Were recent Brazilian crisis originated from real or financial issues?

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Abstract
This paper aims to verify if the origins of recent Brazilian economic default (2009, 2015 and 2016) was related to real economy or pure financial transactions. Therefore, the discrepancy of dispersion index (DDI) and structural path decomposition from flow of funds (FOF) matrixes are developed to Brazilian economy to 2004 to 2015. Financial transactions seem like a mirror of real transactions in almost of years, except in 2008, when financial transactions gave the higher contribution to the imbalance. Complementary, the total value of economic transaction of financial firms grew more than that of non financial firms in precedent period of economic default (2008 and 2014) while the smooth growth of non financial transaction soften DDI in 2009 and 2015. The evolution of power of dispersion indexes corroborated this observation pointing out that government and non financial firms has reduced their financial sharing while financial firms has improved its role as financial intermediary and rest of world is receiving Brazilian saving.

Key-words: flow of funds, asset liability matrix, financial imbalance, system of national account, financial instruments

JEL Code: C67, D53, G20, N26, O16

1 - Introduction

The subprime mortgage crisis highlighted a clear gap on the lack of useful and timely information on where the risks were, their scale and how it is flowing through economy, and the lack of transparency and limited coverage of statistical information on markets and in the financial system, as well as, the lack of theoretical concepts, which allow police makers and market participants to understand transmission and develop effective surveillance and timely responses to the financial streams.

Thereby, financial stability board and international monetary fund (IMF) in close cooperation with national central banks and statistical institutes are conducting and structuring information on the macro and microstructure of the markets, as well as, stimulating and disseminating methods to measure and monitoring economic imbalances.

The crisis provides the context for new insights on how to measure vulnerabilities in the non-financial sectors that can feed back into the financial system and vice versa. Empirical analyses are crucial to address how financial positions of households and nonfinancial firms affect borrowers' defaults, and thus ultimately the position of the balance sheet of financial institutions. In that regard, better data on income and savings available and household debt sector are also required.

The greater availability of sector accounts and financial statements allows advances on systemic risks and vulnerabilities and on interrelation between real sector accounts and financial accounts analysis. As highlighted by FSB (2009), the flow of funds provides

additional focus on vulnerabilities arising from the maturity (liquidity), monetary (internal / external) and capital (leverage) structures of the major financial sectors.

In this context, the flow of funds (FOF) method relived[1] and more robust concepts were developed to explain the theoretical foundations. FOF is a complementary path of national account since it includes financial transactions in the regional analysis, pointing its role as supporting real transactions, allowing the observance of the evolution of real and financial linkages. Its allowance to understand formation and collapse of financial bubble encourages its application.

National Financial Balances (NFB) are key input of FOF method. This account consists of a coherent set of articulated balance sheets held by institutional sectors in the economy. If updated NFB are disposable, police makers should monitor funds to preview imbalances and have time to adjust provision and absorption of funds accordingly to control and convert the undesired situation.

Organization for Economic Cooperation and Development (OECD) disclosure national financial balance and financial account to a set of economies, including Brazil, however, its lag is about 3 years.

Since 1999, monetary policy in Brazil, established by the Monetary Policy Committee (COPOM), has been following an inflation target regime with the main instrument being the short-term interest rate in the overnight interbank reserve market (SELIC). The Central Bank of Brazil (BCB) seeks to ensure the inflation target, through open market operations coupled with rediscounts and requirement of compulsory deposits.

The maintenance of the macroeconomic tripod (free float of exchange rate, inflation target regime and fiscal target) together with developmental economic policy, and liquidity of international market, growth acceleration was achieved by controlling inflation and lowering the real interest rate of the economy. However, recent years show some decreases in its trajectory.

Table 1 show the evolution of Brazilian Gross domestic product (GDP) in current values and in amount exchange, exchange rate, interest rate (SELIC) and inflation target, measured by the general price index (IPCA).

Table 1 Brazilian economic index, 2004 to 2016.

Data	GDP amount exchange %	GDP current values R$1.000.000	Exchange rate USD/BR	SELIC rate	IPCA
2004	5,7600	1957751	2,93	17,74	7,60
2005	3,2021	2170585	2,43	18,00	5,69
2006	3,9620	2409450	2,18	13,19	3,14
2007	6,0699	2720263	1,95	11,18	4,46
2008	5,0942	3109803	1,83	13,66	5,90
2009	-0,1258	3333039	2,00	8,65	4,31
2010	7,5282	3885847	1,76	10,66	5,91

[1] Tsujimura & Mizoshita (2003) present the compilation procedure of the Asset-Liability-Matrix from the Flow-of-Funds accounts in the balance sheet format and its input-output analysis application. Velazquez, et al, (2017) present the Financial and Social Accounting Matrix and the corresponding Asset-Liability-Matrix as a satellite account. Tsujimura & Tsujimura (2018) present a complete system of national account from flow of fund method, using flow data of current, capital and financial account.

2011	3,9744	4376382	1,68	10,90	6,50
2012	1,9212	4814760	1,96	7,14	5,84
2013	3,0048	5331619	2,16	9,90	5,91
2014	0,5040	5778953	2,35	11,65	6,41
2015	-3,7693	6000570	3,33	14,15	10,67
2016	-3,5947	6266895	3,49	13,65	6,29

Source: Central Bank of Brazil (BCB, 2018).

As can be seen in table 1, the amount of PIB has decreased in 2009 and in recent years (2015 and 2016) the decrease happened again. Is the real economy transaction or the financial transaction the causes of these observed economic defaults?

In line with the worldwide trend in the application of the fund flow method to access relevant information about the structure and evolution of economic transactions, on the basis that better information could be used to develop most appropriate economic policies. This paper aims to verify the origins of financial crisis in the view of flow of funds.

Therefore, FOF method is applied to verify if there are imbalances in Brazilian economy and if the origins of financial crisis was related to real economy or pure financial transactions.

Imbalances in flow of funds can be observed by growth in the distance of values of economic transactions between financial and non financial firms, which means that the flow is not flowing ordinarily to enterprises finance their investment excess. Another kind of imbalance can be observed with growth in dispersion of discrepancy, which reflects the distance of assets and liabilities power of dispersion. The structural path decomposition of change in dispersion of discrepancy can show if the origins of the crisis were in real or financial transactions.

Limited to the data availability, FOF matrixes are developed to Brazilian economy to 2004 to 2015. From them power of dispersion indexes are developed to show the relative position of institutional sectors in financial market. To have a wide view of evolution of FOF and access imbalances, the total value of economic transaction to total economy and to each institutional sector are calculated and analyzed. To show when financial crisis arrived to the economy and if its origins are in the real or financial transactions, the discrepancy of dispersion was calculated and structural path decomposition is applied.

We used NFB disposable by Brazilian Institute of Geography and Statistics (IBGE, 2011) and by OECD (OECD, 2018) and balance sheet of Brazilian Central Bank (BCB 2004 to 2015), to develop the application of FOF method.

Even with lagged data to Brazilian economy, FOF method was precisely in point out the moment when the financial crisis reached Brazilian economy, the diagnostic provided by FOF indexes highlight how financial crisis spreads through economy, allowing recommendations and urging for monitoring timely data. It highlights the contribution of the paper.

