning (1988), it is important to emphasize the difference in the possible market structures, considering that sectors with ascending failures, the foreign company may have incentives to establish itself locally.

Another important level of the eclectic paradigm and commonly used in international trade theory refers to location, with factors such as product flow, size of the domestic market, infrastructure development, degree of competition, and subsidy policies being essential. In addition, according to Dunning himself (1988) the flow of foreign direct investment (FDI) arising from transnational companies (TNCs) can be strongly influenced by economic alliances, reductions in transport and entry costs. Alencar (2011) complements the location factor by arguing that NTTs will prefer to produce intermediate products in other countries due to the variables mentioned above, thus the eclectic paradigm theory provides ex-plications on how, why, and where NTTs will allocate their resources.

The last level refers to productive internationalization, involving three other factors according to Dunning (1988): (i) uncertainty when setting up in a new country, given that its production is fractioned among the subsidiaries, (ii) scale gains, and (iii) externality in the market where the firm is setting up.

In relation to empirical studies that analyze the factors that stimulate or inhibit the entry of new investments, the methodological approach is still not very homogeneous. In summary, we can group the attractiveness factors between internal and external, where for Cardoso and Goldfanj (1998) the internal factors include solid monetary and fiscal reforms that are market-oriented via privatization, in addition to the key role of economic stabilization, reducing the risks for the entry of foreign capital.

Regarding the external side, the literature indicates that shocks to world interest rates have been one of the main factors inhibiting the inflow of investments into developing economies, as is the case of Brazil.

Gravitational models have proven to be an important tool for predicting bilateral FDI flows between countries, based on the distance and size between them. The study by Catela Giovanini, Almeida, and Saath (2016) estimates a model with 21 FDI-emitting and 31 FDI-receiving countries, where a binary variable was inserted to measure whether the 2008 crisis generated greater uncertainty about FDI flow among investors.

The studies by Ignácio (2021), Bittencourt, Domingo, and Reig (2006), Araújo (2021), analyze the FDI flow received by Latin America. Most studies highlight the importance of bilateral treaties for capturing FDI, although the study by Araújo (2021) does not identify that bilateral investment treaties (BITs) have a statistically significant effect on FDI. The study carried out by Bittencourt et al. (2006) allows us to identify the "winning" and "losing" countries with the regional integration agreements (RIA) between MERCOSUR-EU.

The use of Vector Autoregressive (VAR) model and one of its variations, the Vector Error Correction (VEC) model, has been used frequently in the literature to measure the strategies of multinational companies. Silveira Augusto, Samsonescu, and Triches (2017) draw on the eclectic paradigm theory in determining that the strategies of multinationals are linked to the size of the market where firms are setting up and efficiency from a VEC model.

Using VAR methodology, Sampaio (2018) in his study concludes that the greatest FDI variance is due to its own lag, highlighting the importance of incorporating structural and institutional factors when modeling. Such empirical identification becomes important as it meets the theories and understanding of Castro (1979) and Possas (1983) on FDI dynamics, privileging the historical process and the role of institutions.

The texts selected in the present literature review, allow us to identify the importance of internal dynamics as a conditioning factor of foreign direct investment. Although most studies emphasize both internal and external factors, few authors suggest the need to analyze the impact of external vulnerability on FDI, where the literature on this relationship is basically non-existent.

Methodology

Error Correction Vector (VEC)

The measurement of the determinants of foreign direct investment has gained great prominence through the combination of autoregressive vectors (VAR) and error correction vectors (VEC). According to Sampaio (2018) and Canova and Cicarelli (2013) rank the following advantages of the Var method: (i) capture dynamic and static interdependence relationships; (ii) treat these relationships between variables without imposing restrictions; (iii) incorporate variations for the time coefficients and for the variance of shocks; and (iv) reflect dynamic heterogeneities in panel data.

