

The Brazilian Economic Crisis during the Period 2014-2016: Is There Precedence of Internal or External Factors?¹

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Abstract

An economic crisis may have originated in the internal macroeconomic conditions or changes in the environment / international economic structure. The recent Brazilian crisis, which began in 2014, had as its main features, a lack of inflation and public accounts, which required a contractionary monetary policy, resulting in one of the most intense and prolonged recessions in Brazilian economic history. In parallel, the international economic situation proved to be very adverse, with fluctuations in commodity prices, the end of the Quantitative Easing program in the US and a relative loss of momentum in the global economy, despite the US economic recovery. In this context, this study aims to evaluate whether internal factors, such as the Brazilian interest rates and gross fixed capital formation, among others or external factors, such as commodity prices and global economic growth, may have affected Brazilian economic performance. For its methodology, the research uses precedence tests in order to verify that the internal and external determinants preceded it, “in the sense of Granger,” the Brazilian GDP. Among the findings of the research, it was possible to identify both internal nature of variables and external nature preceded the Brazilian GDP, suggesting that the crisis originated from a combination of domestic and external factors.

Keywords: Economic Crisis, Granger Causality, International Economics

Jel Classification: G01, B23, F40

1. Introduction

From 2003 to 2008, the Brazilian economy was marked by economic growth combined with price stability. In 2009, the real GDP had negative growth. The point fall in GDP in 2009 was due to the international financial crisis that began in the US. In parallel, the international scenario was favorable and a lasting cycle of high commodity prices benefited the emerging countries in the first decade of this century. However, early in the next decade, Brazil’s economic growth started to lose momentum, but the fiscal stimulus policies, through increased spending and tax cuts, coupled with monetary policy more lenient with inflation, continued to stimulate the market work through to 2014.

Between 2014 and 2016, the Brazilian economy faced one of the worst recessions in history. According to the Business Cycle Dating Committee of (Codace) of the Getulio Vargas Foundation, there was a Brazilian economic crisis that lasted for 11 consecutive quarters from the second quarter of 2014 to the last in 2016. The government’s official discourse and the economic team in the period when the crisis began it was that an international economic crisis would have “contaminated” the Brazilian economy. Thus, the domestic economic policy would have little or no interference in the crisis. In fact, economic crises have many

variables and can be derived from multiple causes because they depend on the economic characteristics of each country and the country's degree of integration with the world economy, among other factors.

It should be noted that in the period leading up to the crisis, there were changes that were not only internal, but also external in nature. From the internal point of view, the "Macroeconomic Tripod," which consisted of the combination of primary surplus with inflation targeting and a floating exchange rate regime, was replaced by the so-called "New Economic Matrix," which, according to Person (2013), consisted of an interpretation that was a combination of real interest rate of the Brazilian economy being set at high levels, combined with an appreciated exchange rate. In this scenario, the state should take a more interventionist and protectionist role in not only reducing the real interest rate, as well as expanding subsidized credit and devaluing the exchange rate, among other actions.

In this context, this paper's research object is to analyze the causes of the Brazilian economic crisis from 2014 to 2016, with the research problem the following question: was the economic crisis of the period 2014-2016 caused by internal conduct of macroeconomic policy or by the international scene? The search for the answer to the research problem involves some intermediate goals, such as the approach of the pillars of the main Brazilian economic policies that preceded the crisis, and verification of possible biases in national economic policies that have worsened the scenario. The work is justified by the need to understand the determinants of the largest recorded recessions since the early twentieth century. For Codace, the Brazilian economic crisis that lasted for 11 consecutive quarters, had an accumulated loss of Gross Domestic Product (GDP) of 8.6% in these 11 quarters. The revision of the national accounts by IBGE showed a decrease in this period by 8.2%, which puts the recession period from 1981-83 as deeper than the recent. Despite the differences between the scenarios, the recovery process has proved slow compared to other crises experienced by Brazil. It is necessary, then, to analyze the structure of the Brazilian economy at the time, along with its main pillars, since, in the period leading up to the crisis, the country was experiencing a growth cycle in the main sectors of the economy with record levels in the employment rate and increased income in the most disadvantaged classes.

From this view, the article is structured as follows. After this introduction, the next section will cover the theoretical framework on crisis and the debate about the causes of the crisis in Brazil, with an emphasis on monetary and fiscal issues. In Section 3, a historical evolution of the Brazilian economy will be presented with the transition from the Macroeconomic Tripod for the New Economic Matrix. Later, in Section 4, the research methodology will be presented, which consists of applying Granger precedence tests in order to identify the variables of internal or external nature preceded the Brazilian GDP behavior. In Section 5, the results and discussion will be presented. Finally, Section 6 presents the final considerations.