Following this introduction, the structure of the paper presents main concepts of flow of funds method of national account in section 2, the application to Brazilian economy, methodology, data and results in section 3. Section 4 concluding remarks highlight main results.

2 – From system of national account to flow of funds (FOF) main concepts

Keynes (1935) defined the fundamentals concepts of national account, as well, as basic identities. Since forties, economists developed measures to aggregates of Keynesian Theory, and almost of countries adopted some kind of system to account national accounts.

The system of national account proposed by Simon Kuznetz (1937) and improved by Richard Stone, most popular and disseminated system of national account (SNA), the input-output system proposed by Wassily Leontief (1936, 1943), the national wealth system proposed by Raymond Goldschmidt (1933) and the system of flow of funds, stimulated by Copeland (1949, 1952) are complementary ways of national account. Table 2 presents main account, resulting balance and economic aggregates of widely used SNA.

Table 2: Account, balance and economic aggregates of SNA

Account	Balance	Economic Aggregates
I. Current account		
I.1. Prodution account	Gross value added	Gross domestic product GDP
I.2. Income distribution account		
I.2.1. Primary distribution of income		
I.2.1.1. Origination of income	Operational profit/ mixed revenue	
I.2.1.1. Allocation of primary Income	Balance of primary income	Gross national income
I.2.2. Sencondary distribution of income	Gross disposable income	National disposable income NDI
I.2.3. Re-distribution of income in currency		National disposable income
I.3. income use account		
I.3.1. Use of income	Gross saving	National saving
I.3.2. Use of disposable income	Saving	National saving
II. Accumulation account		
II.1 Capital account	Net capacity or borrowing requirement	National net capacity or borrowing requirement
II.2 Financial account	Net capacity or borrowing requirement	National net capacity or borrowing requirement
II.3 Other financial assets changes account	Change in net worth came from other changes in amount of financial assets	
III. financial balance sheet account		
III.1. Opening balance sheet account	Net worth	National wealth
III.2. Changes in balance sheet account	Change in net worth came from other changes in amount of financial assets	
III.3. Closing balance sheet account	Net worth	

Source: SNA (IBGE, 2011).

In current accounts the gross value added by production account adjusted by distribution of income results in gross disposable income (Income).

Gross disposable income (Income) less all of use of income (Consumption) equals to gross saving (Saving), which follow the first macroeconomic identity.

I. Income – Consumption = Saving

In the accumulation account, gross saving (Saving) less gross fixed capital formation (Investment) equals to net capacity or borrowing requirement, which follow the second macroeconomic identity.

II. Saving – Investment = Net capacity or borrowing requirement

The financial balance sheet account of (FBSA) presents the stock of financial assets and liabilities held by economic agents on an initial date, other change in amount occurred in these assets and liabilities during the period, and the financial assets and liabilities held on the final date.

In SNA view, net worth is the main result of FBSA account. Changes in net worth come from net capacity or borrowing requirement. Net capacity increases net worth, and may be absorbed by an increase in financial assets or (bigger than) a decrease in liabilities. Net borrowing requirement decreases net worth, and may be solved by increase in liabilities or (bigger than) a decrease in financial assets.

The result of current and accumulation account generate the flow (increases and decreases) of financial assets and liabilities which changes the stock of financial assets and liabilities.

Therefore, net capacity or borrowing requirement equals to change in stock of financial assets and liabilities, which follow the third macroeconomic identity.

III. Financial assets – Liabilities = Net capacity or borrowing requirement

If II is true and III is true, it follows the fourth macroeconomic identity, the fundamental concept of FOF method.

IV. Saving – Investment = Financial assets – Liabilities

Figure 1 presents uses and resources of current, capital and financial balance sheet account in an accounting scheme (T-account).

Figure 1: Linkage between current, capital and balance sheet account

<table>
<tr><th colspan="2">Current account</th><th colspan="2">Capital account</th><th colspan="2">Financial balance sheet account</th></tr>
<tr><th>Uses</th><th>Resources</th><th>Uses</th><th>Resources</th><th>Uses</th><th>Resources</th></tr>
<tr><td>Consumption</td><td rowspan="2">Income</td><td>Investment</td><td rowspan="2">Saving</td><td rowspan="2">Financial assets</td><td>Financial assets - liabilities</td></tr>
<tr><td>Saving</td><td>Saving - Investment</td><td>Liabilities</td></tr>
</table>

Source: Elaborated by authors.

Accumulation account is a continuity of current account, both are flows, together they represent the result of real economy. In figure 1, income is the resource, consumption are uses of current account. Savings are the balance. This result is transferred to capital account where saving is resources and investments are uses of capital, the balance is net capacity or borrowing requirement.

FBSA is a stock account, liabilities are resources and financial assets are uses of funds, they are economy financial wealth. The linkage is that the change observed in stock of financial assets and liabilities represent net capacity or borrowing requirement of capital.

FOF method explore this concept: the result of real economy is absorbed by changes in stock of financial assets and liabilities, therefore, from the analysis of internal changes in elements of FBSA, it is possible to estimate the result of real economy. This is the linkage explored by FOF.

There are two possible economic results from current and capital account (henceforth real economy): 1) net capacity requirement and 2) net borrowing requirement.

Possible result 1 occurs when saving is higher than investment; the result is a positive net capacity/borrowing requirement, saving is bigger than investment. The difference between changes in stock of financial assets and liabilities is positive. The identity which holds in financial account is given by V:

V. Financial assets + Net capacity = Liabilities

Possible result 2 occurs when investment is higher than saving. If the result of current account is a net borrowing requirement it happens because investment was bigger than saving and, necessarily, changes in stock of liabilities will be bigger than changes in stock of financial assets. The identity which holds in financial account is given by VI:

VI. Financial assets = Liabilities + Net borrowing requirement

Figure 2 and 3 presents two possible economic scenarios in accounting scheme.

Figure 2: Possible economic result 1

Current account		Capital account		Financial balance sheet account	
Uses	Resources	Uses	Resources	Uses	Resources
Consumption	Income	Investment	Saving	Financial assets	Net capacity
Saving		Net capacity			Liabilities

Source: Elaborated by authors.

Figure 3: Possible economic result 2

Current account		Capital account		Financial balance sheet account	
Uses	Resources	Uses	Resources	Uses	Resources
Consumption	Income	Investment	Saving	Financial assets	Liabilities
Saving			Borrowing requeriment	Borrowing requeriment	

Source: Elaborated by authors.

FOF Method

The FOF analysis was stimulated by Copeland (1949, 1952), the "system of money flow" presented a set of interrelated T-shaped accounts in a single table that records financial assets and liabilities held by wide economy and by each institutional sector. It is a T-shaped account wherein each use has a corresponding resource with the same amount.

