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# Measuring the Impact of Financial Flows on Macroeconomic Variables: The Case of Brazil After the 2008 Crisis

Roberto Meurer[1]

[1] Department of Economics, Federal University of Santa Catarina, Florianópolis, Brazil

Correspondence: Roberto Meurer, Department of Economics, Federal University of Santa Catarina, 88040-900 Florianópolis, Santa Catarina, Brazil. E-mail: robertomeurer@yahoo.com

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**Abstract**

The effects of changes in foreign portfolio investment flows on Brazilian GDP and investment during the financial crisis of 2008-2009 are evaluated through correlation coefficients, impulse-response functions, and out of sample forecasts. Impulse-response functions results show a positive relation between financial flows and GDP and investment, for both fixed income and equity flows. There is a change in the relationship between flows and changes in GDP and investment form the fourth quarter of 2008. The changes in the relationship between flows and the real variables show up with a shorter lag when the crisis period is included in the estimations. This change is confirmed by the poor out of sample forecasts from a VAR estimated with pre-crisis data. This means that unobservable variables are affecting GDP, investment, and financial flows during the crisis, despite the macroeconomic conditions of the country. The reduced vulnerability of the Brazilian economy consequently lessened the effect of the crisis when compared with previous crisis episodes.

**Keywords:** foreign portfolio investment, growth, investment, crisis, Brazil

## 1. Introduction

In this paper the relationship between financial flows and real variables in Brazil during the global financial crisis will be explored. The real variables are GDP and investment growth. The financial flows to be analyzed are foreign portfolio investment (FPI) flows trade in the country, because these flows are more prone to be immediately affected by changes in domestic and international scenarios. The hypothesis is that the financial flows are not enough to explain the downturn of the economy during the financial crisis of 2008-2009, but that the decisions which led to flow reversal and reduced investment and output are influenced by the same sort of decisions.

Foreign portfolio investors heavily withdrew resources from Brazil in the final quarter of 2008, even without changes in the country's monetary, fiscal, and external accounts, which could help to explain the fall in GDP and investment during the crisis through a financial channel, the FPI flows, which could react fast to changes in the outlook for the economy or a higher uncertainty perception, and resulting in a "fly to quality" as a consequence. These possibilities will be tested through the relation between GDP growth and changes in investment and the following financial variables: domestic interest rate, real effective exchange rate, country risk, and FPI flows. Results show that the drops in investment and GDP were greater than what would be expected from the outflow of FPI. This means that domestic agents reacted to the crisis in a very pessimistic way, or were more risk averse, which led to a greater fall in GDP and investment, without previous deterioration of external or fiscal accounts. On the other hand, historical experience shows that flows react to fiscal and external accounts figures, which means that if the variables related to them were not good, the fall could have been even worse. In other words, it seems that a macroeconomic policy concerned with stability in public debt, inflation, and current account paid off and allowed for a relatively fast recovery of the Brazilian economy.

There is an important theoretical and empirical relation between risk perception by foreign investors and interest rates. In a fixed exchange regime, higher risk perceived by foreign investors should lead to a higher interest rate, in order to attract capital and avoid the depletion of international reserves. In other words, when the debt risk premium is higher on bonds from domestic issuers, the interest rate has to be higher to maintain parity with international rates. In a floating exchange rate regime the higher debt risk results in capital leaving the country, and domestic currency will then depreciate. Given a pass-through from external to internal prices, exchange rate

depreciation has to be followed by a tightening of the monetary policy, increasing the interest rate in order to fight inflation rates. This means that debt risk should lead the policy interest rate.

It is customary for the Brazilian Central Bank to intervene in the forex market, trying to influence the exchange rate or its volatility, even since the adoption of a floating exchange rate regime in 1999. Debt risk, as measured by an index like the EMBI+, on the other hand, is determined in the securities market. Both debt risk and exchange rates can be influenced by the same perceptions and information, but the exchange rate should be less sensitive, because of its relations to the real economy through imports, exports, factor remunerations, and not only financial market indicators.

The crisis has shown again that financial variables have an influence on the behavior of the real economy and how strong this influence can be. Suppressing or reverting previous financial flows had strong impacts on economic growth around the world. In the specific case of Brazil, there was an initial belief that the crisis initiated in 2008 would not strongly affect the economy because it was not generated in the country by Brazilian monetary, fiscal or external conditions. In fact, Brazil and other emerging economies were harshly affected. If the cause of decreased output in emerging economies is not in respective local economy fragilities or economic policies, there has to be a link between the local and world economies which leads to the fall. Given that this crisis originated mainly in the financial system (Aït-Sahalia et al., 2010), the operation of the financial system or international flows of resources could be a good first guess for the origin of the problem. If the flows were responsible, an econometric model linking the flows and real variables should detect them as the cause. The question raised in this paper is if the reversal of FPI flows is enough to explain the slowdown of the Brazilian economy after the crisis. The channels that are working are not modeled, but some hints of the operation can be derived from the results.

The paper is structured as follows. In the second section a brief theoretical revision is presented. It relates to financial flows and their importance for growth, current account and foreign reserves and their relation with economic policy and the exchange rate regime. In the third section the data are explained and put in perspective, along with the descriptive statistics. Section four shows the econometric results and discussion. It covers contemporaneous correlations between the variables, impulse-response functions, and out of sample forecasts. Section five presents the concluding remarks. The results show that the changes in the real variables are not only a reaction to financial flows, and the relations between financial flows and real variables changed during the crisis.

This paper fits in a growing recent strain of analysis of gross capital flows, which take in account if the flows are originated by domestic or foreign investor, instead of net flows which do not disaggregate between investors (Forbes & Warnock, 2012; Broner et al., 2013). Specifically, in this paper it is dealt with flows of foreign investors to and from portfolio investments in Brazil.

## 2. Importance of Flows, Balance of Payments, and Exchange Rate

Relying on FPI for financing economic growth assumes the risk that a country become dependent on FPI flows, and if and when these flows revert, domestic growth is hampered (Griffith-Jones & Ocampo, 2009). The effects of the instability of the financial flows are explored in literature on sudden stops (Calvo, 2003) and current account reversals (Edwards, 2008). When a sudden stop happens, it is necessary to reduce domestic absorption, because less international financing is available as a counterpart to the current account deficit. This lessens the demand for imported products but also for domestic output with foreign inputs, induced by higher costs of imported products given by a depreciated exchange rate or barriers to imports. In more open countries the costs are lower (Edwards, 2008). The sudden stop has more immediate effects on the economy than current account reversals (Edwards, 2007).