According to Johnston and DiNardo (2001), all the equations of a VAR are present in a VEC, so that both become similar except that the latter corrects for cointegration relationships. So that if y_t e z_t are l(1) and not cointegrated, in this case we must estimate the first difference dynamic model:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{\rho-1} \alpha_1(i)\Delta y_{t-i} + \sum_{i=1}^{\rho-1} \alpha_2(i)\Delta z_{t-i} + \epsilon_{it} \tag{1}$$

As is apparent in time series, y_t e z_t often cointegrate, so that Equation (1) needs to be modified. In this case, we simply insert l(0) into the model, so that we continue to estimate a dynamic model, but include the error term.

$$\Delta y_t = \alpha_0 + \alpha_y \hat{e}_{t-i} + \sum_{i=1}^{\rho-1} \alpha_1(i)\Delta y_{t-i} + \sum_{i=1}^{\rho-1} \alpha_2(i)\Delta z_{t-i} + \epsilon_{it} \tag{2}$$

Through the VEC model it is also possible to predict the "Trace Test", whose objective according to Moro (2020) is to verify the null hypothesis that the number of cointegration vectors is less than or equal to *r*:

$$\lambda_{traço}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \tag{3}$$

It is important to stress that it is not the goal of this paper to perform in-depth theoretical demonstrations of the model, but when using a VEC the researcher needs to observe two crucial factors: (i) check if the residuals are white noise, (ii) if the variables are cointegrated, if so αy will be statistically different from zero.

Estimated Model and Database

The contribution of the literature review and the theories of foreign direct investment were extremely important to understand the pattern of investments made in Brazil since economic stabilization. The estimated model considered GDP, international reserves, and the current account deficit as a percentage of GDP to explain the FDI flow, and can be represented as follows:

$$\log(FDI) = \log(GDP) + \log(TC) + \log(RESERV) + u_t \tag{4}$$

The double-log functional form, says that the inflow of foreign direct investment (FDI) is a function of current GDP (GDP), Current Transactions (TS), and International Reserves (RESERV). The FDI and RESERV variables were calculated from the Time Series Management System database linked to the Central Bank of Brazil. FDI is an annual series with data on foreign direct investment inflows into the country measured in millions of dollars, while RESERV indicates the stock of international reserves in the Brazilian economy measured in millions of dollars, also calculated on an annual basis.

The GDP variable was extracted from the World Bank Open Data, being the sum of the gross value added by all resident producers in the economy plus the difference between taxes and subsidies without including the value of depreciation. The data were collected on an annual basis, calculated in US dollars.

The TS variable was collected from the IpeaData, linked to the Institute for Applied Economic Research (IPEA). The current transactions account shows the flows of goods, services, primary income, and secondary income between residents and non-residents of a country, and is measured as a percentage of GDP.

The theoretical explanation for the use of the GDP variable is due to the fact that the country's growth opens spaces for the internal market, thus attracting new investments. The literature seems to indicate a convergence on the use of this variable, but it is necessary to adopt caution in its interpretation, given that the simultaneity between FDI and GDP usually appears frequently in empirical studies.

The use of the TS and RESERV variables indicates the country's external vulnerability, and their presence is not common in most empirical works, but it is possible to find several works such as Moro (2020) that recognize the need to insert such variables, with the RESERV and TS. For a large open economy, the use of these variables makes no sense, but for developing countries their importance becomes crucial, since external problems are often present in the Latin periphery.

Several variables can contribute to explain foreign direct investment, but for reasons of time limitation only the three explanatory variables mentioned above were prioritized, so that the introduction of more variables is encouraged for future work.

Unit Root Test

Time series studies often present stationarity, so that their properties such as mean, variance, and autocorrelation do not change over time, in addition to the covariance of the lagged values depending only on the lag between them. The studies of Granger and Newbold (1974) were pioneers in the area, where they observed that series with trend despite presenting statistically significant results had no economic logic, so the estimators are biased. In this sense, according to Gujarati and Porter (2011) the unit root test allows detecting situations of non-stationarity of a time series.

There are numerous ways to identify whether a series contains a unit root, among which the Dickey Fuller, Augmented Dickey Fuller (ADF), Phillips Perron, KPSS, DFGLS, Structural Break: Zivot and Andrew, Dickey and Pantula tests stand out. In addition to the tests, a priori, the researcher must observe the autocorrelation, in view of the fact that non-stationary series have high autocorrelation.

To identify the presence of unit root, the research opted for the Augmented Dickey Fuller (ADF) test, whose objective is to test for the presence of unit root in Y_t in three steps: (i) model with constant and deterministic trend, (ii) model with constant, (iii) model without deterministic terms.