Each institutional sector is located in the column and corresponding financial assets and liabilities, detailed by financial instruments, located in the rows. To each institutional

sector there are two columns (uses and resources): one to assets and other to liabilities. Since to each payment must have a corresponding receives of funds, the row sums of the asset is equivalent to that of the liability to total economy. However the total payment of a sector does not necessarily match its own total receipt, the difference is posted as surplus of funds, it means saving excess in real economy or deficiency of funds, which means investment excess in real economy.

With this system, is possible to visualize to wide economy and to aggregated institutional sectors, the total stock of assets, the total stock of liabilities, and the excess of assets or liabilities, which means saving excess or investment excess in the real economy. It represents the financial wealth of the economy and of its institutional sectors.

The methods of converting T-shaped accounts into a matrix format were proposed independently by Stone (1966) and Klein (1983). Stone e Klein formulae can be used as a pair because the two methods are symmetrical in mathematical operations. The first step is to extract asset table and liability table from FBSA.

The asset table (P-Table) is composed by all of financial assets negotiated by institutional sectors (p_{ki}), the excess of liabilities in relation to the assets (ρ_i), the total by instrument (t_k^P) and total by sector (t_i). The semantic structure of asset table (P-Table) is presented in table 3.

Table 3: Asset (P-Table)

p_{11}	p_{12}	…	p_{1m}	t_1^P
p_{21}	p_{22}	…	p_{1m}	t_2^P
…	…	…	…	…
p_{n1}	p_{n2}	…	p_{nm}	t_n^P
ρ_1	ρ_2	…	ρ_m	ρ_n
t_1	t_2	…	t_m	t_n

Source: Adapted from Tsujimura & Mizoshita (2003)

Similarly, the liability table (R- Table) consists of all of resources of funds obtained from liabilities by the institutional sectors (r_{ki}), the excess of assets in relation to the liabilities (ψ_i), totals by instrument (t_k^R) and by sector (t_i). The semantic structure of liability table (R-Table) is presented in table 4.

Table 4: Liability R-Table

r_{11}	r_{12}	…	r_{1m}	t_1^R
r_{21}	r_{22}	…	r_{1m}	t_2^R
…	…	…	…	…
r_{n1}	r_{n2}	…	r_{nm}	t_n^R
ψ_1	ψ_2	…	ψ_m	ψ_n

t_1	t_2	…	t_m	t_n

Source: Adapted from Tsujimura & Mizoshita (2003)

Tsujimura & Mizoshita (2003) and Tsujimura & Tsujimura (2010) demonstrated that Stone and Klein methods are identical in the sense that they transfer two transaction x sector matrices into a sector x sector matrix. However, while Stone formula uses the right-hand side (receipts or liabilities) of the T-account at its base, the Klein formula uses the left-hand side (payment or assets) of the T-account at its base.

Define P as asset table and R liability table, p_{ki} and r_{ki} denotes those elements, in format of table 4 and 5. While k indicate transaction instruments, i denotes institutional sector; n and m are the number of transaction instruments and institutional sectors so that P and R are n x m matrices.

Define the diagonal matrices $\hat{T}$, $\hat{T}^P$, $\hat{T}^R$. $\hat{T}$ is the m x m matrix with t_i as its diagonal elements and zeros elsewhere. Likewise, $\hat{T}^P$ and $\hat{T}^R$ are n x n diagonal with t_{pk} and t_{rk} as elements, respectively. Ψ and P are vertical vectors of dimension m whose elements are ψ_i and p_i, where, p_i are saving excess and $\psi_i$are deficiency of funds, according to identity V and VI. Equation 1 to 3 present this relation:

$$t_i = max(\sum_{k=1}^{n} p_{ki}, \sum_{k=1}^{n} r_{ki}) \quad \text{Eq.1}$$

$$t_k^P = \sum_{i=1}^{m} p_{ki}\ ; t_k^R = \sum_{i=1}^{m} r_{ki} \quad \text{Eq. 2}$$

$$\psi_i = t_i - \sum_{k=1}^{n} p_{ki} \geq 0; \rho_i = t_i - \sum_{k=1}^{n} r_{ki} \geq 0 \quad \text{Eq.3}$$

Where ψ_i and ρ_i are surplus and deficiency of funds, respectively, according to macroeconomic identities V and VI.

Stone and Klein formula are denoted by the superscript S and K, respectively and the apostrophe denotes transposed matrix. Equation 4 and 5 present this relation:

$$U^S \equiv R; V^S \equiv P' \quad \text{Eq.4}$$

$$U^K \equiv P; V^K \equiv R' \quad \text{Eq.5}$$

Define matrices B^S, D^S, B^K, D^K the coefficient matrices of the matrices in the equation 4 and 5, by dividing each cell by the column sum, as expressed by equations 6 and 7:

$$B^S = U^S\hat{T}^{-1}; D^S = V^S(\hat{T}^P)^{-1} \quad \text{Eq.6}$$

$$B^K = U^K\hat{T}^{-1}; D^K = V^K(\hat{T}^R)^{-1} \quad \text{Eq.7}$$

The flow-of-funds matrices Y^S and Y^K, and the corresponding coefficient matrices C^S and C^K according to the equation 8 and the sector by sector FOF matrices are represented by equation 9:

$$C^S = D^S B^S; C^K = D^K B^K \quad \text{Eq.8}$$

$$Y^S = C^S\hat{T}; Y^K = C^K\hat{T} \quad \text{Eq.9}$$

Y^S and Y^K are sector by sector FOF account, therefore, y_{ij}^S , how many funds the sector i obtains from sector j (in monetary values) and y_{ij}^K how many funds the sector j employ in sector i (in monetary values).

Total value of economic transactions (TVET)

Each column sum of Y^S and Y^K shows the total value of economic transactions (TVET) of each sector (i.e. sum of enterprises column of Y^S shows the value of total economic transaction made by enterprises). The sum of each column sum represents the TVET of wide economy.

The TVET to each institutional can be written as expressed in equation 10, and TVET to wide economy Z_{ij} is expressed in equation 11:

$$Z_j^S = \sum_{i=1}^{m} y_{ij}^S ; \quad Z_j^K = \sum_{i=1}^{m} y_{ij}^{KS} \qquad \text{Eq.10}$$

$$Z^S = \sum_{j=1}^{m}\sum_{i=1}^{m} y_{ij}^S, Z^K = \sum_{j=1}^{m}\sum_{i=1}^{m} y_{ij}^K \qquad \text{Eq.11}$$

As highlighted in Tsujimura & Tsujimura (2018), the adherence of the evolution of the TVET of non-financial firms and TVET of wide economy matters, because, when TVET of wide economy grows more than TVET of production sectors, it is an evidence of vulnerability and economic imbalance. In the US case it was a sign of financial bubble formation.

