The determinants of foreign direct investment in Brazil: empirical analysis for 2001-2013

Eduarda Martins Correa da Silveira, Jorge Augusto Dias Samsonescu and Divanildo Triches

Abstract

This article aims to analyse the determinants of foreign direct investment (FDI) into Brazil between 2001 and 2013. It uses a vector error correction (VEC) model to analyse both the long-term function and the impulse-response function. The results show that levels of economic activity, wages and productivity are positively related to FDI inflows, which means that investors pursue market-seeking and efficiency-seeking strategies when targeting the Brazilian market. Although less important, the stability of the national economy and the exchange rate also proved statistically significant in explaining FDI inflows.

Keywords

Foreign direct investment, economic growth, productivity, agriculture, industry, tertiary sector, econometric models, Brazil

JEL classification

F23, L21, C22

Authors

Eduarda Martins Correa da Silveira is a PhD student in Economics on the Postgraduate Programme in Economics of the Federal University of Rio Grande do Sul (UFRGS) and holds a Masters Degree the University of Vale do Rio dos Sinos (UNISINOS), Brazil. eduarda.m.c.silveira@gmail.com

Jorge Augusto Dias Samsonescu holds a Masters Degree in Economics from the University of Vale do Rio dos Sinos (UNISINOS), Brazil. gutodias@gmail.com

Divanildo Triches holds a PhD in Economics from the Federal University of Rio Grande do Sul (UFRGS) and is a research fellow and professor on the Postgraduate Programme in Economics (PPGE) of the University of Vale do Rio dos Sinos (UNISINOS), Brazil. divanildo@pq.cnpq.br and divanildot@unisinos.br

I. Introduction

From the 1990s onwards, foreign capital flows into Brazil in the form of foreign direct investment (FDI) have grown strongly, driven mainly by privatizations. Those investments also helped to reduce repetitive current account deficits (owing to the greater openness of the domestic economy to the international market) and to raise domestic productivity levels.

As noted by Lima Júnior (2005), throughout the 1990s most FDI was channelled into the tertiary sector, in response to the deregulation implemented by the Brazilian Government. Apart from alleviating balance-of-payments constraints, FDI capital inflows can stimulate economic growth and technological development in the receiving countries, particularly if the investments are made in export-oriented firms and thus increase export earnings.

With that backdrop, this study sets out to analyse the determinants of FDI flows into Brazil between 2001 and 2013 —a period in which they grew vigorously. The study also aims to identify the strategy adopted by foreign firms, based on the theoretical framework proposed by Dunning (1993), known as the "eclectic paradigm." A vector error correction (VEC) model is used for this purpose, and its corresponding impulse-response function is presented.

As one of the objectives of this research is to identify the strategy pursued by multinational firms, gross domestic product (GDP) and the wage level are variables likely to be associated with a market-seeking strategy. In contrast, an efficiency-seeking strategy would be represented by the productivity, exchange rate, commodity prices and inflation variables; while a resource-seeking strategy would respond to wages and commodity prices. Given these pre-selected variables, one would expect FDI to be positively related to the degree of openness of the Brazilian economy, GDP, the exchange rate and productivity, and inversely related to the inflation rate. In the case of the commodity price index and wage variables, there is no *a priori* expected relation, since this will depend on the strategies adopted by the multinational firms, to be identified through the econometric model and the signs of the respective parameters. Empirical studies have been performed with a similar aim, relating to different time periods and, in most cases, using panel data or focusing only on statistical series obtained from the balance of payments. Consequently, a relatively large number of variables can be identified that prove significant, both for the Brazilian case and globally. Schneider and Frey (1985) identified political instability, country risk, vulnerability, GDP, per capita GDP, labour costs, labour skills, inflation and the balance of payments as determinants of FDI. Dunning (1988) emphasized efficiency, labour costs, the exchange rate and inflation; while Lélis (2010) highlighted the degree of openness of the receiving country and used a dummy variable for privatization.

Krugman and Obstfeld (2010) argue that the determinants of foreign investment are characterized by factor endowments and raw materials, the structure or costs of transport in the countries in question, or, ultimately, by comparative advantages. Other factors that help to attract FDI are technological attainment, vertically integrated production processes, market size and both institutional and macroeconomic stability.

Understanding the behaviour of FDI and its determinants is important, since, in addition to providing short-term balance-of-payments relief, FDI can help enhance the competitiveness and productivity of national production. On the other hand, this type of investment can also represent a constraint, by generating external imbalances when the invested capital is repatriated to the country of origin, or through profit remittances and interest payments. There is also a wide-ranging debate in the literature on the relation between FDI and certain indicators of well-being such as the Human Development Index (HDI), the Gini coefficient, and domestic consumption;[1] while other

[1] See De Groot (2014).

studies consider productivity increases[2] and technology transfer with a view to evaluating the quality of FDI.

The article is structured in five sections including this Introduction. Section II briefly reviews studies on the determinants of FDI flows, highlighting the product life-cycle theory proposed by Vernon, the industrial organization approach adopted by Hymer and the eclectic paradigm hypothesis put forward by Dunning. Section III discusses the methodological aspects of the estimation using vector autoregression models with vector error correction to evaluate the long-term parameters and the impulse-response function; and it discusses the definition of the statistical series. Section IV analyses the results, and section V sets forth the conclusions.

