

Foreign Direct Investment in Brazil: The Effects of Productivity and Aggregate Consumption

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Abstract

The objective of this paper is to analyze the effects of shocks from productivity changes on the flow of foreign direct investment (FDI) to the Brazilian economy, over the period from 1992 to 2011. We hypothesize that domestic productivity increases may encourage foreign direct investment inflows, while foreign productivity increases may discourage the same, *ceteris paribus*. We also test if aggregate demand plays a role in attracting FDI over the long run. SVAR (Structural Vector Auto-Regression) models were estimated based on the proposed hypotheses. We did find evidence that FDI inflows into Brazil react to productivity as well as consumption variations in the directions predicted. Brazilian productivity growth attracts FDI and US productivity growth lowers FDI to Brazil. As expected, long run consumption growth generates an increase in FDI to Brazil. In sum, economic policies that foster countries' long run productivity growth are the recommended ones to attract FDI, according to the results.

Keywords: FDI; Flow of foreign investment; Productivity growth; SVAR models

Introduction

The Brazilian Economy has become internationally more integrated over the last couple of decades, especially by means of foreign direct investment (FDI) and international capital flows in general. According to data by the Brazilian Central Bank (BCB) from 2011, FDI kept increasing at an average rate of 2.7% of GDP between 1995 and 2011, reaching its peak of 5.1% in the year 2000. In spite of the world financial crisis during which worldwide FDI flows shrank by 37%, Brazil experienced a further increase of FDI inflows, hitting a record in absolute terms of the equivalent of US\$ 41.1 billion in 2008 according to the BCB data¹.

International economic theory suggests that an economy will pass on a macroeconomic shock to its trading partners through its capacity to affect relative prices, or terms of trade. This capacity depends on a number of factors, such as the relative size of the domestic economy and its productivity increase in relation to the world economy, its relative weight in international trade, in the way prices of tradable goods and services are determined, the nature of a shock and whether it is temporary or permanent.² Similarly, FDI inflows are likely to be affected by shocks occurring in the economies of trading partners, thereby interfering with the domestic economy's ability to attract international capital.

This study looks at role played by three important variables that might explain such FDI movement towards Brazilian economy. First, the Brazilian productivity increase. So, FDI would come to Brazil in order to get a better return to the investment being made. Second, the size of the demand increase in Brazil over the recent years due to its productivity increase. Third, the productivity increase in United States (US). It might diminish FDI flows to any economy, especially to the Brazilian one.

Thus, in this paper we analyze whether and to which degree variations in productivity growth in Brazil and in the US have affected FDI inflows into Brazil, where we use labor productivity (GDP per hour worked) as a measure for productivity. We will estimate the effects of

productivity shocks on FDI inflows using SVAR (structural vector auto-regression) modelling and impulse-response function simulation.³ The analysis will also estimate the effects on FDI inflows of additional variables like domestic demand, and the effective real exchange rate as a measure of competitiveness.

Theories explaining international investment fluctuations

Initially, cross-border investment models were built upon industrial organization theory in which companies' international investment decisions depended on internal factors, such as cost advantages, or market characteristics, such as market structure. As an example, Vernon [1] put forward the product life-cycle theory according to which initially technology-intensive investments are gradually transferred abroad to less capital-intensive economies as a given product matures. Another factor that has been highlighted as influencing FDI consists in imperfect intermediary markets. According to Hymer [2], Buckley and Casson [3] and Buckley and Ghauri [4], technology leadership in the form of patents, market power, trademarks and design makes FDI more attractive, as compared to the licensing of intellectual property, by virtue of conveying competitive advantages. International expansion by means of FDI would therefore capture this benefit and minimize the transaction costs associated with the intermediation arising from the imperfections in intermediary markets. This competitive advantage perspective was consolidated by Dunning [5] with the so-called OLI-theory (ownership, location and internalization). According to this theory, a firm will decide to invest abroad as a function of having competitive advantages in the form of tangible assets, such as patents, and/or intangible assets, such as trademark, product quality, design etc.