Power of dispersion index (PDI)

The power of dispersion index (PDI) is a measure of direct and indirect effect of a payment or receipt of funds from Stone and Klein formulae. From FOF coefficient matrices ($C^S; C^K$), as expressed in equation 9, define the FOF Leontief Inverse, according to equations 12 and 13:

$$A^S = (I - C^S)^{-1} \qquad \text{Eq.12}$$

$$A^K = (I - C^K)^{-1} \qquad \text{Eq.13}$$

From the FOF Leontief inverse, the power of dispersion index from Stone and Klein formulae are derived and expressed in equations 14 and 15:

$$\omega_j^K = \frac{\sum_{i=1}^{m} a^S ij}{\frac{1}{m}\sum_{j=1}^{m}\sum_{i=1}^{m} a^S ij} \qquad \text{Eq. 14}$$

$$\omega_j^S = \frac{\sum_{i=1}^{m} a^K ij}{\frac{1}{m}\sum_{j=1}^{m}\sum_{i=1}^{m} a^K ij} \qquad \text{Eq. 15}$$

Where:

$a^S ij$ = are the elements of the FOF Leontief Inverse from Stone formulae (A^S);

$a^K ij$= the elements of the FOF Leontief inverse from Klein formulae (A^K).

According to Mizoshita and Tsujimura (2003), the power of dispersion index from Stone formulae, (henceforth DPI-FR) indicates the total demand for funds, direct and indirect, induced by an increase in demand for funds in a given sector j (as pointed out in macroeconomic identity, when a sector has excess saving in real economy).

DPI-FR shows the spreading effect of funds when there are variations in the demand for funds. On the other hand, the power of dispersion index from Klein formulae (henceforth PDI-FE) shows the effect of scattering funds when there are variations in the supply of funds. The supply of funds to the total economy, directly and indirectly,

induced by increases in the fund supply of a given sector j (excess savings in real economy).

In the Stone formulae, the indexes represent the reaction caused by demand for funds (excesses of investment) and in the Klein formulae, the indices represent the reaction originated by the supply of funds (excess savings).

Discrepancy of dispersion index (DDI) and structural path decomposition (SPD)

The power of dispersion indices previously presented are obtained by normalizing either the column sum of the FOF Leontief inverse matrix. The dispersion of assets is obtained by the sum of elements of FOF Leontief inverse from Stone formulae and the dispersion of liabilities are obtained by the sum of elements of FOF Leontief inverse from Klein formulae. The discrepancy of the dispersion is the difference between asset dispersion and liability dispersion.

The elements of FOF Leontief inverse, defined in equations 12 and 13, the asset dispersion is expressed in equation 16 and the liability dispersion in equation 17.

$$w^S = \sum_{i=1}^{m} \sum_{j=1}^{m} a^S ij \qquad \text{Eq. 16}$$

$$w^K = \sum_{i=1}^{m} \sum_{j=1}^{m} a^K ij \qquad \text{Eq. 17}$$

Call them the liability dispersion index (w^S) and the asset dispersion index (w^K), respectively.

The subtraction of the liability dispersion index from the asset dispersion index gives the dispersion of discrepancy index, as shown in Equation 18.

$$w^{S-K} = w^S - w^K \qquad \text{Eq. 18}$$

The dispersion of discrepancy index (DDI) shows the gap between the sum of matrices of cells are receipts and payments.

That is, it shows the distance between the total power of dispersion in Klein and Stone formulae showing systemic risks and vulnerabilities live on interrelation between real economy and financial accounts. It is an imbalance that can be observed from FOF method.

Structural path decomposition (SPD)

The causes for the changes in the Leontief inverse can be decomposed into two categories: i) the total sum of each element of the coefficient matrix, and ii) the apportionment of coefficients among them. While the latter is a purely monetary phenomenon (decision of financial portfolio), the former is the reflection of the objective economy (real economy), because the excess assets and liabilities correspond respectively to excess savings (supply of funds) and excess investments (demand of funds).

The structural decomposition is useful to determine whether the cause of financial bubbles lies in the structure of financial market itself or is merely a mirror image of the objective economy, the lack of investments in plant and equipment, and so on.

The dispersion of discrepancy index was defined in Equation 18. Using Equations 19, defines the decomposition of dispersion discrepancy index.

$$\Delta w^{S-K}{}_{t,t} =$$

$$\left\{\frac{\left(w^{K}{}_{t,t}-w^{K}{}_{t,t-1}\right)+\left(w^{K}{}_{t-1,t}-w^{K}{}_{t-1,t-1}\right)}{2}-\frac{\left(w^{S}{}_{t,t}-w^{S}{}_{t,t-1}\right)+\left(w^{Y}{}_{t-1,t}-w^{Y}{}_{t-1,t-1}\right)}{2}\right\}+$$

$$\left\{\frac{\left(w^{K}{}_{t,t}-w^{K}{}_{t-1,t}\right)-\left(w^{K}{}_{t,t-1}-w^{K}{}_{t-1,t-1}\right)}{2}-\frac{\left(w^{S}{}_{t,t}-w^{S}{}_{t-1,t}\right)-\left(w^{S}{}_{t,t-1}-w^{S}{}_{t-1,t-1}\right)}{2}\right\} \quad \text{Eq.19}$$

Where subscripts t,t, define the first and second period of FOF Leontief inverse.

According to Mizoshita and Tsujimura (2004), the first term of the expanded right side of Equation 19 is the portion attributed to the changes in the real economy (decline or increment in savings and in investments) while the second term is the segment referring to the changes in the structures of the financial market (alterations in asset–liability portfolio allocation).

3. Brazilian FOF

3.1 Methodology and Data

The P and R Tables were extracted from the National Financial Balance (NFB) and the Balance Sheets of Brazilian Central Bank (BCB). From them, FOF matrixes to Brazilian economy were developed according to equations 1 to 9.

National Financial Balance (IBGE, 2011 and OECD 2018) and balance sheet of the Central Bank of Brazil (BCB 2004 the 2015) are the data used in the development of Brazilian FOF.

For the period 2004-2009, the National Financial Balances (NFB) was published for the years 2004 to 2009 as part of the Integrated Economic Accounts (IEC), by the BCB together with Brazilian Institute of Geography and Statistics (IBGE, 2011). However the publication was discontinued.

For the period 2009 to 2015, it is available from the Organization for Economic Cooperation and Development (OECD). The 2015 year data was the latest date until the preparation of this paper. It is expected periodic update. Non-consolidated SNA 2008 is used (OECD, 2018).

Financial assets and liabilities are detailed in seven main financial instruments held by five institutional sectors. Below, the main financial instruments of NFB are listed.

F0 Gold and DES *
F1 Cash and Deposits
F2 Titles
F3 Loans
F4 Shares
F5 Technical insurance
F6 Derivatives
F7 Other

* F0 Gold and DES are not included in the FOF BR because they refer to monetary funds.

The five institutional sectors considered by NFB are: non-financial corporations, financial firms, households, government and the rest of the world (ROW).

"Financial companies" were separated into two groups: the Central Bank of Brazil (BCB) and "financial companies" by subtracting the flows of assets and liabilities of

BCB (obtained from its balance sheet) of financial assets and liabilities flows of the financial companies presented in National Financial Balance.

The balance sheet of the Central Bank of Brazil is disclosed monthly together with other financial statements and explanatory notes. The annual data for the years closed in December 31 of each year between 2004 and 2015 were used. The balance sheet is an accounting statement that represents stock accounts, indicating the inventory of assets (physical and financial assets) and liabilities (liabilities and shareholders' equity) held by an entity on a certain date. The preparation of the BCB's balance sheet follows the General Accounting Plan of the Central Bank (PGC). The BCB balance sheet is available monthly from 1965 to 2017. Figure x presents plan of codification between national balance accounts and accounts of balance sheet of the central bank of Brasil.