2. Theoretical Framework

The impact of economic crises can vary according to the characteristics of each country, such as dependence on the international market, debt and economic expansion policies, among others. To Fiani (2011), excessive state intervention in the economy can damage the economic environment, since the state has no entrepreneurial ability, and often acts in the economy with interests that are opposed to those that generate economic growth. Excessive intervention may occur through excessive regulation of the economy and in commercial practices, which may lead to a significant decline in the potential growth rate of the economy. According to Filgueiras and Gonçalves (2007), the regulatory policies bring losses as transaction costs attached to them and encouraging opportunistic relationships between public and private actors, generating, for example, corruption. Thus, government failures happen when there is systemic inefficiency. Since there are transaction costs that arise from regulatory policies, there is thus asymmetric information in markets and institutional weaknesses and allocative activities, generating stunts and preferences between state and private actors, culminating in loans with subsidized interest rates and special terms and even with a preference for investments in politically stronger regions, to the detriment of others.

Kindleberger and Aliber (2011) point out that each of the various crises in history follow a credit expansion and credit expansions related to international capital flows. In this sense, there is a combination of internal and external factors that cause a crisis. Reinhart and Rogoff (2008) analyzed the determinants of the subprime crisis and identify both internal and external factors, such as potential determinants, of the 2008 US crisis.

Gordon (2005) points out that the literature indicates at least 60 variables affecting the development and growth of the economy. The variables focus primarily on structural changes to mitigate government failures and its harmful effects on the economy as a whole. On the other hand, the author points out that internationalized economies are more susceptible to impacts of the international economic situation, since the global economic environment generates interdependence among countries. In this sense, Baumann, Canuto and Gonçalves (2004), state that the degree of impact on open economies depends on three main factors: the magnitude of the internal market, the variety of import and export and technological capacity, and trade and monetary policy. There are several mechanisms for the international spread of economic instability or international economic cycles, and these mechanisms can be classified among the different spheres of international economic relations, such as the commercial, productive, technological, monetary and financial as Gordon (2005) noted. In the commercial sphere, the most obvious mechanism is the ratio of exports of the country and world income. The multiplier with external repercussions expresses this interdependence between macroeconomic aggregates two countries. For this reason, international economic crises may give rise to protectionist pressures worldwide, which is called a trade war (climbing protectionist measures). Even in the commercial sphere, global crises tend to promote competition in the world market via currency war (climbing exchange rate devaluations). The trade and foreign exchange wars are instruments of mercantilist output economic crises. Countries with a high degree of export specialization in commodities are more susceptible to international economic instability, due to the inconsistency of the terms of trade resulting from trade and currency wars as Gordon (2005) showed.

In the productive sphere, the main mechanisms involve strategies, conduct and performance of transnational or global enterprises. Countries with the highest degree of internationalization of production (denationalization) are more likely to have flows of goods, services, intangible assets and capital. In the context of a global crisis, these dependent countries suffer most from the re-allocation of resources by transnational corporations. In the monetary sphere, while the world economy thrives, there is an extraordinary increase mechanism of international financial flows, i.e., local banks capture the low interest rates, foreign currency funds and lend in the national currency, in accordance with Harding and Pagan (2006). On the other hand, when the world economy is going through a less favorable stage with the international liquidity contraction, there is no recovery of portfolios on a global scale and there is increased risk aversion. Harding and Pagan (2006) argue that countries with high structural external vulnerability (due to, for example, high net external liabilities and governance deficits) are more likely to suffer speculative attacks.

Filgueiras and Gonçalves (2007) point out that fiscal management is a key element in determining the dynamics of monetary economies of production and that fiscal policy influences, by various channels on aggregate demand: directly, through taxes, spending, current transfers and public investment; and indirectly through the multiplier effect on private consumption and investment. Baumann, Canuto and Gonçalves (2004) add that fiscal policy can affect economic growth in both the short and long term, including favoring the occurrence of structural changes, due to its effects on investments. However, Filgueiras and Gonçalves (2007) point out that since the emergence and consolidation of theories and liberalizing macroeconomic policies in the 1980s, the discussion of the fiscal policy impacts on aggregate demand and growth started to show a relevant change: it is up to monetary policy to intervene in aggregate demand and maintain price stability through interest and exchange rates, variables that, in turn, affect the trajectory of debt and GDP, while fiscal policy must compensate for these effects on debt and increase fiscal effort when any threat to the stability of the debt trajectory is found. Baumann, Canuto and Gonçalves (2004) point out that public finances have become an important means of assessing the financial and capital markets, as indicators such

as the primary surplus and the net debt of the public sector became part of the list of country risk indicators and have been incorporated into the analysis of “national economic fundamentals” that are the basis for the confidence of investors.