Theories with a macroeconomic perspective were sparked by the

³See Fernandez-Villaverde et al. (2007) and Hamilton (1994).

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Received March 06, 2014; Accepted May 28, 2014; Published June 09, 2014

Citation: Dias MHA, Dias J, Hirata J (2014) Foreign Direct Investment in Brazil: The Effects of Productivity and Aggregate Consumption. J Stock Forex Trad 3: 127. doi:10.4172/2168-9458.1000127

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¹ The data is available in www.bcb.gov.br.

²Obtsfeld e Rogoff (1985), Corsetti e Pesenti (2001), Devereux e Engel (2003), Giulliodori (2004)

seminal work of Cushman [6] in which the real exchange rate and the associated country risk emerge as important factors influencing FDI decisions.

Cushman's theory combines macroeconomic aspects with microeconomic principles, i.e. it is a theory based on optimizing behavior of the firm that takes into account alternative domestic and foreign investment opportunities. In particular, across various specifications of the model, the factors that appear to influence FDI decisions include the exchange rate; country risk; domestic and international market size; relative input prices (long-run real exchange rate); and the availability of the resources required for investments.

Froot and Stein [7] extended Cushman's [6] theory. Their partial equilibrium model considers, in addition to the real exchange rate, as further determinants of FDI flows factors such as tax incentive structures; relative asset-price slumps induced by nominal depreciation of the foreign currency; trade barriers making export-based internationalization less attractive; and investment opportunities created by industry-specific growth in foreign markets.

Along these lines the focus of the theory gradually shifted from an entrepreneurial and microeconomic perspective towards a macroeconomic perspective that highlights the role of economic policy variables such as taxes, exchange rates, and trade barriers for FDI flows. Empirical estimates of variations across industries confirmed the validity of the theoretical work of Froot and Stein [7], demonstrating the influence of macroeconomic variables on FDI decisions, with the main conclusion being that the real exchange rate is a decisive determinant of FDI flows. This result was also corroborated by the study done by Goldberg and Kolstad [8].

Building on these studies, the economic literature put more emphasis on the role of macroeconomic variables in international investment decisions.⁴ For instance, De Mooij and Ederveen [9] and Davies [10] emphasized the influence of tax rates on foreign investment. According to them it is significant and elastic.

Another element highlighted by some studies is the quality of a country's institutions, in particular when measured in terms of corruption. For example, Wei [11] found a negative relationship between several corruption indices and FDI inflows.

Bloningen et al. [12] investigated the effect of trade barriers, finding that firms generally faced considerable effective tariffs and that these tended to encourage FDI inflows by creating a protective barrier that favors domestic production (encouraging the strategy known as "tariff jumping").⁵

For Brazil, the study by Melo and Rodrigues [13] pioneered the empirical analysis of the determinants of FDI inflows. Their time series model for the period of 1970-1985 suggested that the instability of macroeconomic policies and government investments discouraged FDI inflows. Economic growth, on the other hand, was identified as a pull factor for FDI inflows.

Nonnemberg and Mendonça [14] extended this analysis to a panel of 33 countries including Brazil and

covered the period from 1985 to 2000. Their estimates produced significantly positive coefficients for GDP, trade openness, GDP growth over the last five years, country risk and energy consumption, while inflation rate and years of formal education were insignificant.

⁴Ellingsen and Warneryd (1999) emphasized the political economy of protection

⁵Similar view can be found in Desai and Himes Jr (1999).

Mattos et al. [15], using exclusively Brazilian data from 1980 to 2000, also included the real exchange rate in addition to the aforementioned variables such as inflation, country risk, and GDP growth rate. Using a VAR model, they found that the real exchange rate and GDP growth had a positive effect on FDI inflows whereas inflation and country risk exerted a negative influence.