Figure 4: Plan of Codification between Financial Instruments in the Financial Equity Account, Balance Sheet of the Central Bank and the Balance Sheet of Financial Institutions.

NATIONAL FINANCIAL BALANCE	BALANCE SHEET OF THE CENTRAL BANK OF BRAZIL
	ASSETS
F1 - Cash and Deposits	Availability Deposits Deposits in terms in financial Institutions Resale Commitment
F2 – Bonds	Derivative Bonds Federal Government Bonds
F3 - Loans	Receivable Credits Credits to the Federal Government
F4 - Shares	
F5 - Technical Insurance	
F6 - Other Deb./Credit	Other credit
	LIABILITY
F1 - Cash and Deposits	Contracted Operation to be settled Deposits in Financial Institutions Repurchase Commitment
F2 – Bonds	Derivatives
F3 - Loans	Credits to pay Obligations to the Federal Government
F4 - Shares	
F5 - Technical Insurance	Provisions
F6 - Other Deb./Credit	Others

Source: Elaborated by author from NFB, COSIF (OECD; BCB).

In order to present an overview of the flow of funds the relative position of the institutional sectors in the Brazilian economy were accessed by the power of dispersion indices (PDI), according to equations 14 and 15. They are combined in a graph where the PDI-FR is plotted in horizontal axis and the PDI-FE in the vertical axis. With this combination, four graph positions are possible, table 6 presents this possibilities and propose a name to economic position of institutional sectors according to their graph position.

Table 6: Economic position from PDI graph

Graph position	PDI-FR	PDI-FE	Economic position
First quadrant	>1	>1	Financial intermediary
Second quadrant	<1	>1	Saving sector
Third quadrant	<1	<1	Low monetization

Fourth quadrant	>1	<1	Investment sector

Source: Elaborated by authors.

In order to verify if the origins of financial crisis was related to real economy or pure financial transactions, and, complementary, if the evolution of the distance between transactions of the financial and non financial firms is in some way related to financial crisis, two measures are used:

i) the dispersion of discrepancy index (DDI) was calculated and decomposed, according to equations 16 to 19 .

ii) The distance between the Total Value of Economic Transactions (TVET) of financial firms and the TVET of the non-financial firms (enterprises) are calculated, according to equation 10 and 11.

3.2 Results

FOF matrices of 2015 year, is shown in figure 5 and 6, Stone and Klein respectively in table 7 and 8, respectively.

Table 7: FOF matrix from Stone formulae, Brazil, 2015 (R$1.000.000)

Y^S	Government	Enterprises	Household	ROW	Central Bank	Financial Firms	Total
Government	333573	947808	443256	152170	304673	1470104	3651584
Enterprises	348226	2220580	463737	424196	298244	2607687	6362670
Household	425852	1068489	108813	382764	342368	3801321	6129607
ROW	586009	1440677	363305	367581	405871	1545354	4708796
Central Bank	1285577	115636	8594	426220	197043	693790	2726861
Financial Firms	2214956	4025561	926298	1354760	1235607	8449088	18206270
Total	5194192	9818751	2314003	3107691	2783806	18567344	41785787

Source: FOF BR

Figure 8: FOF matrix from Klein formulae Brazil, 2015 (R$1.000.000)

Y^K	Government	Enterprises	Household	ROW	Central Bank	Financial Firms	Total
Government	333573	348226	425852	586009	1285577	2214956	5194192
Enterprises	947808	2220580	1068489	1440677	115636	4025561	9818751
Household	443256	463737	108813	363305	8594	926298	2314003
ROW	152170	424196	382764	367581	426220	1354760	3107691
Central Bank	304673	298244	342368	405871	197043	1235607	2783806
Financial Firms	1470104	2607687	3801321	1545354	693790	8449088	18567344
Total	3651584	6362670	6129607	4708796	2726861	18206270	41785787

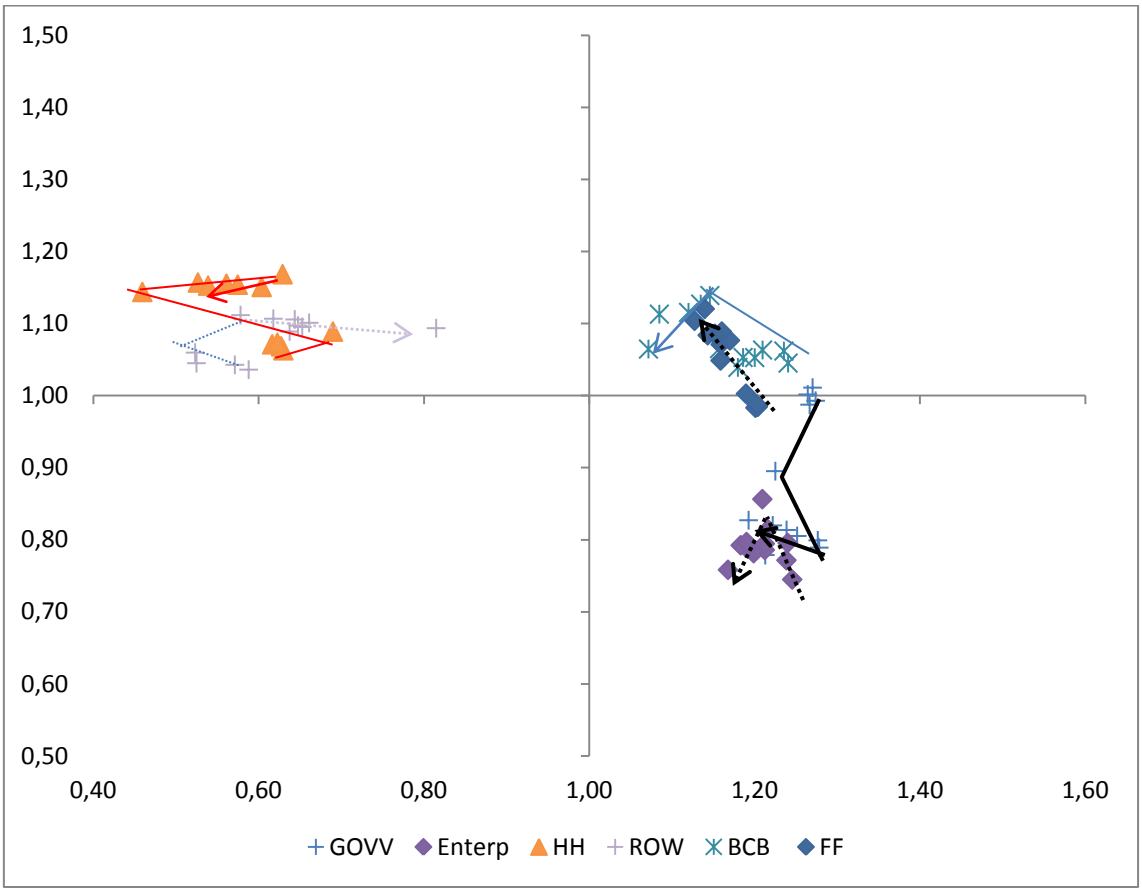
Source:FOF BR

The relative positions of institutional sectors in the economy, from FOF view, given by scattering of power of dispersion index (PDI) are presented in figure 7. GOV means government, Enterp. are non financial firms, HH are households, ROW the foreign economy (rest of the world), BCB is Brazilian Central Bank and FF are financial firms

BCB shows financial intermediary structural position whatever with a reduction in the ability to disperse funds. The BCB graph position shows a trend towards to the center of the chart. PDI FR reduces throughout the period while there was increase in the PDI FE in 2009, after that decreases.