In this context, many countries, especially developing ones, have adopted essentially austere fiscal policy, despite the evolution of its economy in the short and medium term according to Blanchard (2004). These countries also subjected their fiscal management to the wishes of monetary policy and the indispensability of stabilizing their economy, leaving ultimately, background economic growth. It was the need for a nominal anchor for inflation expectations of economic agents that led to the adoption of inflation targeting system in which the primary task of monetary policy is to control inflation. In this new monetary policy framework, inflation control is mainly for setting the value of the basic interest rate. Moreover, the growth rates of monetary aggregates - M1, M2 or M3 - is not a variable over which central banks are interested in exercise any control according to Blanchard (2004). To Oreiro and Feijó (2010), the evolution of theory and monetary policy practice in developed countries has shown that the growing instability in the velocity of circulation of the currency, observed in those countries after the 1970s, made excessively fragile the relationship between the rate inflation and the growth rate of the monetary reference unit.

Blinder (1999) points out that this phenomenon led economists to develop a new way of controlling inflation. For the author, the Central Bank should focus on the relationship between the rate of real effective interest rates and the real interest rate balance, instead of controlling the increase in the money supply. In this context, Blinder (1999) considers that the proper functioning of the inflation targeting system requires that the monetary authorities respond to the fundamental issues in the economy such as: What should be the target inflation rate pursued by the Central Bank? Should a zero inflation target be pursued in the long run? If not, what is the optimal rate of inflation? Should the responsibility for setting the inflation target fit the Central Bank or any other institution, as in the Brazilian case, CMN? How do you determine inflation expectations? Do these expectations reflect the perception of future developments in the inflation rate of formation of prices agents? Or do they just reflect the views of financial market operators? The answers to these questions define the governance structure of monetary policy, i.e. the institutional framework in which monetary policy is conducted. This model includes not only the set of institutions underlying the operation of monetary policy, but also those involved in the preparation and implementation of this policy. To Blinder (1999), the objectives of economic policy should be determined by broad debate among the various representative segments of society. In the specific case of monetary policy, the goals should reflect the balance achieved between the “degree of social aversion” to inflation and the “degree of social aversion” to the loss of production and employment resulting from disinflation policy. However, in the current structure, the inflation targets do not reflect a social consensus on the “optimal rate of inflation” in the long run, much less about the speed at which this long-term goal to be achieved.

For Gordon (2005), the inflation targeting system, the cyclical action against the Central Bank, should not pose a risk to stability in the long term, since there would be a resulting inflationary bias of time inconsistency in the conduct of economic policy, without any benefit in terms of output and employment in the long run. As for Busato and Cavalcanti (2009), the credibility of economic policy is important, since the agents use rational expectations to make decisions, creating the need for consistency of macroeconomic policies over time. Therefore, the monetary authority should be committed to the maintenance of stability and the achievement of goals. The realization of the desired goals, however, would only be possible with a largely independent Central Bank, that could take decisions without hierarchical subordination to any other bureaucratic agency. This, in theory, would eliminate the inflationary bias and, indirectly, favor economic growth.

Considering the importance of both monetary policy as fiscal policy in the context of economic crisis, associated with external nature problems, as demand for exports depends on the global economy and consequently affect the exchange rate, Balassiano (2018) analyzed, using the synthetic control method, which factors (internal or external) were mainly responsible for the Brazilian economic crisis. Among the findings, the author pointed out that the internal factors were mainly responsible for the deterioration in the

Brazilian economy. The author used a final sample of 14 countries, which do not necessarily have convergent characteristics with the Brazilian economy, for synthetic control, which does not invalidate the results of the study, but it may cause some bias in the results. In addition, the country chosen as the “placebo” for the analysis was Chile, which, according to the author, was the Latin American country that was characterized by the adoption of conventional macroeconomic policies in the analysis period. However, as was also highlighted by Borges (2017), the Chilean economy has a particular characteristic which cannot be ignored: it is the only emerging country that applies a counter-cyclical fiscal regime from the behavior of commodity prices, reducing both economic growth in the high cycles, as well as the drop in the economy in periods of low commodity prices, such as an automatic stabilizer.