International financing through FPI can have a stabilizing effect on the economy if the flows occur when the asset prices are low. FPI can also be a feasible financing alternative, diversifying sources of finance. The volatility of the flows is unavoidable because they react to constantly revised information (Errunza, 2001). The "market sentiment" plays an important role in the determination of flows (Baek, 2006). Credit conditions also help to explain the real effects of flows (Chor & Manova, 2012).

The effect of the flows on real variables can happen through the effect on demand via exchange rate or credit, or indirectly by influencing the behavior of the financial system. The effect through exchange rate or credit means that higher inflows would lead to an appreciation of the domestic currency, stimulating imports and making domestic production relatively costly, thus inhibiting its growth. On the other hand, an appreciated currency can induce higher investment in imported equipment and software. The domestic financial institutions or firms could employ international resources as funding to expand domestic credit or investment, thus leading to higher

growth.

The short run effects, through current account financing and exchange rates, are important, and the strong swings in flows give importance to the effects of the FPI. Because of these interrelations between flows and real variables, other variables that are important for the behavior of GDP and investment have to be considered. The exchange rate will affect prices of domestic output relative to foreign, which has an impact on output. On the other hand, the exchange rate reacts to expectations and could be a risk indicator in the short run. Expectations about the domestic economy will also be reflected in the country's risk. The hypothesis is that GDP and investment are negatively affected by local currency depreciations and higher country risk. The channel for this could be the financial gap, because of the influence on flows, or shared expectations about the Brazilian economy among domestic producers, consumers, and foreign investors. This would lead to the possibility that foreign investment flows are related to domestic GDP and investment not only because there is more (less) financing available in periods of optimism (pessimism) but also that the evaluation of the future of the economy by domestic and foreign agents is similar. The interest rate is also included and could work through a direct relation to demand for consumption or investment or indirectly through the exchange rate, with a negative relation between interest rate and GDP and investment.

The economic fundamentals, like inflation, fiscal and external accounts, and their expectations have an important role in the behavior of financial variables, because in the long run financial assets have to reflect what happens to the real variables behind them. But these expectations also influence decisions about real variables like output and investment. This means that there is a strong link between fundamentals and financial variables, which is explored in literature, e.g. Soares, Pinto, and Moreira (2010), and Teles and Leme (2010).

## 3. Data, Context, and Descriptive Statistics

It seems that real and financial variables in the Brazilian economy were behaving normally at the beginning of the crisis, with obvious links to the external scenario and influences from domestic economic policy. Things changed noticeably in the fourth quarter of 2008. GDP dropped and investments fell even more. Brazilian policy makers reacted through fiscal incentives in selected sectors and an ease on monetary policy. As a consequence, in the first quarter of 2009 Brazil's interest rate was reduced to its lowest level in history up to that time.

In the fourth quarter of 2008, Brazilian GDP fell 3.9% and investment fell 10.3% in comparison to the previous period, the all-time peak observed in the third quarter of 2008. In the first quarter of 2009, the declines were another 1.5% and 12.8% in comparison to the fourth quarter of 2008. Recovery began in the second quarter of 2009. The relation of these shortfalls to the international crisis is not straightforward. Unlike previous crises that impacted Brazil, when the recent financial crisis became stronger and spread around the world, Brazil's external accounts situation was comfortable. By the end of September, 2008, the country had accumulated a bulk of 224 billion dollars in reserves, more than the total of the then 211 billion dollars external debt. The current account deficit was around 25 billion dollars in the 12 months prior to September, 2008, about 1.6% of GDP. This deficit was easily financed by foreign direct investment and FPI. This could mean that the impact of the crisis would be small in countries like Brazil, as believed by politicians like Brazil's then President Lula. As the data demonstrates, the crisis hit Brazil strongly and the channel for this effect is an interesting field of research.

Balance of payments data disaggregate FPI in four types of investments: equity traded in the country, equity traded abroad, fixed income traded in the country, and fixed income traded outside the country. As assets traded in Brazil have to be denominated in local currency, trading in the country or outside the country means that investors are exposed to different risks. Beyond the usual market risk, from the international investor's standpoint, assets traded in Brazil also incur the Brazilian currency exchange rate risk. There would be also the convertibility risk, given the possibility that the conversion of local assets in foreign exchange could be restricted or even prohibited. During the time span analyzed in this paper there has not been any restriction of this kind. Rather, it has been the other way around; in times of strong inflows taxes were imposed on inflows in order to try to reduce the flows. This difference in risks is one of the reasons for separating flows traded inside and outside the country. The other is that while flows related to trades inside the country can come from both primary and secondary markets, in the case of trades abroad only primary market operations are registered in the balance of payments. This means that only the first sale of equity or bonds and their repayments have an impact on the balance of payments. All the secondary market trades do not have a direct impact on Brazilian foreign assets and liabilities. One difference that arises between flows in the country and abroad is that the latter are subject to demand and supply shocks, which can lead to situations in which no operations are carried out at all. Secondary market operations can occur at any time, while primary market operations are evaluated by issuers and buyers over the adequacy of the prices for the issuance to take place or not. The disaggregation of the flows between

equity and fixed income follows the traditional classification of financial market assets.

Because the flows related to securities traded abroad are the primary issues or repayments of these securities and depend on the decisions of the Brazilian private sector or government to do so, only the flows related to trades inside Brazil are analyzed. In this way, the decisions of market participants to buy or sell Brazilian securities are feasible at any moment, because of the existence of a secondary market for equity and fixed income securities in Brazil.

It is expected that the behavior of the different flows will show differences between them, but they also should have similarities, due to the common underlying Brazilian economy.

The data employed in this paper is described in Table 1. An L at the beginning of the name of the variable means it is expressed in logarithms and D means it is the first difference of the series. Data are quarterly, from 1995 to 2009.