II. Review of the determinants of foreign direct investment

To explain the determinants of FDI, this study focuses on the product life-cycle theory defended by Vernon, the theory proposed by Hymer —who, according to Buckley (2010), pioneered the analysis of the behaviour of multinational enterprises based on industrial organization theory and market imperfections— and a third theoretical current developed by Dunning (1988), which encompasses the previous two and is known as the eclectic, or ownership, location and internalization (OLI) paradigm.[3]

According to Lélis (2010), product life-cycle theory defines three stages for a given product. The first stage corresponds to product launch: production is not standardized and is restricted to the launch region. In the second, known as the mature stage, the product starts to be consumed in other regions, particularly in countries with a high level of economic development, thereby initiating the process of standardizing production and the movement towards internalization. In the third stage, the author argues, a situation of production standardization is attained. Although demand in the economically developed regions declines, the product reaches a well organized international market, which makes the less-developed regions candidates to receive foreign investment and to host export platforms.

The theoretical approach to the behaviour of multinational enterprises based on market imperfections considers production internationalization theory separately from the theory of international trade and capital movements. The main source of market imperfections stems from the hypothesis of information asymmetry, which means that domestic firms know the local economic environment better than foreign ones, in terms of its legal and cultural aspects.

From the industrial organization standpoint, market imperfections can also originate in power gained by firms in an oligopolistic market structure to control the price and quantity supplied. For Hymer (1976), the two main reasons for firms to set up business abroad are: (i) the profitability obtained from controlling production in more than one country, probably related to the elimination of market competitors; and (ii) advantages in specific activities (ownership), which make it possible to obtain a higher return by exploiting factors such as lower capital costs, management with operational efficiency, technology, access to raw materials, economies of scale, bargaining power and political power.[4]

In terms of the eclectic paradigm, Castro, Fernandes and Campos (2013) argue that ownership advantages are exclusive to the firm, at least for a given time period. These include patents, technologies

[2] See Bonelli (1999).

[3] The product life-cycle theory was developed by Vernon in 1966, the theory of multinational enterprises was put forward by Hymer in 1960 (but according to Buckley (2010) it was only published in 1976) and the eclectic paradigm theory was proposed by Dunning in 1988.

[4] The theoretical conception of FDI from the industrial organization standpoint can also be found in Buckley (2010), Dunning (1988), Kindleberger (1969), Lélis (2010) and Moosa (2002).

and organizational structure, among others; and they determine the firm's superiority over its external competitors. According to these authors, location advantages arise from factors that are available in specific places, which would encourage multinational firms to invest in those areas. Natural resources, infrastructure and market size are examples of this. Internalization advantages stem from domestic exploitation of the intrinsic skills of the multinational firm, instead of allowing the market to exploit them through licensing agreements. According to the eclectic paradigm, the multinational will set up where it can benefit from those three advantages.

Dunning (1993) further elaborated the eclectic paradigm by showing that the actions of multinational firms are motivated by four different types of investment project: (i) *market-seeking* projects, which target the domestic market in the countries that receive the investment, promote import substitution and create trade when the subsidiary uses intermediate products from the country of origin of the FDI; (ii) *efficiency-seeking* projects, which aim to reduce production costs, and can serve both domestic and international markets, because they rationalize production in an international chain to benefit from economies of scope and scale, with unified management and geographically dispersed production activities; (iii) *resource-seeking* projects which seek access to raw materials and low-cost labour, with the aim of exporting products that make intensive use of the resources of the receiving countries, and (iv) those seeking strategic assets, by setting up manufacturing plants, or through mergers and acquisitions, or the operations of joint ventures that enable a joint ownership structure to act in regional or global markets.

In synthesis, Dunning and Lundan (2008) add that, although Vernon's theory uses microeconomic concepts to explain a macroeconomic phenomenon without explicitly analysing market imperfections, the analysis focuses on the firm and, in particular, the location of its production. The product life-cycle theory is the first dynamic interpretation of the determinants and of the relation between international trade and production abroad.

The empirical literature has sought to identify the economic factors that determine the FDI flow. Amal and Seabra (2007) examined those factors in Latin America, to evaluate the relative importance of the macro- and microeconomic and institutional dimensions in the investment decision-making process of multinational firms in the region in a period spanning 1984-2001. Based on panel data and under the eclectic paradigm perspective, the authors conclude that the macroeconomic dimension is a central factor in the FDI decision and in the choice of its location. Investments by multinational enterprises target developing countries, initially in regions that display the best indices of the factors that traditionally determine FDI, such as market size, growth and economic stability.

Lélis (2010) studied Spanish direct investment in Latin America from the early 1990s until 2000. Using panel data, the author concludes that the driving factors identified on the basis of a positive and statistically significant relation with Spanish FDI were: market size, domestic absorption, productivity, a binary variable representing privatizations, the nominal exchange rate of the local currency against the euro, and degree of openness.

According to ECLAC (2015), transnational firms are key players in the Latin American economies, particularly Brazil, which has continental proportions. Nonetheless, those economies individually have very different structures from the standpoint of relative capital and labour endowments; these differences are partly reflected in the economic growth rate. Another factor that drives growth is the capacity to increase productivity, particularly through technological progress and innovation. According to ECLAC (2015), Brazil is way ahead of the other Latin American countries in terms of innovation capacity. The factors that contribute to this situation include research and development expenditure, expenditure on tertiary education and other forms of training, and the number of patent applications.