In the same line of argument, Balassiano (2018) and Matos (2016) showed that external factors cannot explain the slowdown of the Brazilian economy in recent years. Matos (2016) used a panel data model that included indicators for assessment of external shocks, such as the growth rate of the US and China, the options volatility index on the S & P 500 (VIX), the interest rate US 10 years and the terms of trade. As domestic factors, the variables analyzed were the investment and inflation rates, interest rates, the current account as a share of GDP, the output gap and the nominal deficit.

Cubeddu et al. (2014) analyzed the impact of external shocks on developing countries and listed out from the point of view of external shocks, the following variables as relevant: financial and trade liberalization, trade terms, the share of exports to the Eurozone, China and the US and exports of commodities in a sample of 54 countries from 2000 to 2013. The data study found that countries such as Chile, Peru and Venezuela were more affected than Brazil for the international scene, with the Brazilian economy occupying an intermediate position in terms of external impacts on the economy.

In contrast, Borges (2016) and Borges (2017) showed that domestic economic policies did not constitute the main determinant of the Brazilian crisis. Highlighting the fact that there was a long cycle of high commodity prices and comparing the Brazilian economy with countries with similar characteristics, the author states that exogenous factors to domestic economic policy and any unmapped determinants explain the crisis in the interval between the percentages 40% and 60%. Borges (2016) and Borges (2017) points out the internal economic policies as being responsible for levels located in the 10% - 30% range drop in Brazilian product responsibility during the crisis. The author points out that the problems of corruption that led to write-downs and the possibility of Petrobras’ insolvency affected the sovereign risk and the perception of agents on public accounts, and the fall in international oil prices from the end of 2014 was the major determinant of the deterioration of the company’s value. Thus, concluded the author, the domestic economic policy has reduced share of responsibility in the Brazilian recession.

Reinhart, Reinhart and Trebesch (2016) pointed out that the recent cycle of high commodity prices from 1999 to 2011, was one of the longest in history. The authors state that capital flows and fluctuations in commodity prices, as well as fluctuations in international interest rates, have been historically connected with episodes of financial crises and, according to estimates, the recent boom in commodity prices was the second highest since the eighteenth century and one of the four long cycles since 1815. The authors found evidence of financial crises, given by sovereign default in subsequent scenarios to high-end cycles in commodity prices.

3. Historical Evolution: From “Tripod Macroeconomic” to the “New Economic Matrix”

The analysis of the relationship between developmentalism and populism is recurrent in the evolution of Brazilian economic history. The issue has even returned to the agenda with the approach of new-developmentalism and its proposal for a national development project that is not worth the “old” developmentalism, which would be saturated with populist practices as noted by Oreiro and Feijó (2010). In this context, the 15 years that followed the end of World War II were marked by the expansion of the Brazilian economy at a faster pace than any other Latin American country. The annual average growth rate of Brazil’s GDP in this period was, in fact, one of the world’s largest, surpassed in the West only by

Germany, and in the East, only by Japan and the small economies of South Korea and Taiwan. In fact, between 1946 and 1960, the annual average growth rate of the Brazilian economy was 6.3%; to Germany, 10.5%; Japan's 9.1%; to South Korea, 6.5%; and Taiwan, 7.6%, according to Maddison (1997). However, the early 1960s marked the end of this era of accelerated growth of the Brazilian economy. Between 1963 and 1967, the rate of the country's economic growth fell to half of that recorded in the previous decade, generating a heated debate about the type of economic reform that would be able to rescue the historical rates, as shown by Earp and Prado (2003).

Some defended the separation between the economic and political spheres because they believed that the economy was rational, while the policy was passionate. Thus, the market with its rational pricing system, would ensure by itself economic development. State actions, on the other hand, would be innocuous or even harmful to the economy, according to Bresser-Pereira (1982). Others understood that state interventions (mainly monetary instability) were at the heart of the Brazilian delay. For liberal economists, therefore, the idea was wrong that overcoming the crisis of development would be possible on the basis of reform and state intervention in the economy. In fact, excessive state intervention and neglect of economic stability would be the main reasons for the persistence of the Brazilian economic backwardness. These economists argued, therefore, that economic populism was the root of the problem, as it generated monetary instability and an inadequate climate for the expansion of private investment, according to Bresser-Pereira (1982).

According to Bresser-Pereira (1982), there are three sources of imbalance in populism. Populism in fiscal policy, which led the state to carry out expenses that exceeded its tax collection capacity, generating inflationary pressures; populism in credit policy, which financed the investment with expansion of the money supply, and not an increase in domestic savings, leading to a new source of inflationary pressure; and populism in wage policy, which led to an increase in payrolls higher than productivity growth.