Amal [16] conducted an empirical by-sector analysis of FDI inflows into Brazil. The results suggest that FDI inflows can be explained by the industry production growth rate, industry rate of return, relative wages and the return on previous investments. The industry-specific exchange rate, industry production, industry exports and industry openness turned out not to be significant predictors.

In a more recent paper, Amal et al. [17] extended the analysis to Latin America as a whole. Their dynamic model included macroeconomic and institutional variables such as GDP, international trade volumes, portfolio investment flows, inflation, exchange rate, corruption, foreign investor sentiment, political risk, economic freedom and regional integration. The institutional variables such as political risk and economic freedom were significant predictors of FDI inflows into Latin American countries. GDP had a positive influence on FDI inflows, suggesting that the absolute size of an economy matters for investment decisions. The exchange rate appeared to have a negative influence on FDI inflows, indicating that exchange rate fluctuations do affect cross-border investments.

This study complements the previous ones by investigating the potential influence of productivity variations in Brazil and in the US on FDI inflows into Brazil over the long run. Our analysis will employ an SVAR model (structural VAR). The following section will briefly describe our data.

Empirical analysis of FDI inflows into Brazil: 1992-2011

Our empirical analysis focuses on the effects of exogenous productivity variations both in Brazil and in the US on international FDI flows into Brazil. Changes in productivity are taken to represent structural shocks of the Brazilian (domestic) and US American (foreign) economies. We furthermore investigate the effect on FDI inflows of aggregate domestic consumption as a measure of the domestic market size. The shocks are analyzed by means of impulse-response functions.

Data: For our analysis, we use quarterly data for the period from 1992:1 to 2011:I. Our variables are as follows:

Foreign direct investment (INVEX): nominal FDI inflows into Brazil in USD from the rest of the world using updated series in accordance with the methodology of the Brazilian Central Bank.

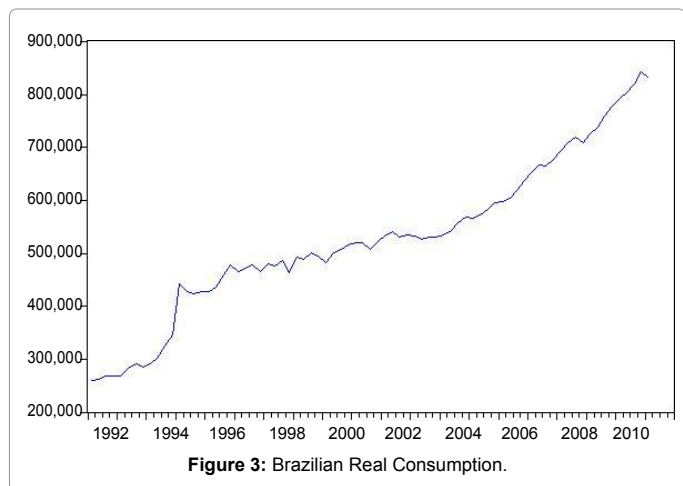
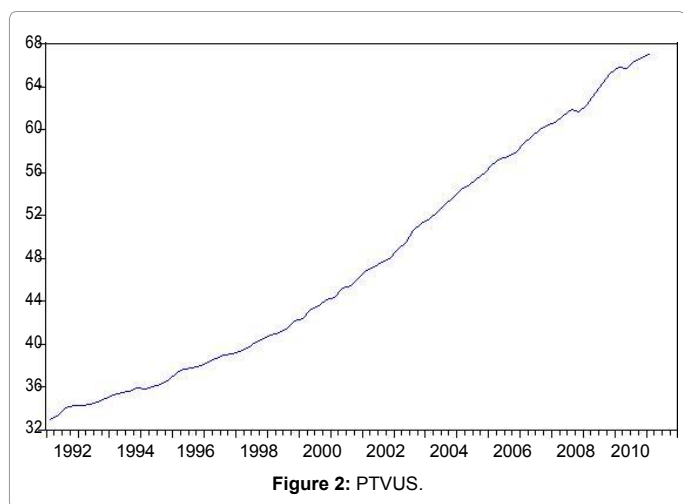
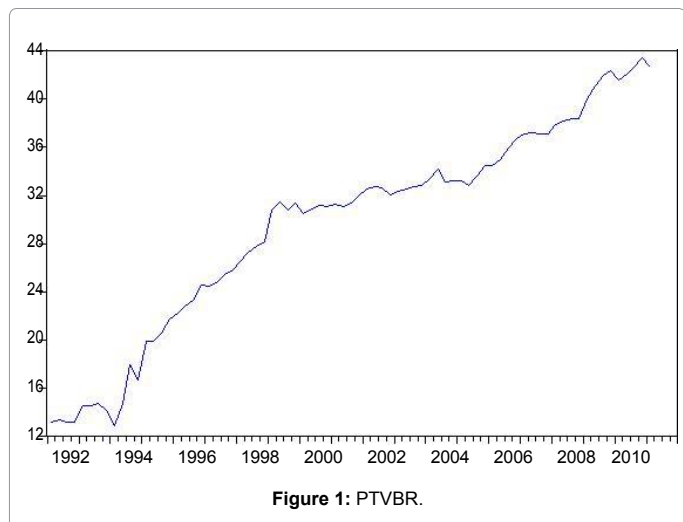
Aggregate consumption (CSRS): consumption of final goods deflated by the consumer price index (IPCA), both series from the Brazilian Institute for Geography and Statistics (IBGE).