Table 1. Data employed–quarterly series: 1995 to 2009

| Variable | Description | Source | Remarks |
|---|---|---|---|
| FC | Fixed Income Foreign Portfolio Investment (non-residents), net flow, traded in the country | Brazilian Central Bank | In billions of US dollars, at prices of the last quarter of 2009, employing the CPI as deflator |
| EC | Equity Foreign Portfolio Investment (non-residents), net flow, traded in the country | Brazilian Central Bank | In billions of US dollars, at prices of the last quarter of 2009, employing the CPI as deflator |
| LGDP | Log of real GDP index | Ipeadata | Log of the seasonally adjusted index, basis 1995 = 100 |
| DLGDP | First difference of LGDP | | |
| LINV | Log of the total investment index | Ipeadata | Log of the seasonally adjusted index, basis 1995 = 100 |
| DLINV | First difference of LINV | | |
| LER | Log of the real effective exchange rate, consumer price deflated | Brazilian Central Bank | Log of the index, basis June 1994 = 100 |
| DLER | First difference of LER | | |
| SELIC | Selic Interest rate, the monetary policy interest rate | Brazilian Central Bank | Average of monthly rates |
| RISK | Brazilian EMBI+ spread over US Treasury bonds | Datastream | In basis points (100 basis points = 1%). Average of daily spreads |
| DRISK | First difference of RISK | | |

The total value of FPI flows in comparison to GDP and current account is significant. The net values of FPI grew from values near to zero prior to 1990 to peaks near 50 billion dollars in 2007 and 2009 with outflows higher than 5 billion dollars in 2002 and 2004, the only years with outflows since 1991. For the period from 1995 to 2009, the average net inflow was 13.5 billion dollars. These figures represent 48% of the financial account balance from 1995 to 2009. On average, FPI represented 89% of the foreign direct investment value. For the total amount of flows, FPI was 66% of the value of foreign direct investment from 1995 to 2009. As a proportion of GDP, FPI ranged from -1% in 2002 to 3.5% in 2007.

Figure 1 shows the quarterly net flows (inflows minus outflows) of FPI traded inside the country from 1995 to 2009. Flows of FPI traded in the country have become more important in both equity and fixed income from 2005 onwards. These flows show strong inflows and outflows in several quarters. In the last quarter of 2008 equity flow (EC) was negative (8.8 billion dollars), but there was also a strong outflow over the whole third quarter (7.2 billion dollars), the same value that entered the country in the second quarter. The crisis may have generated the fourth quarter outflow, but outflows do not occur only in times of crisis. Fixed income flow (FC) shows outflows of US$ 1.6 and 1.7 billion in the last quarter of 2008 and the first quarter of 2009, contrasting with a net inflow of US$ 16.9 billion over the first three quarters of 2008. In the last three quarters of 2009, Brazil again attracted FPI.

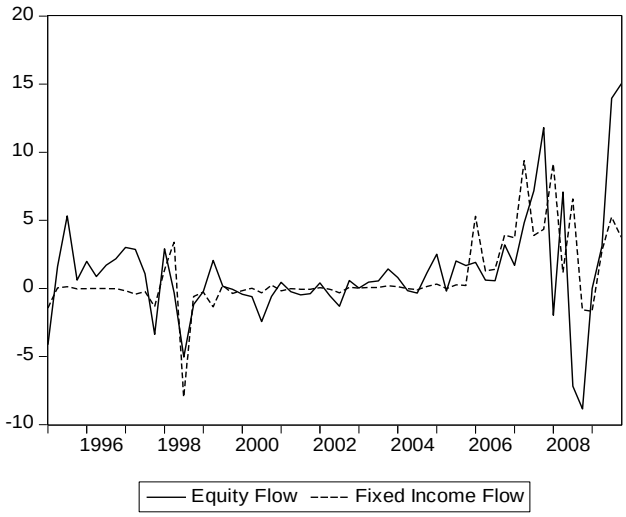


Figure 1. Brazil–net foreign portfolio investment, in billions of dollars of 2009

Figure 2 shows real and financial variables that are linked to the flows. GDP shows steady growth beginning in 2004, but prior to this its growth rate was unstable. GDP fell 3.5% in the fourth quarter of 2008 and another 0.9% in the first quarter of 2009. Investment stagnated since the beginning of the period, but shows growth from 2004 onwards. During the crisis investment was more strongly hit. GDP began to recover in the second quarter of 2009 and at the end of the year its level was 0.6% above that prior to the crisis. Investment also began to recover in the second quarter of 2009, but in the last quarter of 2009 was still 7% below its pre-crisis level. The monetary policy interest rate, dubbed SELIC, changed according to its main objective of controlling the exchange rate from 1995 to 1998. Since then the main purpose of monetary policy has been to control inflation through formal inflation targeting. Immediately before the crisis in September of 2008, the interest rate had been raised due to fears of inflation, given expanded demand and a high level of utilization of capacity in industry. The rate was reduced from January to April, 2009, then reaching historically low levels.

The Brazilian currency suffered a strong depreciation in 1999, forcing a change to a floating exchange rate. Since then the currency has remained sensitive to local and international environments, like the Argentinean crisis in 2001 and the fear of Lula winning the Presidential election in 2002. The exchange rate continuously appreciated from 2003 until the third quarter of 2008. With the crisis, in the fourth quarter of 2008 the Brazilian currency depreciated, but after that appreciated again. Risk was at historically low level at the beginning of the crisis.

The local currency depreciated during the beginning of the crisis, and turned to appreciation in 2009, almost the same behavior of the EMBI+ spread, a measure of risk which peaked in October of 2008. It is clear that the financial crisis had strong effects on real and financial variables. The possibility of a “decoupling” of the emerging market economies, like the Brazilian, soon would be ruled out. The situation of fiscal and external accounts does not explain the strong fall in output and investments, unlike the other crises which had plagued the Brazilian economy in previous times.

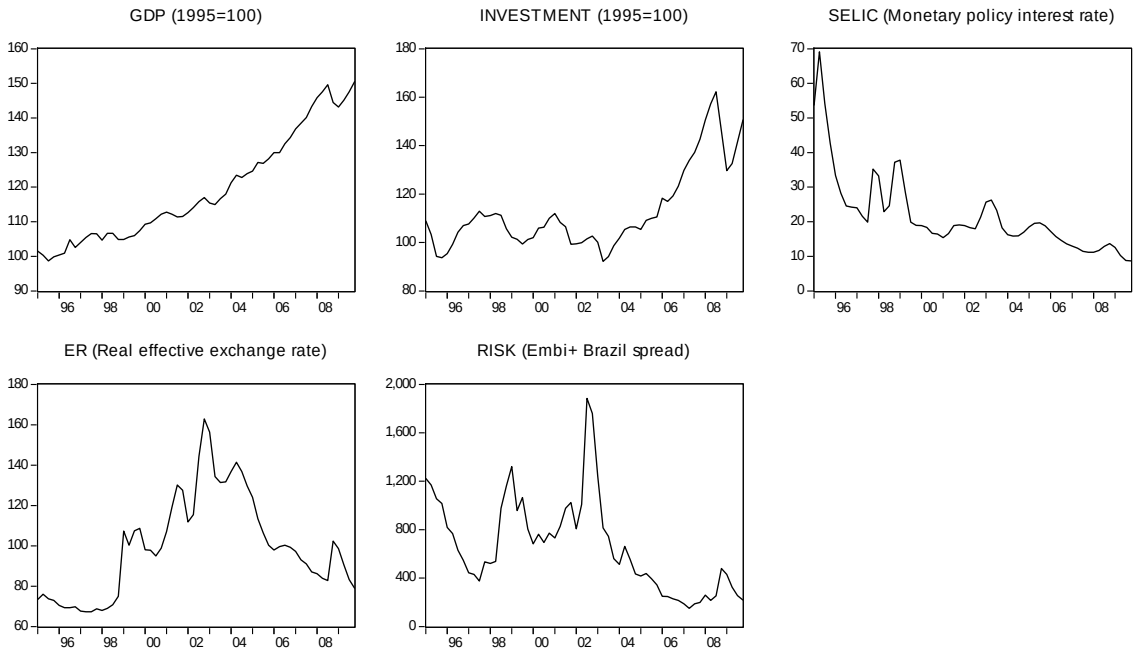


Figure 2. Brazil–GDP index, Investment index, interest rate, real effective exchange rate and EMBI+risk–1995Q1 to 2009Q4