The fall in international commodity prices since the 2008 crisis has led to a substantial reduction in FDI entering the natural resources sector of the Latin American economies. Those investments were retargeted on the tertiary sector, particularly in countries with the largest markets.

Foreign investment has also played a crucial role in accommodating the growing current account deficit of the region's economies, which requires a large capital account surplus. Thus, at a time of slower economic growth owing to slacker global demand for exports, the Latin American countries increasingly need to attract FDI projects that can boost their production capacity and foster greater diversification.

Lima Júnior (2005) studied the main determinants of FDI flows to the Brazilian economy between 1996 and 2003, using a panel database for 49 sectors. The study shows that the size, output growth-rate and trade-openness coefficients tend to be the most important factors in attracting foreign investments into Brazil. In addition, the inflation rate, the performance of stock markets, and the existing FDI stock also affect the behaviour of FDI flows.

Costa (2002) also used a panel data model to analyse FDI flows in the 1990s, and showed that Brazil's GDP and that of the investor countries were statistically significant, along with the exchange rate, wage costs, privatizations, geographic distance and the natural resource endowment.

The study by Castro, Fernandes and Campos (2013) sought to analyse the factors driving the attraction and concentration of FDI in the Brazilian and Mexican economies between 1990 and 2010. These authors also used the vector error correction model. The key results show that trade openness has been one of the key factors stimulating that type of investment in both countries. The main strategy of the multinational enterprises seems to be market-seeking (related to the attraction of the national market) in the case of Brazil, and efficiency-seeking in the case of Mexico. The relation found between international commodity prices and the FDI flow was inverse and significant in both countries, to the authors' surprise.

Mattos, Cassuce and Campos (2007) also used a VEC model to analyse how FDI inflows in Brazil responded to changes in the levels of its main determinants in 1980-2004. The results show that FDI was most sensitive to country risk, trade openness and the Brazilian inflation rate. In contrast, it was relatively insensitive to changes in the pace of GDP and the exchange rate.

III. Methodological procedure and definition of variables

This study used a VEC model to evaluate the effects and identify the determinants of FDI in Brazil. This type of model allows for a system in which all variables have reciprocal influence, so they are considered endogenous and explained by their lagged values, following Enders (2010) and Patterson (2000). The estimation, in generalized form, is processed through variables in differences in the short run, and long-term information according to the error-correction mechanism, as in equation (1):

$$\Delta y_t = \pi_0 + \phi y_{t-1} + \sum_{i=1}^{n} \pi_i \Delta y_{t-i} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \gamma_t D_t + \varepsilon_t \quad (1)$$

where Y_t is the (n x 1) vector of endogenous variables; π_0 is the (n x 1) vector of the intercept terms; ϕ is the (n x 1) cointegrating vector or the long-term adjustment coefficients of the model; π_i is the (n x n) matrix associated with the parameters of the model's endogenous variables; β_i is an (n x n) matrix associated with the parameters of the (n x 1) vector of the exogenous variable x_t; γ_t is the (n x n) matrix associated with the parameters of the dummy variables, and D_t denotes the (n x 1) vector of the dummy variables, while ε_t is the (n x 1) vector of the residuals or stochastic errors. The model further assumes that $E(\varepsilon_t) = 0$ and $E(\varepsilon_t \varepsilon_\tau) = \sigma^2$, for $t = \tau$ and $E(\varepsilon_t \varepsilon_\tau) = 0$ for $t \neq \tau$.

To estimate the VEC model, the initial procedure involves analysing the stationarity of the series through unit root tests, such as the augmented Dickey-Fuller test and the Phillips-Perron test. If the variables display unit roots, they need to be cointegrated; in which case the Johansen test is used. The next stage uses impulse-response functions to assess the model's performance in explaining the determinants of FDI. This method makes it possible to evaluate how a shock or a change in a given variable produces effects on the others. Following Hamilton (1994, p. 318), the impulse-response function can be expressed in equations (2) and (3), as follows:

$$y_t = \mu + \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-2} + \ldots \tag{2}$$

thus, matrix ψ_s can be interpreted as:

$$\Psi_s = \frac{\partial y_{t+s}}{\partial \varepsilon_t} \tag{3}$$

where ψ_s is the matrix of multipliers of the effect of an innovation or shock on the endogenous variables. The rows and columns of the matrix ψ_s capture the results of an innovation, ε_t, in the value of the $i\text{-}th$ variable in time $t+s$. As the impulse-response functions considered are generalized, the order of the variables does not affect the results (Pesaran and Shin, 1998). The Granger causality test is used to interpret and evaluate changes in the variables, as per equation (4):[5]

$$y_t = \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + \varepsilon_t \tag{4}$$

where k is the number of lags, defined according to the Akaike or Schwarz criteria. Thus, if $\beta_i = 0$, the variable x_t fails to cause y_t; in other words, the lagged values of the variable x_t do not precede y_t, so y_t is explained either by other variables or else by itself.