In this context, further to the developmentalism of the discussion, in 1999 the Brazilian economy got rid of one of the last bands of the stabilization process implemented in 1994: the rigidity of the exchange rate regime. Since then, a regime of inflation targeting was implemented. According to Oreiro (2015), in 1999, there also began a macroeconomic policy regime that became known as the "Macroeconomic Tripod," that was based on the primary surplus combination with targeting regime inflation and floating exchange rate. Also according to Oreiro (2015), already in 2006 this regime had undergone transformations, with the change in accounting for investments in the primary surplus target. Other measures, such as the abandonment of the downward trend in inflation targets and the Brazilian Central Bank's role in the foreign exchange market to minimize the nominal appreciation of the exchange rate, have made the tripod more flexible and stimulated the economy through incentives on the demand side.

According to Jorge and Martins (2013), the financial crisis caused by the fall of Lehman Brothers in September 2008 had a significant impact on the world economy, reversing the trend of economic growth trajectory. The Brazilian economy was heavily impacted by the crisis and in the fourth quarter of 2008, GDP fell by an annualized 14.7% in the quarterly comparison. At the international level, the financial crisis brought a significant worsening of the fiscal situation of the vast majority of countries, especially the developed ones, requiring huge efforts from governments to rescue systemically important institutions. It is noteworthy, however, that even other countries that were not directly involved with the huge credit boom directed at real estate were not immune to the crisis. The degree of integration between financial markets was such that the derivatives originating from troubled countries hit financial institutions around the world. Although there was, in the years preceding the crisis, improvement in debt indicators in the country, there were no adjustments promoted to curb the rising government spending.

In response to the effects of the crisis, the government deepened the easing of Macroeconomic Tripod, as highlighted by Oreiro (2015). According to Jorge and Martins (2013), the government postponed the collection of taxes, such as the Tax on Industrialized Products (IPI), the Social Integration Program (PIS), the Contribution to Social Security Financing (Cofins) and the tax income withholding and accelerated the return of tax credits for businesses. Spending on the Growth Acceleration Program (PAC) and social programs were maintained and scaled up, especially by the Treasury loans, public banks (mainly Bank of

Brazil and Caixa Economica Federal) and the National Bank for Economic and Social Development (BNDES).

It is worth noting that one instrument that is important in the implementation of government stimulus is expansion of the BNDES balance sheet. The policy was aimed at the establishment / creation of national champions and the choice of “strategic” sectors that received subsidies, such as the automotive industry, and protection (in the form of local content and the price) in the case of the shipping industry, to name only two examples. Note that the growing volume of BNDES disbursements was concentrated to large and medium industries, especially the construction sector, as well as energy and food. As shown in Figure 1, there was a growth trend of the 2008 disbursements until 2013, when disbursements reached a total of R \$190 billion. From then on, there is a reversal in disbursements in 2017, with values lower than in 2008 in nominal terms.

Jorge and Martins (2013) point out that the permission given by the Budget Guidelines Law for abatement investments and exemptions from the primary surplus target required a lower tax effort from the viewpoint of control of expenses and allowed the expansion of public spending to expand aggregate demand. Even with a government effort to achieve the primary surplus targets not slaughtered by investments and tax relief, the authors point out that the deepening of the European crisis and uncertainty in the international environment, in addition to the drop in international commodity prices and Brazilian exports, generated effects on the slowdown of the Brazilian economy that was already beginning in 2013.

Oreiro (2015) points out that, from 2008, primary federal spending increased considerably, providing a highly expansionary fiscal policy. A modest primary surplus was able to maintain a stable debt-to-GDP ratio with a slight downward trend until the 2013, when the Gross Government Debt-to-GDP ratio reached the level of 51.69%, as can be seen in Figure 2.

Figure 2 shows the evolution of the general government debt as a proportion of GDP in Gross and net terms. It is possible to see a downward trend in the period 2008-2013, except for the one-off effect resulting from the international financial crisis in 2009. However, from 2014, the trajectory moves upward with a considerable increase of the Gross Government Debt-to-GDP passing rapidly from about 51.69% to 74%, which requires of the public sector a strong contingency of investments and the need to review exemptions and expansion of subsidized credit through BNDES. The pillars of the main economic policies of Brazil between 2010 and 2014 were based on government spending as a means of fostering public income policies. In the Brazilian economic performance, compared with the major world economies during the crisis, there is a difference in the movements of the product, since the US economies, Eurozone and China, had sustained growth in the period, macroeconomic stability and no financial or economic crisis triggered. From an internal point of view, however, Paula and Pires (2017) pointed out that the gross fixed capital formation was the main factor that contributed to the slowdown of the Brazilian economy in 2011, precisely in the context of the New Economic Matrix.