$$Y_t = \alpha + \beta_t + \rho Y_{t-1} + \epsilon_t \quad \rightarrow \quad \Delta Y_t = \alpha + \beta_t + \gamma Y_{t-1} + \epsilon_t \qquad (5)$$

$$Y_t = \alpha + \rho Y_{t-1} + \epsilon_t \quad \rightarrow \quad \Delta Y_t = \alpha + \gamma Y_{t-1} + \epsilon_t \qquad (5.1)$$

$$Y_t = \rho Y_{t-1} + \epsilon_t \quad \rightarrow \quad \Delta Y_t = \gamma Y_{t-1} + \epsilon_t \qquad (5.2)$$

where α, β_t are deterministic components and ϵ_t is white noise. If one of the steps is not satisfied, we cannot claim there is the presence of a unit root, so the hypothesis test is set up in such a way:

$$H_0: \rho = 0 \leftrightarrow \gamma = 0$$

$$H_1: \rho = 1 \leftrightarrow \gamma = 1$$

The null hypothesis, if $\rho = 0$ says that there is presence of unit root and the alternative hypothesis, $\rho = 1$ says that there is no unit root, this being a one-tailed left-handed test.

Table 1 demonstrates the result of the Augmented Dickey Fuller test for the time series considered in the model, so the number of lags was determined using the Bayesian selection criterion (BIC), which is more conservative than the Akaike (AIC).

Table 1

Augmented Dickey-Fuller Unit Root Test (ADF)

Series	Expressions	Lags	t-calculated	tc (1%)	tc (5%)	p-value
FDI	Constant and Trend	2	-2.53	-4.15	-3.50	0.0216
GDP	Constant and Trend	2	-0.550	-4.15	-3.50	0.589
TS	Constant and Trend	2	-2.534	-4.15	-3.50	0.0214
RESERV	Constant and Trend	2	-1.366	-4.15	-3.50	0.1898
FDI	Constant	2	-0.980	-3.58	-2.93	0.340
GDP	Constant	2	-1.506	-3.58	-2.93	0.150
TS	Constant	2	-2.491	-3.58	-2.93	0.0227
RESERV	Constant	2	-1.140	-3.58	-2.93	0.2694
FDI	Open-ended Deterministic	2	0.268	-2.62	-1.95	0.792
GDP	Open-ended Deterministic	2	-0.194	-2.62	-1.95	0.848
TS	Open-ended Deterministic	2	-1.983	-2.62	-1.95	0.062
RESERV	Open-ended Deterministic	2	0.394	-2.62	-1.95	0.6979

Source: Prepared by the author using the RStudio statistical software and the IpeaData, Brazilian Central Bank, and World Bank databases.

The ADF test demonstrated the presence of a unit root for all the analyzed series at the 5% confidence level, confirming that they are non-stationary variables. In this case, we should proceed to the next step and perform the cointegration test.

Cointegration Test

Among the cointegration tests, the Engle-Granger, Johansen, and Phillips-Ouliaris tests stand out. The test selected for the research was the Engle-Granger test, constructed from the following steps:

1. Test for non-stationarity of the series
- Perform the unit root test
- If both are stationary use traditional methods
- Variables are not integrated if they are of different orders

2. Estimate the long-run relationship if $yt = \beta_0 + \beta_1 Z_t + \epsilon_t$
- If the variances are stationary, y_t and Z_t are cointegrated of order (1,1)

Table 2

Engle-Granger Cointegration Test

t-calculated	t-reviewer (1%)	t-reviewer (5%)
-3.9835	-4.592	-3.915

Source: Prepared by the author using the statistical software RStudio.

The Engle-Granger test suggests that we cannot reject the null hypothesis at the 1% confidence level, so the series cointegrate, and there is a long-term relationship between them.

Main Results

Throughout the methodology, three different models were tested. The first model in linear form presented clear signs of spurious regression as expected in time series.

Table 3 shows the main results obtained through the estimation performed.

Table 3

Linear Model Analysis

Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)
Intercept	$1.210e^{+04}$	$7.853e^{+03}$	1.540	0.138
GDP	$-9.632e^{-09}$	$1.090e^{-08}$	-0.884	0.386
RESERV	$3.580e^{-01}$	$5.145e^{-02}$	6.958	$5.51e^{-07}$***
TS	$-1.860e^{+03}$	$1.639e^{+03}$	-1.135	0.269

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14620 on 22 degrees of freedom

Multiple R-squared: 0.9235; adjusted R-squared: 0.913

F-statistic: 88.51 on 3 and 22 DF, p-value: $1.963e^{-12}$

Source: Prepared by the author using the statistical software RStudio.

The model suggests that only the international reserves variable (RESERV) is statistically significant, while the explanation coefficient presents a value of 0.9235, this being a clear sign of spurious regression according to Granger and Newbold (1974).