The variables are as commonly defined in the literature and make it possible to identify and evaluate the determinants of FDI.[6] Quarterly data spanning 2001-2013 were obtained in index-number form and subjected to a logarithmic transformation, for the following variables: (i) foreign direct investment, *IED*, obtained from the Central Bank of Brazil, excluding inter-company loans; (ii) gross domestic product, *PIB*, used as a proxy variable for the level of activity, related to the market-seeking strategy of multinational firms and obtained from the Brazilian Geographical and Statistical Institute (IBGE); (iii) the nominal exchange rate, *CAMBIO*, taken from the Central Bank of Brazil, associated with the resource-seeking strategy; (iv) the inflation rate, measured by the Extended National Consumer Price Index (*IBCA*), as a proxy for financial stability, also obtained from the Central Bank and related to the resource-seeking strategy; (v) degree of openness of the economy, *ABERT*, calculated as the ratio between the sum of merchandise exports and imports and the value of gross domestic product in current dollars; (vi) labour productivity, *PRODU*, defined as the ratio between industrial output and the number of hours paid, available on the Ipeadata website, representing the efficiency-seeking strategy, and (vii) labour cost, SAL, measured using the payroll of real wages per worker, and obtained from Ipeadata, which represents the resource-seeking strategy or market-seeking strategy, since, if market size is a factor for attracting FDI, it is possible that the higher the wage, the more interesting the country becomes for FDI.

[5] Bueno (2011), Hamilton (1994) and Greene (1997) consider this test to be an investigation of precedence rather than causality, because it does not test either endogeneity or exogeneity.

[6] See the studies by Amal and Seabra (2007), Castro (2012), Costa (2002), Dias (2012), Lélis (2010), Ribeiro (2006) and Sarti and Laplane (2002), among others.

Lastly, the natural-resource endowment, *COMMOD*, is a proxy variable that proved significant for Brazil and several Latin American countries, and can represent either the resource-seeking or efficiency-seeking strategies. In this study, this variable is represented by the index of international commodity prices available on the Central Bank of Brazil website. Bearing in mind the effects of the subprime mortgage crisis in the United States real estate market and its potential effects on FDI flows and other macroeconomic variables, it was decided to include a dummy variable in the fourth quarter of 2008 and first quarter of 2009.

IV. Description and analysis of the results

As figure 1 shows, the main destination for FDI in Brazil between 2001 and 2013 was the tertiary sector, which grew its share from 40% to 60%. The lowest level of that type of investment occurred in 2003 and 2004, when it was below US$ 10 billion. The highest values were recorded in 2011 and 2012, of over US$ 30 billion. The average annual growth rate of FDI was roughly 8%, reflecting the expansion of investments in civil construction, retail trade, financial services and business headquarter activities, and business management consulting services.

Figure 1
Brazil: trend in foreign direct investment by economic sector, 2001-2013
(US$ million)

Source: Central Bank of Brazil.
Note: The agriculture sector encompasses investments in crop, livestock and mineral extraction activities.

The manufacturing sector attracted the second-largest amount of foreign investment in the Brazilian economy, with a share fluctuating between 30% in 2005 and 2013, and over 50% in 2004. Brazilian manufacturing industry followed a very similar trend to the tertiary sector, but with a slightly lower average annual growth rate of around 6.5% over the period analysed. In this case, metallurgy and sectors related to the automotive industry, food production and the production of oil derivatives and biofuels, led the way.

Lastly, the agriculture sector (broadly defined) proved the least attractive for FDI, with a share averaging around 10%. As shown in figure 1, the smallest values in absolute terms were recorded between 2001 and 2007, when they did not surpass US$ 5 billion. The largest inflow of investment occurred in 2010, of above US$ 15 billion. That was the only year in the series in which the manufacturing, agriculture and livestock sectors surpassed the tertiary sector. Segments related to oil

and natural gas extraction, mineral extraction and forestry production were the main destinations of FDI in the agriculture sector (broadly defined) in 2001-2013.

In terms of econometric procedures, the order of integration of the predefined variables was first verified as follows: *CAMBIO*, *COMMOD*, *IPCA*, *PIB*, *PRODU*, *SAL* and *ABERT*. This was done using the augmented Dickey-Fuller unit root test, as indicated in table A1.1 of the annex.[7] The vast majority of the variables display a unit root in the two specifications, in other words, with a constant but without trend and with both constant and trend. The exceptions were *IPCA*, where the test indicated the acceptance of the null hypothesis, in other words, that it is stationary in levels for the two specifications at a 1% significance level; and the variables *IED* and *COMMOD*, which are also stationary with constant only and with trend at the 5% and 1% levels, respectively. The results of the augmented Dickey-Fuller unit root test showed that, with variables expressed as first differences, all of the series are stationary in the two specifications at a 1% significance level.

Next, the Granger test was performed to evaluate the statistical causality relation between each of the model's endogenous variables and FDI. Table A1.2 of the annex reports the results of that test, which show that the hypothesis of "Granger causality" among the variables *CAMBIO*, *PIB*, *PRODU* and *SAL* for the FDI flow cannot be rejected —at the 1% level in the first three cases, and at 5% in the last. This means that movements in the exchange rate, GDP, productivity and labour cost precede, or "Granger cause," movements in FDI. The Granger causality test also reveals the absence of any association between FDI and the economy's degree of openness. In the case of international commodity prices, the hypothesis that *IED* (FDI) does not "Granger cause" *COMMOD* is rejected at a significance level of just over 10%.