It is possible to identify biases in the national economic policy that aggravated the economic crisis, an increase in public spending and the change in the nominal result of the public sector, from -3% in 2013 to -10.30% in 2016, according to data obtained from the National Treasury. Note that the 2014-2016 crisis of the Brazilian economy originated from shocks on both the supply and the demand side, and, as pointed out by Barbosa Filho (2017), was mostly caused by policies that reduced the growth capacity of the economy Brazilian and generated a high fiscal cost. The growth rate of Brazilian GDP has fallen from an average of 4% per year to less than 2% per year. At the same time, the Brazilian public sector showed a surplus primary of 2.2% in 2012 and generated a primary deficit of 2.7% in 2016.

Lack of capacity government financial raised the reduction of several investments in the Brazilian economy from 2015, especially the reduction of public spending. Therefore, it generated a fiscal crisis that systematically raised the country risk, the interest rate and, consequently, the uncertainty of the markets, substantially reducing consumption and investment in 2015 and 2016, which also contributed to the recession, including due to loss the credibility of the Central Bank of Brazil, the price adjustment and how monetary policy was conducted, which had to greatly accelerate the upward cycle to reenter the rate set by

the National Monetary Council. Barbosa Filho (2017) noted that in 2012, there was a reduction in the interest rate of the economy in the inflation acceleration scenario in the context of the New Economic Matrix. Barbosa, Camêlo and João (2016) estimated the real interest rate of the Brazilian economy and a Taylor Rule, in order to assess whether there may have been some change in the behavior of the Central Bank of Brazil. The study found evidence that, from 2011, the Central Bank of Brazil became more lenient with respect to inflation.

In parallel with the fiscal and monetary issues, as regards the external sector, the movement of exports and imports in billions of dollars from 2011 to 2017 can be observed in Figure 3. Note that there is a drop in exports between 2011 and 2016, combined with increased imports in the period 2011 to 2014, which meant that, as in 2013, the trade surplus was less than R \$1 billion, with a deficit of R \$6.6 billion in 2014. The dynamics of the global economy, slowdown in growth in emerging countries and low European economic growth, coupled with the fall in commodity prices and the appreciation of the Real, were the main determinants of this behavior. With the decline in the Brazilian GDP, the recession scenario in 2015 and the effects of the currency devaluation caused by the crisis, imports dropped sharply and exports started to grow, even if slowly, recovering positive trade balances.

Figure 3 therefore shows an imbalance in Brazil's balance precisely in the time of the economic crisis in 2014, when the balance was negative at \$6.6 billion. In later years, there was a surplus in the trade balance, as in 2015, the positive balance was already US \$17.7 billion and, in 2017, reached US \$64 billion. Therefore, it is important to highlight the role of the trade balance of countries, mainly in exports, as a component of long-term effective demand trend. The trade balance also has an important role in addressing the external funding needed for the development and economic growth.

Already Figure 4 shows the real growth of US GDP. It is possible to see an upward trend in the 2011-2015 period, averaging 2.2% per year and the peak of 2.9% in 2015. The US, as the largest economy in the world, has an influence on all other countries, according to the dependence and strength of the economy in question. Historically it is possible to see a direct relationship of international economic crises, especially in 1929 and 2008 with respect to the contagion of major economic powers and its effects in developing countries.

In this context, Figure 4 shows a period of economic boom, with growth of US GDP, between 2013 and 2016, coinciding with the period when Brazil faced one of the worst crises in its history. The interest rate can also be considered a barometer for the flow of capital. Thus, it appears that there was an increase in US interest rates in the period, which would justify an increase in the flow of financial capital of much of the world (not only in Brazil) to the US. You can see also that the rise in US interest rates caused a slowdown in the growth trajectory of the US economy.

When analyzing the GDP of countries, the most obvious mechanism to use is the ratio of exports of the country and world income, and the multiplier with external repercussions naturally expresses this interdependence between macroeconomic aggregates two countries. According to Gordon (2005), the international economic crisis may give rise to protectionist pressures worldwide and start a trade war. Even in the commercial sphere, global crises tend to promote competition in the world market via a currency war (climbing exchange rate devaluations). Countries with a high degree of export specialization in commodities are more susceptible to international economic instability, due to the inconsistency of the terms of trade resulting from trade and currency wars, and in this sense, when analyzing the evolution of US GDP, there is no direct relationship with the Brazilian economic crisis.