Table 2 shows the descriptive statistics of the variables. Flows have a similar pattern, with positive and negative values, and their coefficient of variation (standard deviation divided by average) is above three.

Table 2. Descriptive statistics of the variables–1995Q1 to 2009Q4

| | FC (billion dollar) | EC (billion dollar) | DLGDP (≅ % Change) | DLINV (≅ % Change) | SELIC (%) | ER (index June 1994=100) | RISK (basis points) |
|---|---|---|---|---|---|---|---|
| Average | 0.829 | 1.154 | 0.007 | 0.006 | 21.736 | 99.570 | 658.364 |
| Maximum | 9.380 | 15.049 | 0.038 | 0.067 | 69.120 | 162.883 | 1884.643 |
| Mínimum | -7.983 | -8.849 | -0.035 | -0.118 | 8.650 | 67.237 | 149.809 |
| St.Dev. | 2.631 | 3.958 | 0.013 | 0.040 | 11.418 | 25.014 | 386.427 |
| Coef.Var. | 3.175 | 3.429 | 1.973 | 7.158 | 0.525 | 0.251 | 0.587 |
| N > 0 | 32 | 37 | 44 | 41 | 60 | 60 | 60 |

For the real variables GDP and investment growth the results are also as expected, with greater stability in GDP in comparison to investment. The financial variables interest rate, exchange rate, and risk show high volatility. The interest rate has a maximum of 69.1% and a minimum of 8.7%, with a high average of 21.7%. The highest exchange rate is 2.4 times the value of the lowest. These values are already smoothed by the average in the quarter and because nominal changes in prices are taken into account by calculating the real effective rate. Risk shows high variability because of the structural change in Brazilian foreign accounts and volatility in international financial markets.

Table 3 shows the unit root test results for the variables. These tests are carried out in order to avoid spurious results in the regressions. Log of GDP (LGDP), log of investment (LINV), log of real effective exchange rate (LER), and risk are stationary in first differences. The SELIC rate is level stationary. The equity flow is stationary, but the fixed income flow is not. An examination of the behavior of this flow, Figure 1, shows that there seems to be a structural break in 2006Q1. Without enough observations to undergo the whole procedure suggested in Perron (1989, 1990), Perron's (1989) suggestion of estimating two regressions with one autoregressive term for the period before and after the break is followed. A Wald test rejects the null hypothesis that the autoregressive coefficient is equal to one for each equation. This means that the variable is stationary with a structural break in 2006Q1. The reason for this break is the exemption of foreign investors from income

tax on earnings from public debt securities from February, which leads to a hike in inflows.

Table 3. ADF tests results 1995Q1 to 2009Q4 (tests include intercept)

| Variable | t-ADF | Prob | Lags |
|---|---|---|---|
| FC | -1.843 | 0.3566 | 0 |
| EC | -4.804 | 0.0001 | 3 |
| LGDP | 1.125 | 0. 9973 | 0 |
| DLGDP | -7.7592 | 0.0000 | 0 |
| LINV | -0.1873 | 0.9339 | 2 |
| DLINV | -6.8748 | 0.0000 | 1 |
| SELIC | -6.010 | 0.0000 | 3 |
| LER | -1.333 | 0.6088 | 0 |
| DLER | -6.338 | 0.0000 | 0 |
| RISK | -1.879 | 0.3399 | 0 |
| DRISK | -6.574 | 0.0000 | 0 |

## 4. Results and Analysis

This section will attempt to explain the behavior of the GDP and investment change variables. The contemporaneous correlation and the impulse-response functions to shocks on the financial flows are analyzed, as it is an out of sample forecast for the crisis period.

Tables 4 and 5 show the correlations between the variables of interest for the 1995Q1-2008Q3 and 1995Q1-2009Q4 periods. The correlations between DLGDP and DLINV are positive and statistically significant as expected. One reason is that investment is a part of GDP. Correlations are also positive and significant between FC and the real variables DLGDP and DLINV. The correlation between interest rates and the real variables is negative and statistically significant, showing that there is some monetary policy channel that operates as fast as during the same quarter. An interesting result is a statistically significant negative correlation between the interest rate and FC. It shows that higher interest rates are associated to fixed income outflows (or lower inflows). This could be related to a higher risk perception of domestically traded fixed income securities when interest rates are higher. This relation also shows up through the positive correlation between domestic currency depreciation and country risk. The negative and significant correlation between country risk and financial flows appears only for EC flows, and can be explained by the high level of Brazilian interest rates in comparison to the rest of the world and to the growing share of foreigners in the Brazilian domestic public debt that favored FC inflows.

Table 4. Correlation coefficients: 1995Q1-2008Q3 (Statistically significant at 5% level in bold)

| | DLGDP | DLINV | SELIC | DLER | DRISK | EC | FC |
|---|---|---|---|---|---|---|---|
| DLGDP | 1.000000 | | | | | | |
| DLINV | **0.636955** | 1.000000 | | | | | |
| SELIC | **-0.494595** | **-0.543436** | 1.000000 | | | | |
| DLER | -0.092963 | -0.083995 | 0.109115 | 1.000000 | | | |
| DRISK | 0.037590 | 0.064963 | 0.025368 | **0.556404** | 1.000000 | | |
| EC | 0.088031 | 0.117349 | -0.109270 | -0.204805 | **-0.311801** | 1.000000 | |
| FC | **0.284609** | **0.385158** | **-0.357147** | -0.137129 | -0.133194 | **0.287061** | 1.000000 |

Table 5. Correlation coefficients: 1995Q1-2009Q4 (Statistically significant at 5% level in bold)

| | DLGDP | DLINV | SELIC | DLER | DRISK | EC | FC |
|---|---|---|---|---|---|---|---|
| DLGDP | 1.000000 | | | | | | |
| DLINV | **0.707995** | 1.000000 | | | | | |
| SELIC | **-0.399748** | **-0.397461** | 1.000000 | | | | |
| DLER | **-0.242688** | -0.208899 | 0.122761 | 1.000000 | | | |
| DRISK | -0.040105 | -0.009534 | 0.028777 | **0.570790** | 1.000000 | | |
| EC | **0.305789** | **0.365781** | -0.184466 | **-0.349231** | **-0.295013** | 1.000000 | |
| FC | **0.352569** | **0.454842** | **-0.366982** | -0.207421 | -0.156461 | **0.400869** | 1.000000 |

For the pre-crisis period the correlations between DLGDP and DLINV and the EC flow are not statistically significant. This happens because the financial flows anticipate the behavior of the real variables, and they have no contemporaneous correlation.