Given the lack of causality with respect to the degree of external openness, the effect of this variable on FDI was evaluated through the impulse-response function. This procedure makes it possible to verify the short-run reaction of the *IED* variable (FDI) to a shock to the error term in the endogenous equation, in this case in the openness variable *ABERT*. The result was that the degree of openness of the Brazilian economy has a short-term negative effect on FDI —contrary both to expectations and to the results reported in the literature.[8] This might be reflecting specific features of the empirical studies, which were concentrated mainly in the 1990s —a period marked by the adoption of the Real Plan, together with intensive foreign-capital inflows fuelled by privatization processes and an appreciation of the local currency against the dollar.

The degree of openness of the Brazilian economy was therefore excluded as a variable in the analysis, to reduce the chance of generating spurious relations. Bearing in mind that most of the series is integrated of order one, or I(1), the possibility of a cointegration relation between them needs to be assessed. To that end, the order of the vector autoregression was defined, identifying the number of lags of the model using the Schwarz and Akaike criteria, supported by the Lagrange multiplier test for residual autocorrelation and the White heteroscedasticity test for the model with two and three lags. The joint analysis of the tests, considering a 5% significance level and the criteria, selected the two-lag model as the best fit. In addition, as the inverse roots of the autoregressive characteristic polynomial were inside the unit circle, the model is consistent and susceptible to economic analysis.

The next procedure was the Johansen cointegration test, the results of which are shown in table A1.3 of the annex. The trace and maximum eigenvalue statistics show the existence of four cointegration relations at a 5% significance level, which makes it possible to validate the use of the VEC model.

[7] Although the Philips-Perron test was also performed, the results did not report significant changes.

[8] Degree of openness has been considered important by Nonnenberg and Mendonça (2005), Lélis (2010), Laplane and others (2001), Mattos, Cassuce and Campos (2007), Sarti and Laplane (2002) and Castro, Fernandes and Campos (2013), among others.

The VEC model was then estimated, showing the long-term relation between FDI and its determinants, as reported in table 1. The estimated parameters of the variables representing the exchange rate (*CAMBIO*), inflation (*IPCA*), GDP (*PIB*), productivity (*PRODU*) and wages (*SAL*) are statistically different from zero at the 5% level. The coefficient of the commodity prices time series (*COMMOD*) was not significant.

Table 1
Estimation of the long-term function

Variable	Coefficient	Standard deviation	t-statistic
CAMBIO	1.8048	0.7387	-2.4431*
COMMOD	-0.0288	0.5588	0.0516
IPCA	-0.4429	0.1470	3.0122*
PIB	30.228	6.8129	-4.4369*
PRODU	11.2645	3.2466	-3.4696*
SAL	3.8851	1.8209	-2.1336*
TEND(01Q1)	-0.3266	0.0558	5.6690*

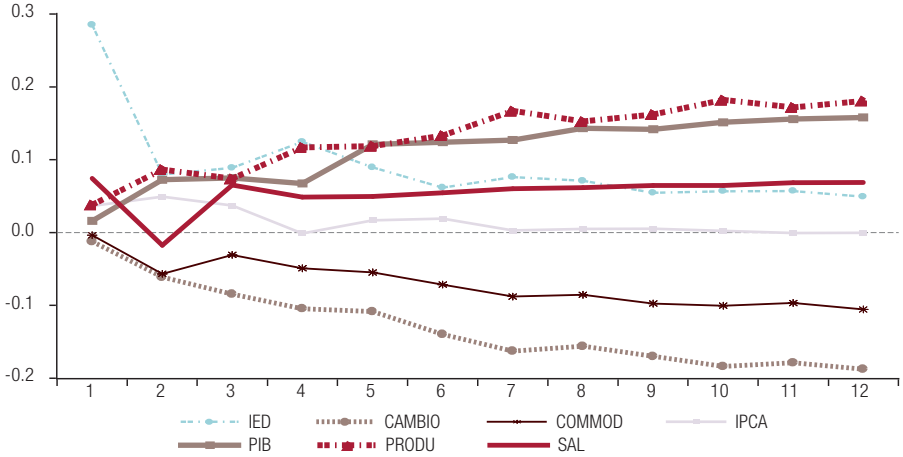
Source: Prepared by the authors, on the basis of the program Eviews 7.0.
Note: *CAMBIO, COMMOD, IPCA, PIB, PRODU* and *SAL* correspond to exchange rate, international commodity prices, extended consumer price index, gross domestic product, labour productivity, and labour costs, respectively. All variables are lagged by one period. The asterisk (*) indicates a 5% significance level.

In terms of the magnitudes of the long-term coefficients, the level of economic activity, measured by GDP, is the main determinant of FDI in Brazil. This result is corroborated by Lima Júnior (2005) and by Castro, Fernandes and Campos (2013). Next in importance are the variables representing labour productivity and wages, although with a considerably lower parameter. Both displayed a positive association with FDI; in other words, shocks in the variables *PIB*, *PRODU* and *SAL* produce direct effects on this type of investment. This confirms the results of the Granger causality test described above. The determinants of *PIB* (GDP) and *SAL* (wage costs) suggest that FDI inflows are market-seeking. Labour productivity may represent a location advantage, which would indicate that investment inflows are efficiency-seeking according to the eclectic paradigm.