By analyzing Figure 5, it is found that, in 2015, the basic Brazilian interest rate, Selic, reached its highest level since 2011, with a level of 14.3% per year and, from 2016, begins its trajectory decreasing until, in 2017, the lowest in recent years, from 7.0% a year. The increase in interest rates reflects the need to control inflation, which distanced itself from the target set by the CMN, and adjust monetary policy in the face of capital flight due to the increase in US interest rates and essentially the increasingly discredited international community in relation to domestic economic policies. 2014 to 2016 inflation pressures begin to slow down the increase in unemployment and, consequently, a significant reduction in household consumption.

4. Methodology

In order to evaluate whether the Brazilian economic crisis originated from external or internal determinants, the research methodology of this study is to conduct Granger precedence tests to evaluate the variables that affected (or not) the Brazilian economic performance. According to the theory presented in Granger (1969), if a certain variable X causes another variable Z, then it is reasonable to expect that variations in X are previous to variations in Z. This means that the variable X helps predict future values of Z for some time horizon. The completion of the test requires initially that the series used are stationary. Once the stationary series is completed, then the lag selection tests are conducted. Initial discussions took place on the selection of lags, in view of Maddala and Lahiri (1992), who indicated that the lag-scale process was in some sense arbitrary. This is because there are a variety of alternative methods to available to determine the optimal size of gaps in a model. The development of more recent research allowed the improvement of the tests used to check lags without arbitrariness. In this sense, Davidson and MacKinnon (1993) suggest trying to identify the number of lags in the first place and only then make up the causality tests. The authors argue that the choice of a large number of lags would be preferable, since it would check how the exclusion of some lags affect the outcome of the estimates. On the one hand, the choice of a few gaps can cause serious bias due to the omission of relevant variables. On the other hand, choosing more gaps than necessary can lead to bias inclusion of irrelevant variables. In fact, this is the modeling method originally proposed by Hendry (1980), which suggests that the choice of the best model should be done gradually, starting with a very general model, and from several tests, narrowing the scope of the model in the final analysis.

To solve the issue related to the optimal choice of lags, we will initially estimate a model of Autoregressive Vectors (VAR) with respective tests for lag selection in the template context. The use of Autoregressive Vectors models is widespread in economics and research, and, according to Cavalcanti (2010), they are among the instruments most commonly used in empirical research in the area of macroeconomics. VAR models, largely, are popular because of the perception that they allow the analysis of the interrelationships between multiple variables from a minimum set of identification restrictions, i.e. restrictions to identify the “exogenous” component of each variable, making it possible to estimate the effect of a “shock” of this variable on the other. In the context of this study, the estimate of the VAR was used solely to determine the appropriate number of lags precedence to statistical tests. We will therefore estimate VAR models for each pair of stationary variables in order to identify the ideal number of lags for the statistical precedence test.

In this context there will be five tests / criteria applied for selecting the best model: Statistical test, sequential LR modified with each error at 5% significance level, the final prediction error test, Criteria of Akaike, Schwarz Criteria and Criteria of Hannan-Quinn. The tests are discussed in detail by Lütkepohl (2005). The tests will be realized with stationary variables in the context of a VAR model with estimates that choose from 1 to 5 lags.

The variables used in the survey were collected on a quarterly basis starting in the 1st quarter of 2008 to the 4th quarter of 2017 and are as follows: i) real growth rate of Brazilian GDP, represented by the acronym GDP_BR, which shows the quarterly change in national production and is the main variable of this study, given that all the other variables of the research were analyzed in relation to the Brazilian GDP, whereas the goal is to assess whether there is (or not) statistical precedence of other variables in relation to the behavior of Brazilian economy. The data source of this variable is the IBGE. ii) the US GDP growth rate, represented by the acronym, GDP_US, which represents the quarterly variation in production of the world’s leading economy, which usually impacts the economies of other countries. The source of this series is the Bureau of Economic Analysis. iii) the European Union’s GDP growth rate, represented by the acronym, GDP_UE, which represents the quarterly variation in production of the countries of the Eurozone, whose source of data is Eurostat. iv) the global GDP growth rate, represented by the acronym, GDP_W, which represents the quarterly variation of world production and was obtained in Bloomberg. v) US interest rates, represented by the prime interest rate, obtained on the basis of Bloomberg and represented by IR_US. vi)