As shown in Table 4, the Engle-Granger cointegration test was applied, so that we cannot reject the null hypothesis at the 1% confidence level, so the series cointegrate, and there is a long-term relationship between them. From the test result a vector of residuals was created to analyze the error correction model.

Table 4

Vector of Corrected Errors (VEC)

Coeficientes	Estimate	Std. error	t-value	Pr(>|t|)
Intercept	$2.722e^{+03}$	$2.349e^{+03}$	1.159	0.2602
L(Erro)	$-4.940e^{-01}$	$1.648e^{-01}$	-2.998	0.0071**
d(GDP)	$2.995e^{-08}$	$1.118e^{-08}$	2.678	0.0145*
d(RESERV)	$1.074e^{-01}$	$1.004e^{-01}$	1.069	0.29770
d(TS)	$-3.459e^{+03}$	$1.807e^{+03}$	-1.914	0.07006

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 10440 on 20 degrees of freedom

Multiple R-squared: 0.7077, Adjusted R-squared: 0.6493

F-statistic: 12.11 on 4 and 20 DF, p-value: $3.673e^{-05}$

Source: Prepared by the author using the statistical software RStudio.

The VEC estimates suggest that the speed of adjustment is -0.4940, being highly significant, with a probability of committing the type I error of less than 0.01. It is important to emphasize that the negative sign agrees with the literature, since it is this that makes the adjustment.

The variable with the greatest explanatory power is the current transaction, so that a positive variation of one US dollar in Brazilian reserves results in a reduction of -3.459 percentage points in FDI, keeping GDP and RESERV constant. Thus, discrepancies between GDP and current transactions (trade balance, balance of services, plus unilateral transfers) tend to reduce the attractiveness of investments. The statistics proved significant at the 10% confidence level, and a priori we can affirm that there is a linear relationship between FDI inflows and current transactions.

GDP has also been shown to be statistically significant at the 5% confidence level, so that a one dollar increase in Brazilian GDP results in a 0.00000002995 percentage point increase in FDI, holding everything else constant. The RESERV variable which helps measure the role of external vulnerability, says that a change in international reserves, results in an increase in FDI by 0.074 percentage points, holding everything else constant.

Although the sign of the result is in agreement with the literature, it was not statistically significant, and it cannot be said that there is a relationship between reserves and FDI.

Despite the substantial improvement of the model, we must still test for autocorrelation and partial autocorrelation. Through the figures below it is possible to identify that the lag period II is outside the interval (statistically different from zero), with the need to correct it.
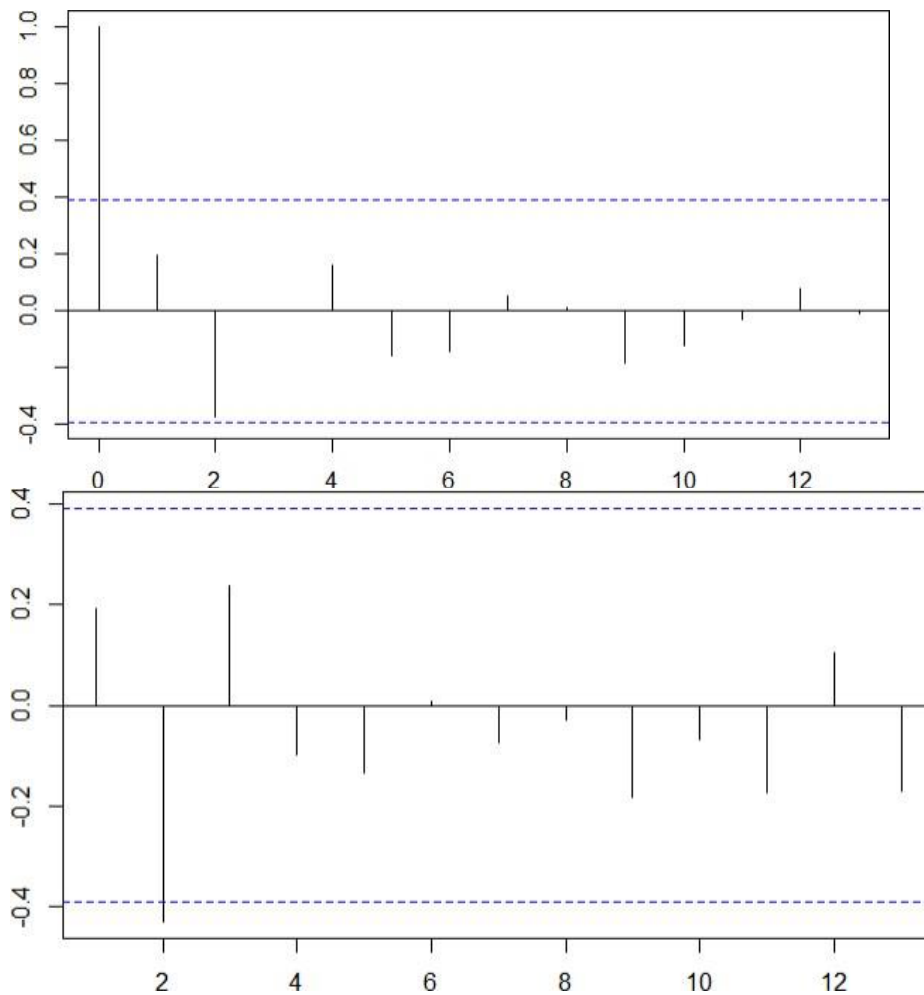