The long-term relation between the exchange rate and FDI is also positive. Thus, an exchange-rate devaluation can be interpreted both as an increase in the value of national assets compared to international ones in the long term (resource-seeking), and also as a lower investment cost in the national economy in United States dollar terms (efficiency-seeking). In addition, although statistically significant, economic stability —represented by the inflation variable IPCA— reported one of the lowest values among the parameters estimated, which means it was not very important for FDI inflows in the period analysed. Moreover, holding everything else constant, FDI displayed a long-term declining trend.

The impulse-response function is used to evaluate the short-run reaction of FDI to a shock in the endogenous variables. The results reported in figure 2 and in table A1.4 of the annex clearly show that changes in output and productivity caused the greatest responses in FDI in the 12-quarter period analysed. This association is positive and confirms the results of long-term estimations. Here again, the evidence seems to support the idea that FDI flows towards the Brazilian economy are attracted by domestic market size and efficiency; whereas wages (SAL) also provoke a positive and permanent change in FDI, albeit smaller. This suggests that investments are not attracted by lower costs or by the search for cheaper productive resources, but by Brazil's market potential, thus strengthening the previous conclusion.

Figure 2
Impulse-response function on foreign direct investment



Source: Prepared by the authors, on the basis of the program Eviews 7.0.
Note: *IED, CAMBIO, COMMOD, IPCA, PIB, PRODU* and *SAL* correspond to FDI, exchange rate, international commodity prices, extended consumer price index, gross domestic product, labour productivity, and labour costs, respectively.

The response of FDI to an inflation shock (*IPCA*) is virtually insignificant. There is a small fluctuation in investments up to the fourth quarter, after which the response becomes virtually non-existent. The short-term behaviour of the exchange rate, represented by the variable *CAMBIO*, shows that a rise in the exchange rate has permanent negative effects on FDI. This suggests that a devaluation of the national currency generates expectations of a period of domestic economic instability, which would cause investments to be put on hold until the short-term movement in the exchange rate is confirmed in the long term. This finding is supported by the coefficient shown in table 1, where a devaluation of the exchange rate produces a long-term positive effect on FDI, albeit smaller than the other parameters.

In short, domestic market size and its growth potential were the most important factors attracting FDI into the Brazilian economy in 2001-2013. This result is ratified for earlier periods by other studies, particularly Castro (2012). The level of productivity and the exchange rate tend to complete the set of the principal variables explaining the movement of international investments targeting Brazil.

V. Conclusion

The flow of FDI into Brazil is strongly related to the level of economic activity: the higher the GDP growth rate, the larger will tend to be the flow of FDI into Brazil. The same association can also be seen with productivity and wages. These findings show that FDI inflows are driven by the size of the domestic market, so the dominating strategy of multinational enterprises, in terms of the eclectic paradigm, is market-seeking. The tertiary sector was the main target for foreign investments in the period analysed, particularly the civil construction, retail trade, financial services and business management consulting segments.

The exchange rate displayed the expected sign in the long run, indicating that a devaluation of the national currency leads to an increase in the long-run flow of FDI. That means that the reduction in national costs relative to the cost in international currency, caused by the rise in the exchange rate, is positively related to foreign investment, thereby confirming the efficiency-seeking hypothesis. This hypothesis is also ratified by the productivity (*PROD*) and inflation (*IPCA*) variables, with productivity

reporting the second-largest estimated parameter. The stability of the national economy, represented by the inflation variable *IPCA*, reported a relatively lower coefficient, although statistically significant and negatively related to the FDI flow. This suggests that investors view the Brazilian economy as low-risk, or simply that they pay closer attention to the activity-level and productivity indicators. In any event, governments sought to maintain economic stability in the period analysed.

Although the prices of commodities (of which Brazil is a major producer) were very high on world markets in the period analysed, that variable was not significant for FDI inflows. In other words, the parameter cannot be considered different from zero at a 5% significance level.

Lastly, this research set out to identify the determinants of FDI in the Brazilian economy and how they relate to the strategies pursued by multinational enterprises. Although foreign currency inflows alleviate potential pressures on the balance of payments in the short run, economic policy-makers should take steps to create macroeconomic conditions that allow for a positive flow of that type of investment, since it is trending downwards. Although beyond the scope of this research, it is also important to analyse the impact of FDI on Brazil's macroeconomic variables, such as the potential for multiplying domestic output and the virtue of improving the productivity and competitiveness of domestic products and fostering an improvement in social-welfare indicators.

Bibliography

Amal, M. and F. Seabra (2007), "Determinantes do investimento direto externo na América Latina: uma perspectiva institucional", *Revista de Economia*, vol. 8, No. 2, Brasilia.

Bonelli, R. (1999), "A note on foreign direct investment and industrial competitiveness in Brazil", *Oxford Development Studies*, vol. 27, No. 3, Taylor & Francis.

Buckley, P. (2010), "Stephen Hymer: three phases, one approach?", *Foreign Direct Investment, China and the World Economy*, P. Buckley, Chippenham, Palgrave Macmillan.