Financial firms, as well as, BCB reduced their ability to spread funds when raises funds, however, financial firms moved from fourth to first quadrant consolidating the financial firms position as financial intermediary. Even with a reduction in PDI FR, there was a high increase in PDI FE. Indicating improvement in the ability to disperse funds when employ funds.

Figure 7: Economic FOF position of institutional sectors, Brazil, 2004-2015.



Source: FOF BR.

Government presents relevant change from first quadrant to four. It was much closer to and moved away from the horizontal axis. Since 2004 to 2015, government has reduced its role as financial intermediary and increased its role as investor sector.

Non-financial firms increased PDI-FE until 2009, after that, reduced its ability to employ funds. As the main investor sector of the economy, the concern is to the decrease in PDI-FR, which shows restriction on enterprises finance.

Household maintain its structural position as savings sector, the bigger provider of funds, presenting growth in the PDI FE and decrease in PDI-FR.

While all of domestic sector reduced their PDI-FR, foreign economies, the rest of the world, increased their PDI-FR. It means that saving surplus of the Brazilian economy is being heavily allocated abroad.

The dispersion of discrepancy index (DDI) to Brazilian economy, asset dispersion, liability dispersion and change in discrepancy (SPD) from 2004 to 2015 is presented in table 9.

There is a significant increase in the discrepancy in the year 2008, followed by a sharp decline in the year 2009. Since 2010 until 2014, the discrepancy decreases. In 2014 there is an increase followed by a decline in 2015.

Table 9: dispersion of discrepancy index,

Year/ Index	Asset Dispersion	Liability Dispersion	DDI	CDI
2004	40,16	34,64	5,52	0,00
2005	45,02	38,65	6,37	0,85
2006	47,01	40,38	6,63	0,27
2007	47,54	41,50	6,04	-0,60
2008	61,83	51,05	10,77	4,74
2009	52,95	47,26	5,69	-5,09
2009*	39,31	36,19	3,12	-2,57
2010	38,49	35,78	2,72	-0,40
2011	41,24	38,71	2,53	-0,18
2012	42,38	40,10	2,28	-0,25
2013	44,12	41,95	2,17	-0,11
2014	47,45	45,05	2,40	0,23
2015	46,06	44,60	1,46	-0,94

Source: FOF BR

The high DDI in 2008 highlights the intensity of the financial crisis and its effects in Brazilian economy. In the following year, 2009, Brazil experienced decreases in its economy, especially in the GDP growth rate.

The increase observed in 2014 also precedes decreases in economic growth. In fact, the total GDP amount (volume) of Brazilian economy decreased in the following year 2015. There is a difference in magnitude of DDI between 2008 and 2014.

It is interesting to note that variations in the supply and demand for funds, the variations derived from the need for capital or the excess of savings seem to influence the DDI more than purely financial actions

The decomposition of the change in DDI is shown in table 10 and figure 8 shows the graph with the evolution of the contribution of the objective economy (OE), derived from changes in supply and demand for funds; and the contribution of the financial market (FM), derived from changes in financial asset and liability portfolio.

Table 10: Structural path decomposition of DDI, Brazil, 2005-2015

Year	Total	OE	FM	OE%	FM%
2005	0.85	4,15	-3.30	56	-44
2006	0.27	1.41	-1.15	55	-45
2007	-0.60	-1.92	1.32	59	-41

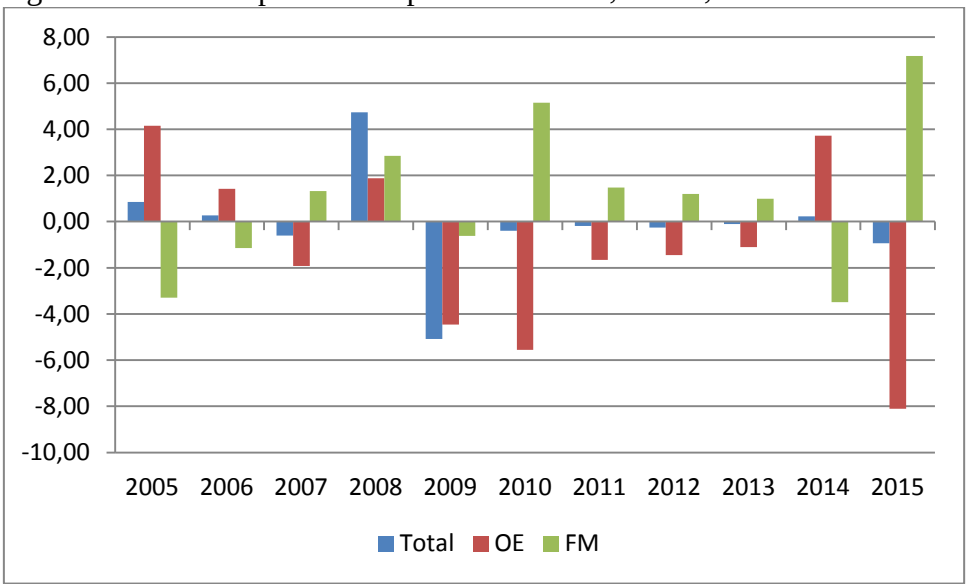
2008	4,74	1.88	2.85	40	60
2009 *	-5.09	-4.46	-0.62	88	12
2010	-0.40	-5.56	5,15	52	-48
2011	-0.18	-1.66	1.48	53	-47
2012	-0.25	-1,45	1.19	55	-45
2013	-0.11	-1.10	0,99	53	-47
2014	0.23	3.72	-3.49	52	-48
2015	-0.94	-8.11	7.17	53	-47

Source: FOF BR.

The change in DDI in the beginning period is mainly caused by changes in objective economy. Financial portfolios just adjust the result of current and capital account. The growth of economic activities requires greater effort to raise funds to finance investments and also options for allocating funds to the surplus savings of saving sectors.

The decomposition of DDI shows that changes in the supply and demand of funds are in the same direction of change in DDI all of the years. The contribution of changes in the supply and demand of funds to change in DDI is proportionally greater than the contribution of the change in the portfolios of financial assets and liabilities, except for the year 2008.

Figure 8: Structural path decomposition of DDI, Brazil, 2005-2015.