Figure 1. Graphical analysis of autocorrelation and partial autocorrelation.
Source: Prepared by the author using the statistical software RStudio.

To perform the correction, we included terms in the regression, so as to make the residuals random. The table below shows the new test performed, where it was possible to correct the lagged series, thus obtaining residuals within the confidence interval (uncorrelated residuals).

Table 5

Error Correction Vector (ECV) Final

Coefficients	Estimate	Std. error	t-value	Pr(>|t|)
Intercept	$6.364e^{+03}$	$1.699e^{+03}$	3.746	0.002169**
L(Erro)	$-7.859e^{-01}$	$1.346e^{-01}$	-5.838	$4.31e^{-05}$***
d(GDP)	$2.990e^{-08}$	$7.592e^{-09}$	3.938	0.001485**
d(RESERV)	$1.245e^{-01}$	$7.125e^{-02}$	1.747	0.10248
d(TS)	$-3.871e^{+03}$	$1.232e^{+03}$	-3.142	0.00721**
L(d(FDI))	$2.782e^{-01}$	$1.057e^{-01}$	2.633	0.0197*
L(d(GDP), 2)	$-3.502e^{-09}$	$7.475e^{-09}$	-0.469	0.6467
L(d(RESERV),2)	$-2.822e^{-01}$	$6.761e^{-02}$	-4.173	0.00094***
L(d(TS), 2)	$-1.965e^{+02}$	$1.282e^{+03}$	-0.153	0.8803

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6418 on 14 degrees of freedom

Multiple R-squared: 0.9224, adjusted R-squared: 0.878

F-statistic: 20.79 on 8 and 14 DF, p-value: $1.652e^{-06}$

Source: Prepared by the author using the statistical software RStudio.

The lagged model suggests that the short-run variation in current transactions is negative and highly significant with t = -3.142 and p-value less than 0.01, so the probability of making the type I error is practically zero, so that a one percentage unit increase in the TS results in a reduction of -3.871 percentage points on FDI inflows, holding everything else constant. For the two-period lag of the TS, the statistic proved not to be statistically significant, with t-statistic = -0.15 and a strictly high p-value of 0.8803.

For the second variable that sought to measure the role of external vulnerability, international reserves, we obtained a surprising result in view of the fact that only its lag in period II proved to be statistically significant, so that an increase in reserves tends to reduce the inflow of FDI starting in the second year.

The result of the statistic is highly significant, with the error probability being strictly low.

Another interesting result of the test was the high impact that the lag of FDI itself has on its present moment, explaining about 0.2782 percentage points of the inflow of foreign direct investment at the 5% confidence level. Therefore, we can expect that a high level of FDI in the present will influence at least the next two years of investments in the Brazilian economy.