Effective real exchange rate (EREX): series produced by IPEA – Instituto de Pesquisa Economica Aplicada.⁶

Productivity in Brazil (PTVBR): labor productivity measured as nominal GDP (expressed in Brazilian Real, BRL, and seasonally adjusted) divided by the total hours worked during the respective year, using IBGE data.

Productivity in the US (PTVUS): labor productivity measured as nominal GDP (expressed in USD and seasonally adjusted) divided by

⁶The data is available in www.ipeadata.gov.br.



the total hours worked during the respective year, using data from the US Bureau of Labor Statistics.

We transform the Brazilian nominal series to US dollar using the nominal exchange rate of the period. Following that these series are converted into real ones using the effective real exchange series by IPEA. Figures 1 and 2 expose the clear upward trend measured by US

dollars per hour worked in productivity in both economies during the period covered, where the Brazilian series is marked by considerable volatility. US productivity exceeds the productivity of the Brazilian economy by a factor of more than 2.

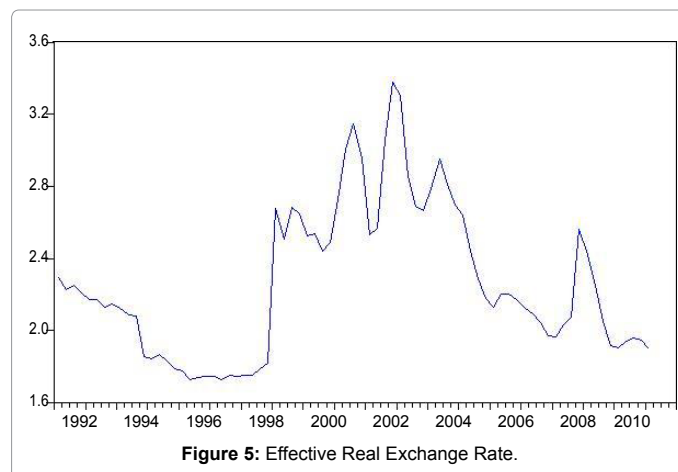
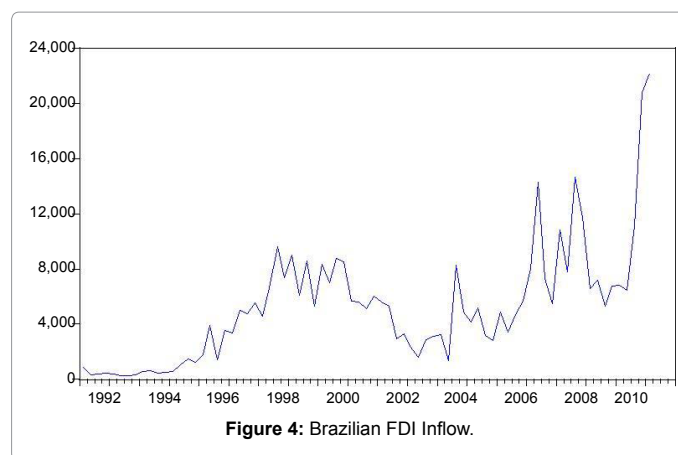
Aggregate consumption in Brazil displays a remarkable upward trend but also sizeable oscillations, with the impact of the 1994 “Plano Real” (currency reform) being neatly reflected by a sudden spike in consumption expenditures, as can be seen in Figure 3.