Source: FOF BR

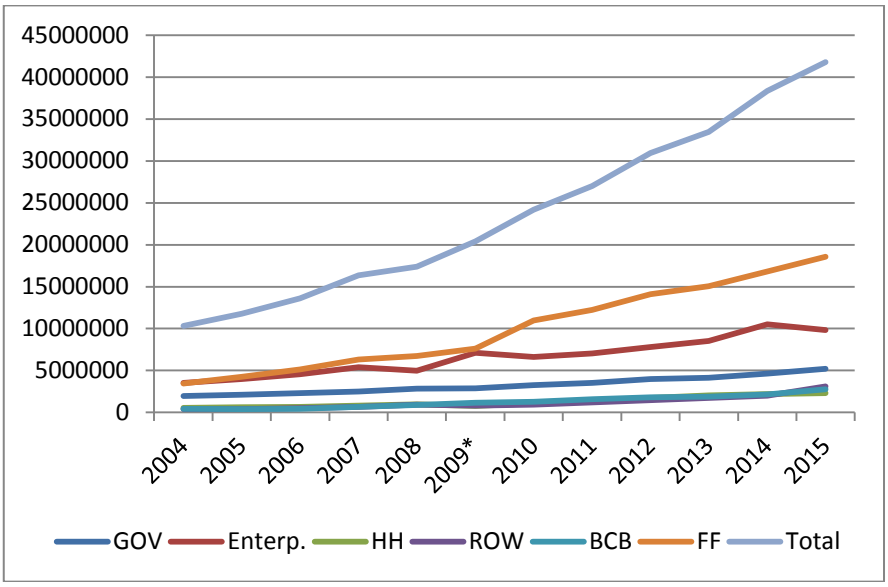
Changes in the financial markets are in the opposite direction of change in DDI in most years except in 2008 and 2009. The significant increase in 2008, has its influence of the objective economy, but was mainly caused by changes in the financial portfolio.

The sharp fall in 2009 was mainly caused by changes in the real economy and changes in financial portfolios contributed to decrease the imbalance.

The (less scale) high in DDI occur in 2014 was mainly caused by objective economy, but, different of 2008 increase, financial market contribution was in contrary direction.

The total value of economic transactions (TVET) in terms of payments between sectors to total Brazilian economy and corresponding to institutional sectors, from 2004 to 2015 are presented in figure 9 and table 11.

Figure 9: Total Value of Economic Transactions, Brazil, 2004-2015 (R $ 1,000,000).



Source: FOF BR.

Table11: Total Value of Economic Transactions, Brazil, 2004-2015 (R $ 1,000,000).

	GOV	Enterp.	HH	ROW	BCB	FF	Total
2004	1980442	3536057	540543	388415	425708	3469735	10340901
2005	2103258	3974336	624785	389198	405336	4263382	11760296
2006	2294311	4560828	684147	506128	434918	5143296	13623628
2007	2514400	5390525	818788	664828	653817	6329344	16371702
2008	2850115	4961657	987557	948506	906049	6735164	17389048
2009*	2898063	7132866	782385	813614	1157572	7628623	20413123
2010	3261163	6606889	1099216	949984	1290269	10975660	24183181
2011	3528978	7047736	1404167	1201977	1583378	12232893	26999129
2012	3993067	7819786	1723474	1483512	1808919	14095092	30923850
2013	4147845	8536494	2047522	1749859	1907649	15066712	33456082
2014	4623150	10530203	2210815	2003950	2156982	16823190	38348291
2015	5194192	9818751	2314003	3107691	2783806	18567344	41785787
Δ %	162	178	328	700	554	435	304

Source: FOF BR

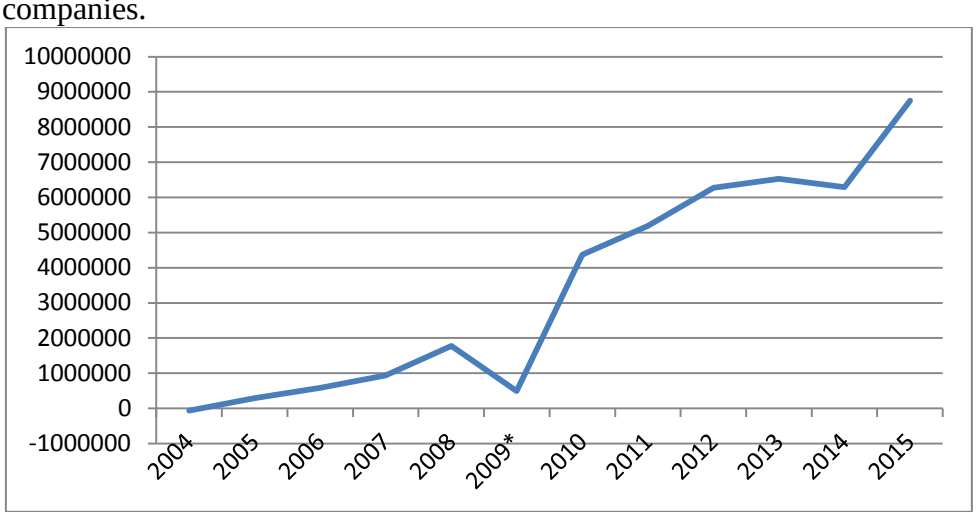
TVET grew more than 300% between 2004 and 2015, however with decreasing rates. The highest growth rate is observed in 2007. Lower growth rates are observed in the years 2008 and 2013.

The evolution of total TVET is not symmetrical between institutional sectors. Each sector presents differentiated evolution corresponding to its level of participation in the total transactions. It can be observed that the TVET of the government and non-financial firms showed lower growth than the total economy, while the other sectors increased more than proportionally to the increase of the total, especially TVET growth

in the rest of the world, around 700% in the period. As it is obtained by Klein formulae FOF matrix, it correspond to the increase of ROWs FDI-FR.

The evolution of the difference between the TVET of the financial firms and the TVET of the non-financial firms is presented in figure 10.

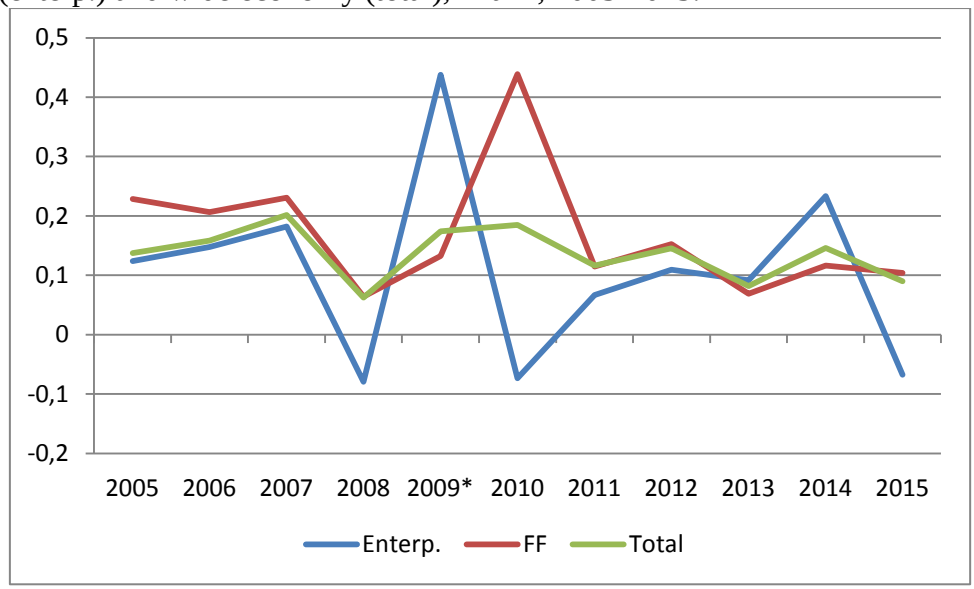
Figure 10: Difference between TVET of financial companies and non-financial companies.