When the crisis period is included in the calculation of the correlations, the main change is that correlation between flows and real variables turns significant also for the EC flow, while for the FC flow it gets higher. This shows that instead of only the anticipation of the behavior of GDP and investment by the equity flows, this relation also happens contemporaneously. This means that more optimism or pessimism about the future affects the financial flows but also the production decisions, beyond the lagged effects. The specific cause for the changes in the correlations is the strong fall in GDP and investment in 2008Q4 and 2009Q1 and recovery after that, while there is a strong outflow of EC in 2008Q4 (8,8 billion dollars) and high inflow from 2009Q2 to 2009Q4. This results show that there is a change in the pattern of the relationship of flows, investment and GDP during the crisis, reacting to unobservable factors.

An advantage of the VAR estimation is that it does not include contemporaneous relationships, avoiding the endogeneity issue. The impulse-response functions were estimated with data for the pre-crisis period, 1995Q1 to 2008Q3 and for the period including the crisis, 1995Q1 ton 2009Q4. As the Brazilian Central Bank adopted a semi-fixed exchange rate from 1995 to 1998, a dummy variable will be included for this period. The estimated VARs for changes in GDP and investment are:

$$DLGDP_t = c + a_1DLGDP_{t-1} + a_2DLGDP_{t-2} + a_3DLGDP_{t-3} + a_4DLGDP_{t-4} + a_5DLGDP_{t-5} + b_1DLINV_{t-1} + b_2DLINV_{t-2} + b_3DLINV_{t-3} + b_4DLINV_{t-4} + b_5DLINV_{t-5} + d_1SELIC_{t-1} + d_2SELIC_{t-2} + d_3SELIC_{t-3} + d_4SELIC_{t-4} + d_5SELIC_{t-5} + e_1DLER_{t-1} + e_2DLER_{t-2} + e_3DLER_{t-3} + e_4DLER_{t-4} + e_5DLER_{t-5} + f_1FC_{t-1} + f_2FC_{t-2} + f_3FC_{t-3} + f_4FC_{t-4} + f_5FC_{t-5} + g_1DRISK_{t-1} + g_2DRISK_{t-2} + g_3DRISK_{t-3} + g_4DRISK_{t-4} + g_5DRISK_{t-5} + \varepsilon$$

$$DLGDP_t = c + a_1DLGDP_{t-1} + a_2DLGDP_{t-2} + a_3DLGDP_{t-3} + a_4DLGDP_{t-4} + a_5DLGDP_{t-5} + b_1DLINV_{t-1} + b_2DLINV_{t-2} + b_3DLINV_{t-3} + b_4DLINV_{t-4} + b_5DLINV_{t-5} + d_1SELIC_{t-1} + d_2SELIC_{t-2} + d_3SELIC_{t-3} + d_4SELIC_{t-4} + d_5SELIC_{t-5} + e_1DLER_{t-1} + e_2DLER_{t-2} + e_3DLER_{t-3} + e_4DLER_{t-4} + e_5DLER_{t-5} + f_1EC_{t-1} + f_2EC_{t-2} + f_3EC_{t-3} + f_4EC_{t-4} + f_5EC_{t-5} + g_1DRISK_{t-1} + g_2DRISK_{t-2} + g_3DRISK_{t-3} + g_4DRISK_{t-4} + g_5DRISK_{t-5} + \varepsilon$$

$$DLINV_t = c + a_1DLGDP_{t-1} + a_2DLGDP_{t-2} + a_3DLGDP_{t-3} + a_4DLGDP_{t-4} + a_5DLGDP_{t-5} + b_1DLINV_{t-1} + b_2DLINV_{t-2} + b_3DLINV_{t-3} + b_4DLINV_{t-4} + b_5DLINV_{t-5} + d_1SELIC_{t-1} + d_2SELIC_{t-2} + d_3SELIC_{t-3} + d_4SELIC_{t-4} + d_5SELIC_{t-5} + e_1DLER_{t-1} + e_2DLER_{t-2} + e_3DLER_{t-3} + e_4DLER_{t-4} + e_5DLER_{t-5} + f_1FC_{t-1} + f_2FC_{t-2} + f_3FC_{t-3} + f_4FC_{t-4} + f_5FC_{t-5} + g_1DRISK_{t-1} + g_2DRISK_{t-2} + g_3DRISK_{t-3} + g_4DRISK_{t-4} + g_5DRISK_{t-5} + \varepsilon$$

$$DINV_t = c + a_1DLGDP_{t-1} + a_2DLGDP_{t-2} + a_3DLGDP_{t-3} + a_4DLGDP_{t-4} + a_5DLGDP_{t-5} + b_1DLINV_{t-1} + b_2DLINV_{t-2} + b_3DLINV_{t-3} + b_4DLINV_{t-4} + b_5DLINV_{t-5} + d_1SELIC_{t-1} + d_2SELIC_{t-2} + d_3SELIC_{t-3} + d_4SELIC_{t-4} + d_5SELIC_{t-5} + e_1DLER_{t-1} + e_2DLER_{t-2} + e_3DLER_{t-3} + e_4DLER_{t-4} + e_5DLER_{t-5} + f_1EC_{t-1} + f_2EC_{t-2} + f_3EC_{t-3} + f_4EC_{t-4} + f_5EC_{t-5} + g_1DRISK_{t-1} + g_2DRISK_{t-2} + g_3DRISK_{t-3} + g_4DRISK_{t-4} + g_5DRISK_{t-5} + \varepsilon$$

For the impulse-response functions generalized impulses are employed. The results reported on Figures 3 and 4 are generated by VARs with the longest lag between AIC, SC, or HQ criteria, allowing for up to five lags. Choosing the longest lag allows for real variables to react to financial variables. Figure 3 shows the results for the impulse-response functions of a shock in FC on DLGDP and DLINV for the periods 1995Q1-2008Q3, panels a and b, and 1995Q1-2009Q4, panels c and d. The VAR includes five lags, according to the AIC, which generates a less parsimonious model. Results for DLGDP show a positive reaction to the flow, which is statistically significant up to the sixth quarter in the pre-crisis sample and up to the fourth quarter in the whole sample that includes the crisis. In the case of DLINV the relation is simillar. The effect of the shock is positive and statiscally significant up to the seventh quarter. When the crisis period is included in the sample the effect is positive only up to the fourth quarter. This means that the relation betwenn flows and economic activity is less persistent when the crisis period is included.