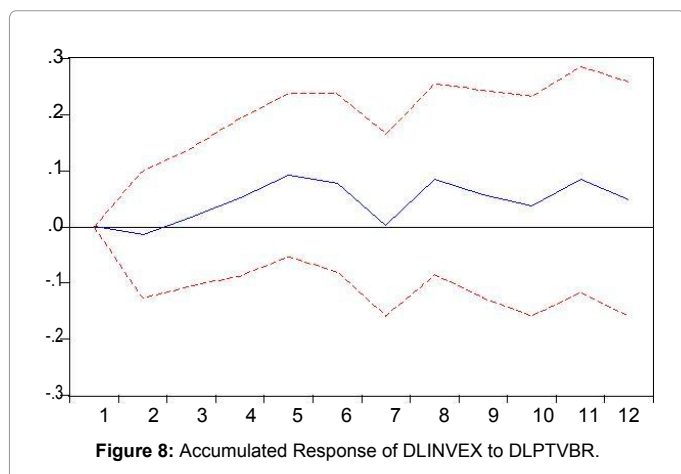
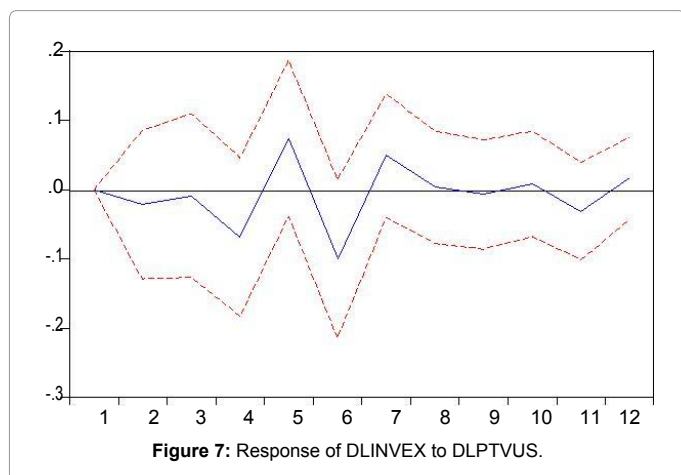
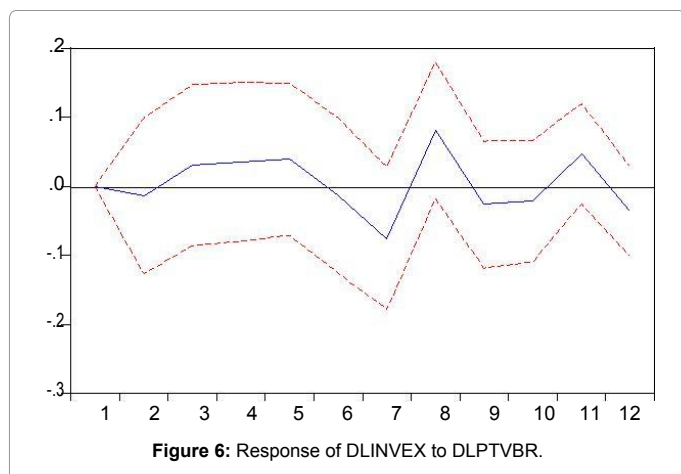
Figure 4 shows FDI inflows (in USD) into Brazil over the period analyzed. The series is marked by rather pronounced fluctuations, with some periods experiencing particularly strong movements, such as the years 2001, 2004, 2006-2008 and 2010.