It is worth mentioning that the procedure used to estimate the error correction model was through the inclusion of a residual variable, so the correction consisted of an estimated variable, making the standard error inefficient.
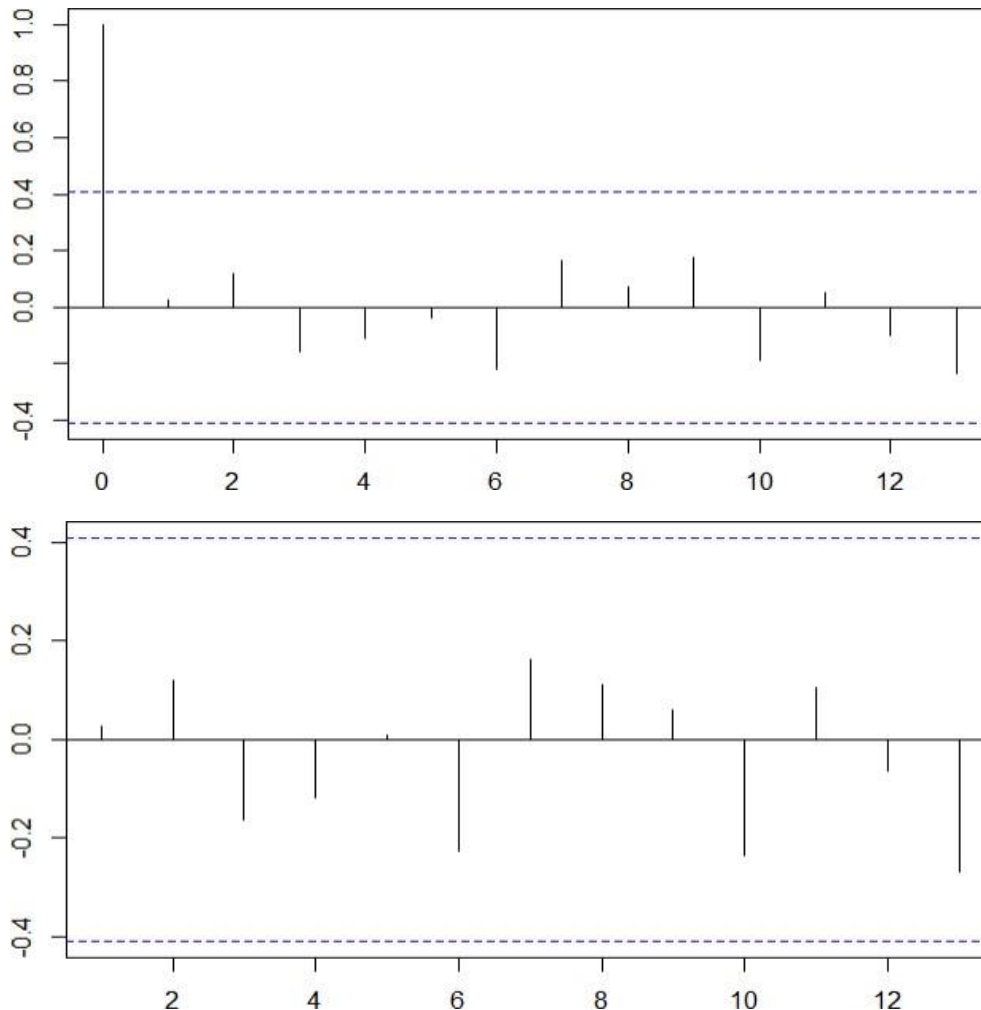
Figure 2. Graphical analysis of autocorrelation and partial autocorrelation.

Source: Prepared by the author using the statistical software RStudio.

Through partial autocorrelation we can state that the inclusion of new lagged terms in the regression resulted in random residuals, where the lag in the second year is now in the confidence interval as is illustrated by Figure 2 above.

Conclusion

The countries of the Latin periphery experienced a long external debt crisis in the 1980s, and this was a period of low external capital flow. During the mid-1990s there was a substantial improvement for most countries, this event was combined with the rise of neoliberalism in Latin America pushing for less protection of domestic markets and facilitating the inflow of foreign resources.

The FDI expansion in the Brazilian economy began after the economic stabilization of 1994, and in 1996 the country began to receive an unprecedented volume of foreign investment. Since then, several researchers have worked to understand the main factors that attract FDI and its impact on the domestic economy. The literature review sought to understand how researchers from different areas and schools of thought have analyzed and analyze the role of foreign direct investment to date, so that the diversity of research lines allowed

us to investigate the relationship between vulnerability and FDI, there being few works with this focus in the literature.

Based on the estimation of the VEC model, which is frequently used in the literature on FDI determinants, we can measure important results to understand how international reserves and current transactions influence its flow. The main results obtained are due to the high explanatory power of current transactions as a percentage of GDP to explain FDI, whether in its present moment or lag. The lag of international reserves, suggesting that only in the second period can they explain the FDI flow, also proved to be an important result, so that few models other than the VEC could capture this relationship.

Despite the good quality obtained with the model adjustment, it is important to highlight its limitations, such as, for example, the small number of observations and the method for correcting the lags, developed through the inclusion of an error term preventing the standard error from being efficient.

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