Bueno, R. de L. da S. (2011), *Econometria de séries temporais*, São Paulo, Cengage Learning.

Castro, P.G. de (2012), "Os determinantes do investimento direto estrangeiro no Brasil e no México: uma análise empírica para o período de 1990 a 2010, Brasil", Federal University of Viçosa.

Castro, P.G., E.A. Fernandes and A.C. Campos (2013), "Os determinantes do investimento direto estrangeiro no Brasil e no México: uma análise empírica" [online] https://www.anpec.org.br/encontro/2013/files_I/i7-2bf472e0d97d8e932bc37c86feac6d31.pdf.

Costa, C.G. (2002), "Fatores de atração do investimento direto estrangeiro para a economia brasileira nos anos 90 e as repercussões sobre a especialização internacional no Brasil", *Informação Internacional: análise econômica e política*, Ministry of the Environment of Portugal.

De Groot, O. (2014), *Foreign Direct Investment and Welfare* (LC/L.3800), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).

Dias, M.H.A. (2012), "Choques de produtividade e fluxos de investimentos estrangeiros para o Brasil", *Working Paper*, No. 41 [online] http://www.bndes.gov.br/SiteBNDES/export/sites/default/bndes_pt/Galerias/Arquivos/produtos/download/pde/PDE2011_DiasUEM.pdf.

Dunning, J.H. (1993), *Multinational Enterprises and the Global Economy*, Reading, Massachusetts, Addison-Wesley.

___(1988), "Trade, location of economic activity and the multinational enterprise: a search for an eclectic approach", *Explaining International Production*, J.H. Dunning, London, Unwin Hyman.

Dunning, J.H. and S. Lundan (2008), *Multinational Enterprises and the Global Economy*, London, Edward Elgar.

ECLAC (Economic Commission for Latin America and the Caribbean) (2015), *Foreign Direct Investment in Latin America and the Caribbean, 2015* (LC/G.2641-P), Santiago.

Enders, W. (2010), *Applied Econometric Time Series*, New York, Wiley.

Greene, W.H. (1997), *Econometric Analysis*, Upper Saddle River, Prentice Hall.

Hamilton, J.D. (1994), *Time Series Analysis*, Princeton, Princeton University Press.

Hill, R.C., W.E. Griffiths and G.C. Lim (2011), *Principles of Econometrics*, Hoboken, Wiley.

Hymer, S. (1976), *The International Operations of National Firms: a Study of Direct Foreign Investment*, Cambridge, Massachusetts, The MIT Press.

IMF (International Monetary Fund) (n/d), "Balance of Payments Manual" [online] http://www.imf.org/external/pubs/ft/bopman/bopman.pdf.

___(n/d), "Glossary of foreign direct investment terms" [online] http://www.imf.org/external/np/sta/di/glossary.pdf.

Kindleberger, C.P. (1969), *American Business Abroad: Six Lecture on Direct Investment*, New Haven, Yale University Press.

Krugman, P.R. and M. Obstfeld (2010), *Economia internacional: teoria e política*, São Paulo, Pearson ABDR.

Laplane, M. and others (2001), "La inversión extranjera directa en el MERCOSUR: el caso brasileño", *El boom de inversión extranjera directa en el MERCOSUR*, D. Chudnovsky (org.), Buenos Aires, Siglo XXI.

Lélis, M.T.O. (2010), "Movimento recente do investimento espanhol na América Latina: condicionantes macroeconômicos, Brasil", thesis, Porto Alegre, Federal University of Rio Grande do Sul.

Lima Júnior, A.J. (2005), "Determinantes do investimento direto estrangeiro no Brasil", Belo Horizonte, Federal University of Minas Gerais.

Mattos, L.B. de, F.C. Cassuce and A.C. Campos (2007), "Determinantes dos investimentos diretos estrangeiros no Brasil, 1980-2004", *Revista Economia Contemporânea*, vol. 11, No. 1, Rio de Janeiro.

MDIC (Ministry of Development, Industry and Commerce) (2014), "Acordos multilaterais: Organização Mundial do Comércio (OMC)" [online] http://www.mdic.gov.br/sitio/interna/interna.php?area=5&menu=2530.

Moosa, I.A. (2002), *Foreign Direct Investment: Theory, Evidence and Practice*, Wiltshire, Palgrave.

Nonnenberg, M.J.B. and M.J.C. Mendonça (2005), "Determinantes dos investimentos diretos externos em países em desenvolvimento", *Estudos Econômicos*, vol. 35, No. 4, São Paulo, University of São Paulo.

Patterson, K. (2000), *An Introduction to Applied Econometrics: a Time Series Approach*, New York, Palgrave Macmillan.

Pesaran, H.H. and Y. Shin (1998), "Generalized impulse response analysis in linear multivariate models", *Economics Letters*, vol. 58, No. 1, Amsterdam, Elsevier.

Ribeiro, M.S. (2006), "Investimento estrangeiro direto e remessas de lucros e dividendos no Brasil: estratégia microeconômica e determinantes macroeconômicos (2001-2004)", tesis, Belo Horizonte, Federal University of Minas Gerais.

Sarti, F. and M.F. Laplane (2002), "Investimento direto estrangeiro e a retomada do crescimento sustentado nos anos 90", *Economia e Sociedade*, vol. 8, Campinas, State University at Campinas (UNICAMP).