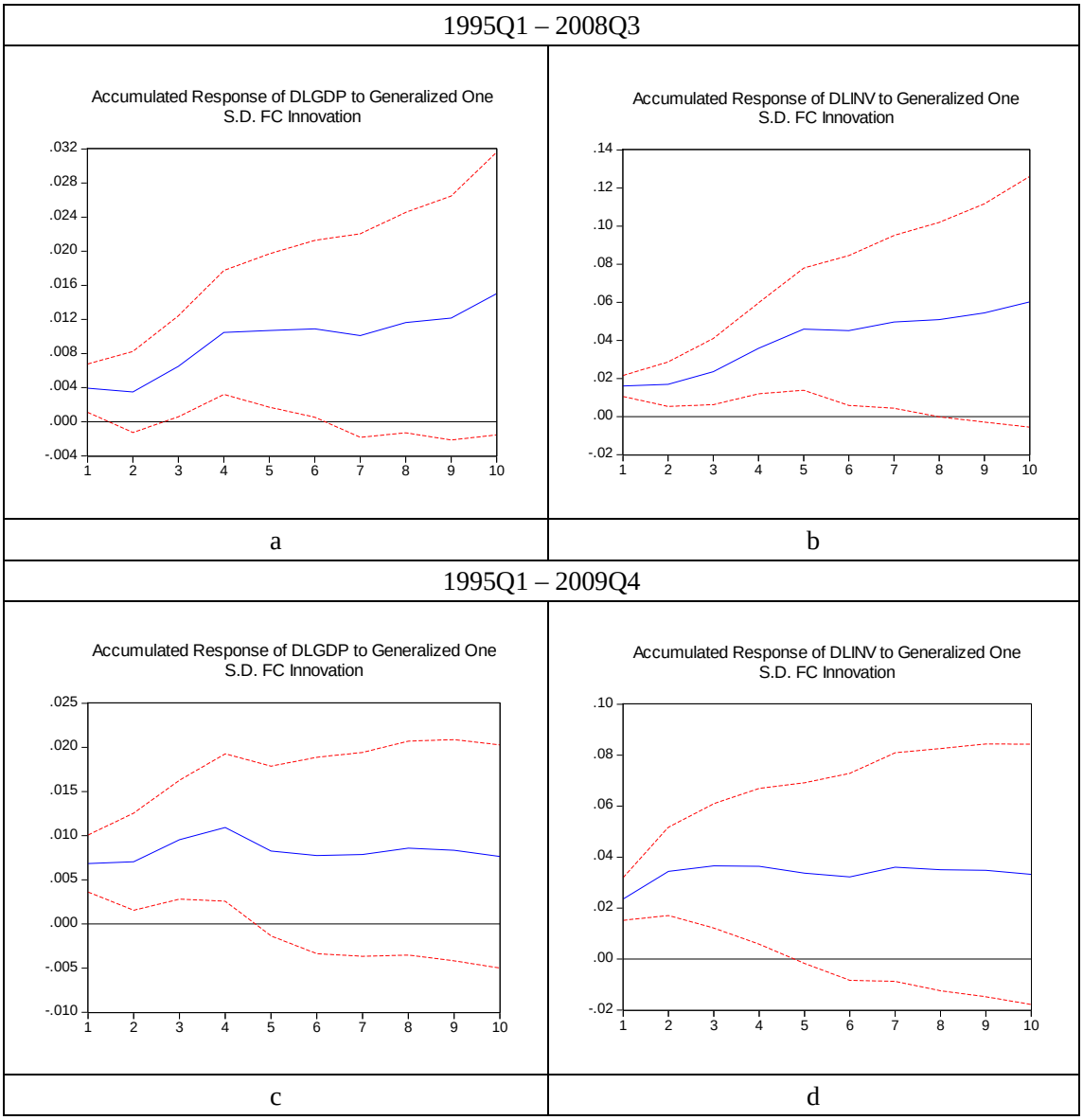


Figure 3. Response of DLGDP and DLINV to a shock in FC flow

As the relation between portfolio flows and investment is not straight, it is necessary to explore possible transmission channels which could explain the empirical relations shown through the VAR. These results are not reported, but are available on request. One explanation may be through interest rates, because a positive shock on flows has a negative and persistent effect on the interest rate before the crisis. The change in the relationship between the variables as a consequence of the crisis also appears in this case, as the relation between flows and interest rate is not significant anymore in the sample that includes the crisis. The relation between domestic and external financial market can also be illustrated by the positive reaction of the SELIC interest rate to a shock on country risk.