Figure 5 neatly reflects the extremely low level of FDI during the high-inflation years of 1992 to 1994 as well as a drop in FDI during 2002 and 2003 which were marked by political and economic uncertainties – in part caused by the 2000/2001 asset market crisis – and the energy crisis.

The Figure 6 shows a very intensive period of Brazilian Real money appreciation during the period of 1992 – 1999 before the US dollar. Such appreciation relative to US dollar did return after 2004. The observed spike of depreciation in the above figure happened in 2008 due to the international financial crisis.

Since our objective is to identify the factors that have an effect on FDI inflows in the long run, we will now focus on the results of the econometric analysis.





Empirical Analysis of the Results

Effects of Brazilian and US productivity shocks on FDI inflows into Brazil from 1992 to 2011

First we transformed all series of our model into logarithm ones. Therefore, their change would represent growth changes effects over the long run in the structural SVAR model. Thus, the log change of FDI inflow (DLINVE) depends on the log change of productivity of the Brazilian economy (DLPTVBR) and of the log change of American

economy (DLPTVUS) and on the log change of aggregate consumption in Brazil (DLCSRS) and on the log change of the real effective exchange rate (DLEREX). The performed unit root tests showed that the describe variables are all stationary.

Though not reported here, preliminary estimates revealed that the DLEREX variable was significant in any of our tests. Hence, we dismissed the log change of the real effective exchange rate as a further predictor of DLINVE.

The final long-run SVAR model yields a coefficient matrix C (4x4) ⁷ using 5 lags as determined by the Wald statistic and the criteria for the ordering of lags.⁸

$$y_t = \begin{bmatrix} DLPTVUS \\ DLPTVBR \\ DLCSRS \\ DLINVE \end{bmatrix} C = \begin{bmatrix} +0.07 & 0 & 0 & 0 \\ -0.004 & +0.05 & 0 & 0 \\ -0.02 & +0.03 & +0.013 & 0 \\ -0.08 & +0.26 & +0.08 & +0.20 \end{bmatrix} e_t = \begin{bmatrix} px_t \\ p_t \\ d_t \\ I_t \end{bmatrix} \quad (1)$$

The Wald estimates for joint exogeneity test or the block exogeneity test based on the Granger causality test produced the following result: $\chi^2=17.33$. Thus, the variables statistically satisfy the joint exogeneity criteria. The aggregate consumption when considered in the Granger causality test by itself showed to have some influence of DLINVE. The above specification reflects this condition by making DLCSRS dependent upon DLPTVBR and DLPTVUS being the last one the ultimate exogenous variable.

The Jarque-Bera test for normality of the estimated equation errors yields $\chi^2=79.47$. This result rejects the normality of the SVAR residuals. However, the most important is to verify if the error distribution is stationary. We perform two stationary tests on the SVAR residuals. Both DFGLS = -6.95* and PP = -8.90* were significant at 1%. In other words, the residuals are stationary and not normally distributed. In the SVAR stability test all eigen values are within the unit-root circle, i.e. they are stable over the long run.

Equation (5) indicates that the Brazilian productivity has a positive effect on FDI inflows. The elasticity of FDI inflows with respect to Brazilian productivity is +.26. While aggregate consumption, representing the domestic market size, seems to have a positive effect on FDI inflows (+.08), it is likely to be endogenous to the model. Furthermore, US productivity has a negative effect on FDI inflows into Brazil, with a coefficient of -.08 (all coefficients are significant). This suggests that an exogenous productivity increase in the US will have a depressing effect on the flow of FDI into the Brazilian economy.