Schneider, F. and B. Frey (1985), "Economic and political determinants of foreign direct investment", *World Development*, vol. 13, No. 2, Amsterdam, Elsevier.

Vernon, R. (1999), "International investment and international trade in the product cycle", *The Internalization of the Firm*, P. Buckley and N. Ghauri, London, Thomson Learning.

Annex A1

Table A1.1
Augmented Dickey-Fuller unit root test

Variable	Levels		First differences	
	c	c/t	c	c/t
ABERT	-2.9016	-2.9133	-6.2652*	-6.2187*
CAMBIO	-1.2838	-1.9686	-5.0792	-5.0290*
COMMOD	-2.2025	-3.5147**	-4.8422*	-4.8019*
IED	-1.1155	-4.7242*	-7.4540*	-
IPCA	-4.1764*	-4.3265*	-	-
PIB	-0.2528	-3.1692	-5.1135*	-5.0583*
PRODU	-1.2190	-3.1192	-6.9131*	-6.8668*
SAL	-1.3988	-3.1640	-4.2604*	-6.7917*

Source: Prepared by the authors, on the basis of the program Eviews 7.0.
Note: *IED, CAMBIO, COMMOD, IPCA, PIB, PRODU, SAL* and *ABERT* correspond to exchange rate, international commodity prices, extended consumer price index, gross domestic product, labour productivity, labour costs and economic openness, respectively. The column heading c denotes the test with constant and without trend, and c/t the test with constant and trend. The asterisks (*, **) indicate rejection of the null hypothesis at the 1% and 5% significance levels, respectively.

Table A1.2
Results of the Granger causality test

Null Hypothesis	F-statistic	Prob.
ABERT does not cause *IED*	1.043	0.361
IED does not cause *ABERT*	0.427	0.655
CAMBIO does not cause *IED*	7.343*	0.002
IED does not cause *CAMBIO*	0.579	0.565
COMMOD does not cause *IED*	0.879	0.422
IED does not cause *COMMOD*	2.301	0.112
IPCA does not cause *IED*	0.871	0.426
IED does not cause *IPCA*	0.607	0.549
PIB does not cause *IED*	7.694*	0.001
IED does not cause *PIB*	0.985	0.382
PRODU does not cause *IED*	6.862*	0.003
IED does not cause *PRODU*	0.384	0.683
SAL does not cause *IED*	3.850**	0.029
IED does not cause *SAL*	0.379	0.687

Source: Prepared by the authors, on the basis of the program Eviews 7.0.
Note: *IED, CAMBIO, COMMOD, IPCA, PIB, PRODU, SAL* and *ABERT* correspond to exchange rate, international commodity prices, extended consumer price index, gross domestic product, labour productivity, labour costs and economic openness, respectively. The asterisks (*, **) indicate rejection of the null hypothesis at the 1% and 5% significance levels, respectively.

Table A1.3
Results of the Johansen cointegration test

Cointegrated equations	Trace	P-Value	Maximum eigenvalue	P-value
0	224.18	0.0000	65.99	0.0007
≤1	158.19	0.0000	46.50	0.0298
≤2	111.69	0.0004	38.50	0.0478
≤3	73.17	0.0067	31.36	0.0616
≤4	41.83	0.0640	26.48	0.0409
≤5	15.34	0.5460	10.69	0.5356
≤6	4.65	0.6465	4.65	0.6465

Source: Prepared by the authors, on the basis of the program Eviews 7.0.

Table A1.4
Response in FDI to generalized impulses of 1 standard deviation

Period	*IED*	*CAMBIO*	*COMMOD*	*IPCA*	*PIB*	*PRODU*	*SAL*
1	0.2850	-0.0123	-0.0036	0.0365	0.0159	0.0380	0.0742
2	0.0797	-0.0614	-0.0566	0.0492	0.0725	0.0865	-0.0175
3	0.0885	-0.0843	-0.0306	0.0369	0.0750	0.0740	0.0650
4	0.1245	-0.1045	-0.0490	-0.0011	0.0674	0.1169	0.0487
5	0.0894	-0.1085	-0.0547	0.0167	0.1211	0.1187	0.0495
6	0.0617	-0.1396	-0.0714	0.0193	0.1240	0.1330	0.0545
7	0.0760	-0.1626	-0.0879	0.0028	0.1269	0.1671	0.0603
8	0.0709	-0.1561	-0.0853	0.0049	0.1431	0.1525	0.0618
9	0.0545	-0.1699	-0.0974	0.0051	0.1418	0.1621	0.0646
10	0.0568	-0.1838	-0.1003	0.0022	0.1512	0.1820	0.0647
11	0.0570	-0.1788	-0.0968	-0.0007	0.1558	0.1719	0.0685
12	0.0491	-0.1876	-0.1056	-0.0003	0.1578	0.1809	0.0687

Source: Prepared by the authors, on the basis of the program Eviews 7.0.
Note: The period is expressed in quarters. *IED, CAMBIO, COMMOD, IPCA, PIB, PRODU* and *SAL* correspond to FDI, exchange rate, international commodity prices, extended consumer price index, gross domestic product, labour productivity and labour costs, respectively.