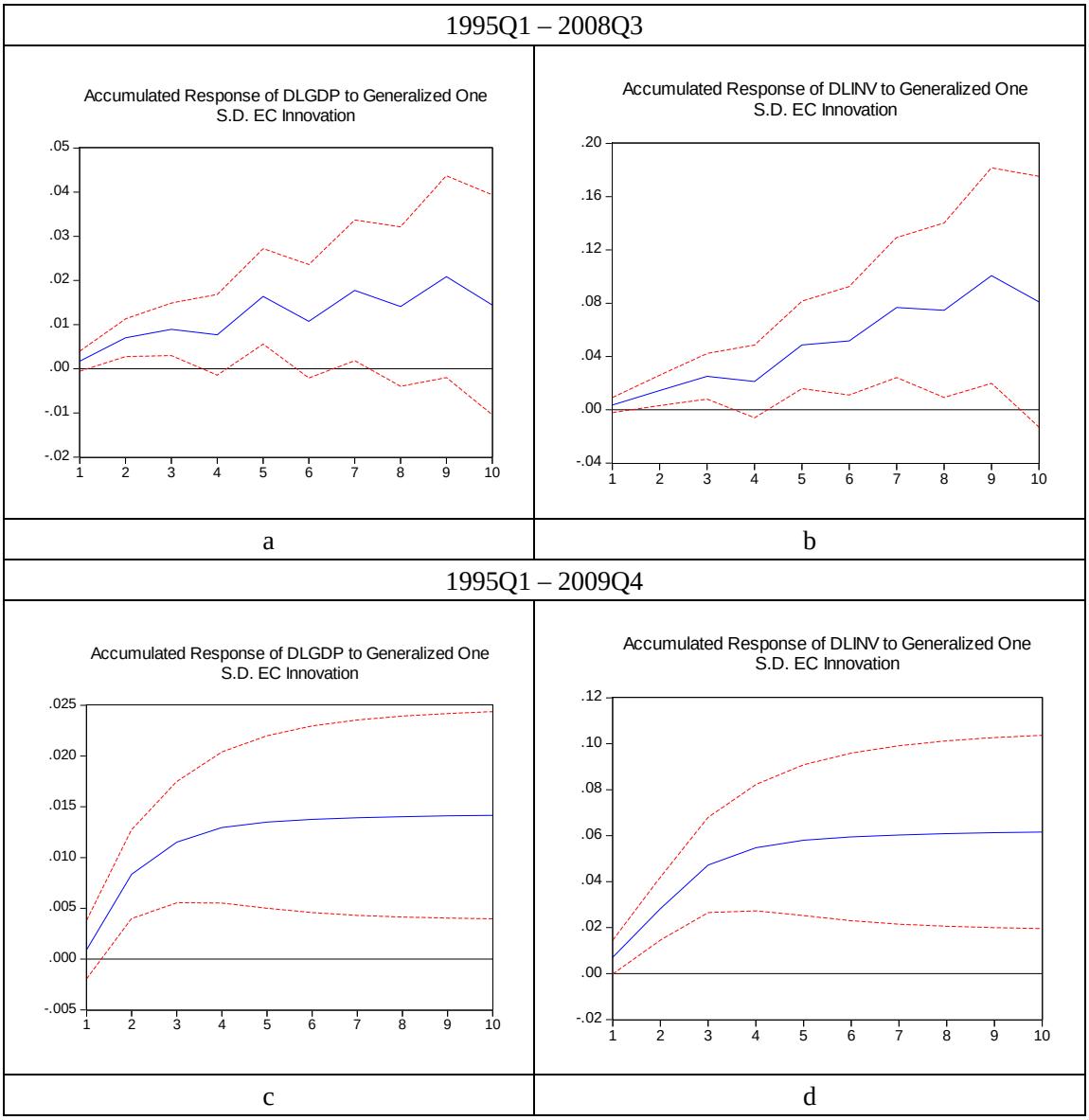


Figure 4. Response of DLGDP and DLINV to a shock in EC flow

Figure 4 shows the results of the impulse-response functions for a shock on EC. For the pre-crisis period the VAR includes five lags, following AIC. There is a significant positive effect on DLGDP up to the fifth quarter and up to the ninth quarter on DLINV. The magnitude of the effect is higher on investment, which is in line with the share of investment in GDP. When the crisis period is included in the VAR there are some important changes in the results. The optimal lag is one according to all criteria. The permanent effect of the shock on DLGDP and DLINV is reached faster, up to the fourth quarter. This faster reaction of the real variables is in line with the change in contemporaneous correlations discussed above. This reinforces that there is a change in the decision making process that affects investment, output and portfolio flows, because of the uncertainties generated by the financial crisis, leading to a modified relationship between the variabels when compared to the pre-crisis period.

Results from further impulse-response functions (not included, but available on request), show that a positive shock in FC is related to domestic currency appreciation and to lower interest rates. For a shock in EC flows, the interest rate reacts as it would to an FC shock, while a clear relation with the exchange rate does not appear.

In order to test the robustness of the hypothesis that the instability generated by the financial crisis changed the relationship between the analyzed variables an out of sample forecast for DLGDP and DLINV with the VAR estimated with pre-crisis data was carried out. Results are shown in Figure 5. The forecasted values are for the 2008Q4-2009Q4 period.