Source: FOF BR.
* Beginning of the OECD series.

There is an increase in the difference between TVET of financial firms and non-financial firms over time, with a peak in 2008, simultaneously with the spread of the international financial crisis to peripheral countries. This distance decreased in 2009, simultaneously of countercyclical credit and economic policies facilitating the flow to corporate finance. Since 2010 to 2013 the distance increases, with a small light decrease in 2014. Figure 11shows the evolution of the TVET rate of distance of financial firms and non-financial firms over time

Figure 11: Evolution of the TVET rate of financial firms (FF), non financial firms (enterp.) and wide economy (total), Brazil, 2005-2015.



Source: Elaborated by authors.

From 2005 to 2008, the growth rate of financial firms and total economy was above the growth rate of non-financial corporations.

The Brazilian FOF behavior is similar to US FOF behavior observed by Tsujimura and Tsujimura (2018) between 2005 and 2007. The authors highlighted that the period corresponds to the formation of the subprime mortgage bubble.

In Brazil, the period extends to 2008. The crisis only affects effectively the real variables of the Brazilian economy (reduction in GDP growth rate, decrease in investment, unemployment increase, among others) in 2009.

In 2009, the growth rate of TVET of non-financial firms is higher than that financial firms TVET and total TVET.

Between 2010 and 2012, the growth rate of financial firms transactions was above the growth rate of non-financial firms transactions, indicating imbalances.

In 2013 and 2014, the setting reverts back, TVET growth rate of non-financial firms is greater than financial firms, but in 2015, returns to imbalance.

According to internal reports (IBGE, 2018), the Brazilian GDP showed a decrease in the growth rate of the total volume produced since 2010, with a small recovery in 2013, followed by a drastic fall in the GDP growth rate in 2014 (growth of 0.5%).

In this sense it is necessary to concern that the most recent period shows an increase in the distance between financial firms and non-financial firms TVET, It is not possible to know if it is peak, since there is not updated data of the NFB of Brazil, however, the GDP amount (volume) has dropped in 2015 and in 2016.

The evolution of the gap between total transactions and transactions of non-financial firms points a growing gap, which indicates a greater concentration of transactions exclusively in the financial sector.

These results together point to an increase in total economic transactions, which on the one hand indicates growth of the participation of the various agents in the financial market, on the other hand, the observation that the growth of non-financial corporations' transactions does not accompany the growth of total TVET, is an indicator of the emergence of economic imbalances.

Change in DDI in parallel of financial and non-final firms TVET distance, highlight that in level (financial and non-final firms TVET distance), the distance in 2015 is close to that observed in 2008.

4. Concluding Remarks

From a wide view of flow of funds, power of dispersion showed institutional sectors economic structural position. Financial firms improved its role as financial intermediary and BCB permeated that evolution, household improved its role as saving sectors, government take closer to enterprises as investments sector, however restrictions on ability to raise funds is shown to them. Foreign economies are receiving a relevant part of Brazilian domestic saving.

There are imbalances in Brazilian flow of funds in the observed period. The TVET grew more than 300% since 2004 to 2015, however with decreasing rate, and with heterogeneous distribution between institutional sectors.

It was observed that the lowest rate of TVET growth and a significant increase in the discrepancy dispersion index previous economic default in Brazil. These facts have occurred in 2008 and 2014. Brazilian economy had a decrease in PIB growth rate in 2009, and a decrease in the total amount of PIB in the years 2015 and 2016.

The structural decomposition, showed that changes in real economy were almost the main contributor to changes occurred in discrepancy dispersion. Changes in real economy were always in the same direction of discrepancy, while changes in financial market usually stay in contrary direction of discrepancy.

The distance between financial firms total economic transaction and enterprises total economic transactions, grew in the years before economic default (2005 to 2008).

In 2008, changes in financial portfolio were crucial to the economic default, the distance between financial firms and enterprises total economic transactions was so high and, the decomposition shows that in this year the great contribution of high discrepancy dispersion came from financial changes.

Next year, 2009, the decline of discrepancy was almost caused by real economy whatever the small contribution of financial market was in the same direction of decline in discrepancy. The high growth of non financial firms transactions contributed to soften the discrepancy.

The distances between financial firms and enterprises total economic transactions also grew between 2010 and 2013, smallest rate in 2013.

After three years of declining discrepancy, in 2014 it grows. The smallest level of discrepancy of 2014 than in 2008 is an effect of enterprises economic transactions that grows a little bit bigger than financial firms economic transaction and the distance of then declined in 2014.

Even with the decrease in discrepancy, attention is draw to that the distance between financial and non financial economic transaction is still growing in the most recent data.

Disclosure of updated data of national financial balance, especially need to apply FOF method complementary to SNA would allow to keep up with the evolution of flow of funds, consequently, the systemic risks and vulnerabilities expressed in FOF indexes, power of dispersion and distance between financial and non-financial financial transactions, for example, in time to control imbalances.

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Velazques (2017)

Expanded abstract

This paper aims to verify if the origins of recent Brazilian economic default (2009, 2015 and 2016) was related to real economy or pure financial transactions. The mehod used was the Flow-of-funds (FOF) originally proposed by Copeland (1942, 1952), complemented by Stone (1966) and Klein (1983), recently improved by Tsujimura & Mizoshita (2003), Tsujimura & Tsujimura (2018).

The FOF method was applyied to Brazilian economy from the year 2004 to 2015 (restrict to availability of data). Data used are Balance sheet of Central Bank of Brazil (available in BCB web site), and National Financial Balance of Brazil (available from IBGE until 2009 and from and OECD from 2009 to 2015).

Results presents the evolution of discrepancy of dispersion index (DDI) with high values in precednt year of an economic default (2008 and 2014), however highest values in 2008. Structural path decomposition of change in dispersion of discrepancy showed that financial transactions seems like a mirror of real transactions in almost of years, except in 2008, when financial transactions gave the higher contribution to the imbalance.

The total value of economic transaction of financial firms grew more than that of non financial firms in those precedent period of economic default (2008 and 2014) while the smooth growth of non financial transaction soften DDI in 2009 and 2015.

The evolution of power of dispersion indexes corroborated this observation pointing out that financial firms has improved its role in the economy , however, recently, government and non financial firms reduced their financial sharing while rest of world received Brazilian household´s savings.

The novelty of research is to go on flow of funds theoretical concepts which allow to measure and monitoring economic imbalances.