In accordance with theoretical models, positive productivity shocks in the Brazilian economy have a stimulating effect on FDI inflows, both temporary and accumulated, as shown by Figures 7 and 8, respectively, where the FDI response is just slightly negative up to the second quarter after a shock. Temporary shocks lead to stronger volatility in the FDI response than accumulated shocks. A permanent shock can increase FDI inflows by up to +.09 in the fourth and fifth quarter.

As expected, positive productivity shocks in the US economy tend to reduce the FDI inflow into Brazil. According to Figure 9, a temporary shock equivalent to one standard deviation has a negative effect on Brazilian FDI receipts, with volatility increasing over the first

⁷Inside the parenthesis is the standard deviation with the star meaning they significant at 1%.

⁸The lag length criteria indicated 05 lags was ideal ones according to the following statistics: LR=32, 15; FPE=1,58e-09; AIC=-9,01. We also used two dummy variables reflecting the economic changes of 1994 and 2004.

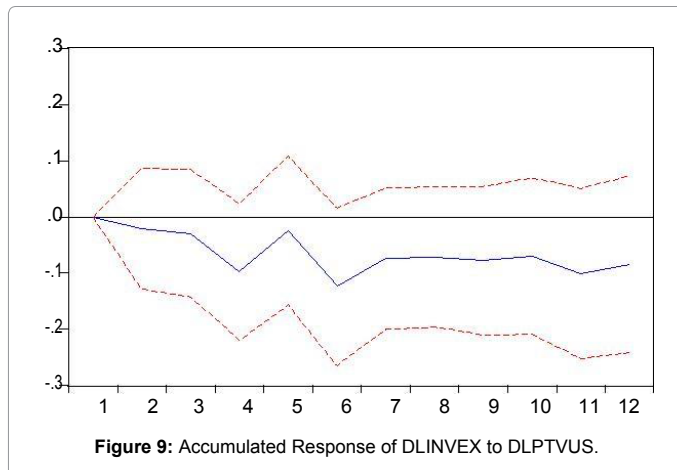


Figure 9: Accumulated Response of DLINVEX to DLPTVUS.

two years. While there are occasional positive peaks in the fifth and seventh semester, the strongest negative effect materializes in the sixth quarter with -0.10 .

The accumulated shocks in US productivity (Figure 7) cause negative effects over the 12 quarters considered in the simulation, reaching -0.12 .

While these impacts may appear small, the effects of productivity variations on FDI flows suggest that these investments tend to gravitate towards economies that experience an increase in their productivity relative to the US. Therefore, policies that enhance an economy's overall productivity may be able to contribute to capturing a share of international investments, including those from the US.

Furthermore, the results from the SVAR analysis suggest that changes in US productivity have no significant effect on the productivity of the Brazilian economy. In other words, the Brazilian productivity seems to be somewhat independent of changes in US productivity, i.e. we found no evidence for productivity spillover effects.

Conclusion

This study analyzed influences on FDI inflows into the Brazilian economy using an SVAR model, using the American economy as a reference. The dynamics of investment flows were investigated using simulations of impulse-response functions for productivity shocks originating in Brazil and in the US.

Generally speaking, the productivity of the Brazilian economy emerged as a pull factor for FDI while accumulated productivity shocks of the US economy have a negative effect on Brazilian FDI inflows, reducing the Brazilian economy's ability to attract international capital.

In our view the reason for not finding any role for effective exchange rate in explaining the FDI inflow to Brazil is due to the fact that productivity does affect relative prices of the economies. In this way exchange rate is just a dependent variable of this more long run process of relative change in productivity among the economies. However, it must be said that further study investigating such broader role of relative productivity increase must be done.

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