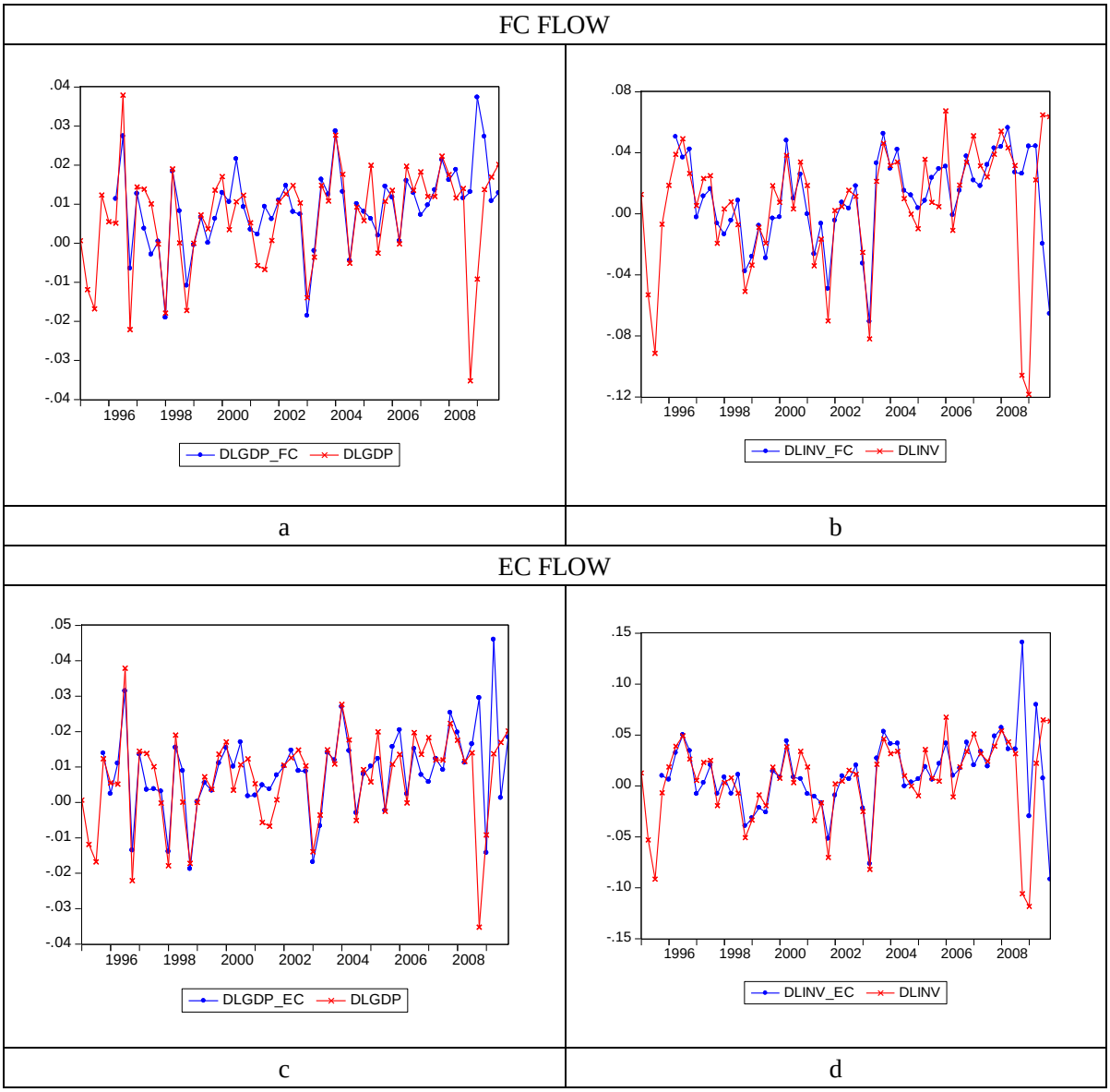


Figure 5. Observed and fitted values, resulting from VAR estimations from 1995Q1 to 2008Q4 (fitted 2008Q4 to 2009Q4 are out of sample forecasts based on observed values of the lagged variables)

It can be observed that there are big differences between forecasted and observed values for both FC and EC flows. For the FC flow, panel a of Figure 5 shows that the VAR forecasts stability for DLGDP in 2008Q4 and a strong growth in 2009Q1 and 2009Q2. What is observed, however, is a strong fall in this two quarters, followed by a recovery in the last quarters of 2009. This forecasts are influenced by the fact that there were outflows of FC only in 2008Q4 and 2009Q1, while in 2007 and the first three quarters of 2008 there was a strong inflow. As was seen in the impulse-response results, inflows in FC are related to growth in GDP. The poo performance of the forecasts reinforces that GDP and flows reacted faster quickly than before the crisis.

The forecast For DLINV employing the FC flow is a small growth in investment in 2008Q4 to 2009Q2, while actually there is a downturn, even stronger than in GDP. When DLINV recovers in 2009Q3 and 2009Q4 the forecast is a strong fall. One possible channel to explain these poor results is the negative relationship between exchange rate and country risk and both investment and GDP.

The results employing EC flows, shown on panels c and d of Figure 5, do not forecast the downturn in GDP and investment in 2008Q4, instead the forecast is strong growth. On the other hand the fall in 2009Q1 is forecasted. For the last three quarters of 2009 the performance of the models is poor. The growth in GDP and investment forecasted for 2008Q4 can be explained through the strong capital inflows in 2007 and in the second quarter of

2008. The outflow of 7,2 billion dollars in 2008Q3, before the crisis, has a lagged effect on DLGDP and DLINV up to 2009, when the economy begins to recover. The poor out of sample performance confirms changes detected in the VAR results that include the crisis period.

Results employing FC and EC render similar results in the forecasts because both react to all available information about the Brazilian economy, although FC is influenced by the structurally high Brazilian interest rates, which allow for carry trade operations even when interest rates in the rest of the world rise, given the high absolute difference between domestic and foreign interest rates.

The forecast results for both GDP and investment change show that investment was a key factor in explaining poor GDP performance. The assumption of a correct forecast for investment, which would justify the forecast of GDP employing the contemporaneous observed value of investment change, certainly is difficult to accept for the fourth quarter of 2008. In other words, the importance of investment seems to be one of the main variables in explaining the fall of GDP at the end of 2008 and beginning of 2009.

The results for investment signify that a change occurred in this variable's behavior in relation to the previous period. In-country investment and FPI flows can be influenced by the same expectations, but the reaction in investment was even stronger than the response in FPI. Beyond exchange rates and interest rates, the transmission mechanism behind the relationship between flows and real variables includes unobservable variables, as uncertainty perception.

The relationship between the financial flows and real variables ends in highlighting that macroeconomic conditions have strong roles in the behavior of the economy, confirming previous results in literature like Soares, Pinto, and Moreira (2010) and Teles and Leme (2010), but are not enough to explain the jumps in the real variables during the crisis. The better condition of the Brazilian economy during the crisis of 2008 in comparison to previous crises allowed for a faster recovery, based on domestic demand.

## 5. Conclusion

The financial crisis triggered a generalized fall in output throughout the world. Even fast-growing economies slowed their growth rates as a result. The recession was triggered in the financial sector and spread to the worldwide economy. In the case of emerging economies, there were mixed feelings. On the one hand, there was the traditional fear that with every crisis these economies would suffer because of their inherent higher risk. On the other, as the crisis originated in developed countries and the economic conditions of the emerging economies were better than in previous crisis episodes, there could be a "decoupling" of the emerging economies. Soon it was realized that the decoupling was not to happen.

As in other crises, the FPI flows went from countries and markets considered risky to safer assets, the flight to quality. The case of developing countries' flights to quality is not only related to flows from more risky stocks to less risky bonds, as in Baur and Lucey (2009), but also to outflows from a broader set of assets to developed countries. If emerging markets were dependent on the inflow of resources to finance their economic growth, the reversal of the flows would hamper the growth capabilities of these economies. In this case, there would be a link between the financial flows and growth. In fact, the FPI flows were negative in Brazil in the fourth quarter of 2008 and the first quarter of 2009.

The results of the impulse-response functions in this paper show that there is a positive relationship between financial flows and GDP changes and investment in Brazil. This means that flows anticipate the behavior of the real variables. Correlation coefficients with contemporaneous data also show the positive relationship, which is even stronger when the crisis period is included in the calculations in comparison to the period preceding the crisis. This means that investment and flows are reacting to the same kind of expectations. These results, however, have to be taken cautiously because of the short length of the series and structural changes in the Brazilian economy during the period covered by the data.

With more solid fundamentals concerning Brazilian fiscal and external accounts when the 2008 crisis erupted, FPI outflows were less intense in comparison to previous crises. It also allowed that broader economic policy measures could be adopted, due to greater degrees of freedom in government actions. The positive outlook for the economy resulted in positive FPI flows by the second quarter of 2009. GDP growth was concentrated in domestic demand factors, namely consumption, and investment and flows followed this positive trend.

Further research will be necessary to explain the operation of the relations between FPI flows and growth. But it is clear from the results in this paper that the financial link is significant in explaining the behavior of growth and investment in the Brazilian economy as well as the transmission mechanism behind it. Interest rates and exchange rates seem to have a role in this sense, meaning the effects of the flows have to be considered when

economic policy decisions are made concerning interest rates or factors that may limit capital flows.

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