price of iron ore at \$ considering that Brazil is a major exporter of this commodity, represented by IronOre_P variable obtained on the basis of Bloomberg. vii) Price of Brent crude oil barrel in dollars represented by OIL_P obtained on the basis of Bloomberg. viii) price index US consumer, represented by P_US also obtained on the basis of Bloomberg. ix) Exchange Rate R \$ / US \$, represented by ER and obtained the Central Bank of Brazil. The rate refers to the purchase price of end of period. x) Brazil's exports in dollars, accumulated in the last 12 months, obtained from the Central Bank of Brazil and represented by X and xi) Brazil's imports from the rest of the world in dollars, accumulated in the last 12 months, represented by M and also obtained by the Central Bank of Brazil. xii) Current account as a share of GDP obtained by the Central Bank of Brazil and represented by CA_GDP and xiii) Net debt of the public sector as a proportion of GDP, which clears the stock of debt in proportion to the product of the country, represented by DEBT_GDP obtained in Macrodados. xiv) Selic-over, which is the basic interest rate of the Brazilian economy, represented by IR_BR. The rate shown is sourced from site of Brazil's Central Bank and was accumulated in the quarter. xv) Gross Fixed Capital Formation, expressed in terms of real quarterly growth, which represents the investment of the private sector of the economy, the IBGE obtained and represented by GFCF.

Table 1 presents descriptive statistics of the variables. You can see that the average growth of the quarterly product of Brazil and the USA over that period, is very close to zero. The average per quarter of global growth was 3.2% in the period. The US interest rate had a very close minimum value of zero as a result of its expansionist policy after the financial crisis of subprime.

It is of note that both the price of iron ore and oil fluctuated significantly in the period. The price of iron ore had an even bigger swing, with a minimum value of \$38.49 and maximum of \$177.23. The relationship between the real (R \$) and the US dollar (US \$) more than doubled between the minimum and maximum values, and, thus, large amplitude. The behavior of the variables can be seen in Figure 6. You can see that, especially at the beginning of the period, in 2008 and 2009, the variables related to production (GDP of Brazil, the United States, Europe and the World), the US interest rates, the level of prices and commodity prices (iron ore and oil) showed high oscillation.

To evaluate the stationarity of the series used for the estimate, which is a necessary procedure prior to performing the tests of precedence, there will be the root test unit Dickey-Fuller and / or increased Dickey-Fuller (ADF) as Dickey and Fuller (1979). The number of lags for carrying out the ADF test was selected according to the best criterion offered by Schwarz, and additionally by the choice of the number of lags required to remove any residues of serial correlation. The test results can be observed in Table 2 and the test format selected from the statistical significance of the estimated regression coefficients for the test (with or without constant and with or without bias). As can be seen in Table 2, it was possible to reject the null hypothesis that the series has a unit root for most of these series and with significant portion at a significance level of 1%. For series in which it was not possible to reject the null hypothesis, differentiation was adopted, which was adopted in two different ways.

For series that were not expressed in the percentage form, the log difference was applied, showing what happened to the iron ore price series (IRON_P), with oil prices (OIL_P), exchange rate (ER) and Exports (X). As for the variables Current Account balance to GDP and net public sector debt to GDP ratio, already expressed in the form of rate and proved non-stationary as the ADF test, was only applied to first difference for the series become stationary. In order to address the issue of non-stationarity of the series with the differentiation process, we proceeded to the choice of the best model in terms of the number of lags.

As mentioned above, five tests were applied / criteria for selection of the ideal number of lags for carrying out the test precedence. In the estimation context of a VAR model bivariate with one of variables must be the Brazilian GDP, they were five tests conducted, whose results were presented in Table 3: LR, which is the statistical test modified sequential LR, the prediction error test end (FPE), Akaike (AIC), the Schwarz criterion (SC), and finally the criterion of Hannan-Quinn (HQ).

Therefore, five criteria were applied in each of the 15 estimates of the variables that may have preceded the Brazilian GDP. As can be seen in Table 3, in some cases, such as the pair GDP of Brazil and GDP in the euro zone, all of the criteria pointed to one lag as the best option. This also occurred in the analysis of the Brazilian GDP to US prices, the exchange rate and exports, among other variables. In other cases, three or four criteria were identified as the optimal number of lags. Four criteria showed the optimal number of 3 lags for the joint analysis of Brazil's GDP and the US and the optimal number of 4 lags between the GDP of Brazil and Brazilian imports from the rest of the world. The ratio between the Brazilian product and the world was reported by three criteria with the number of lags equal to 3 as the ideal. This also occurred with other variables, such as US interest rates, oil prices and iron ore, among others.

5. Results and Discussion

From transformation of non-stationary series in stationary with logarithmic difference or only with the application of difference to series that were already expressed in percentage and the definition of the optimal number of lags from different lag length selection criteria, the Granger precedence test was performed in order to identify whether internal or external command variable preceded Brazil's GDP.

According to what was presented in the methodology, the series has quarterly variables, beginning in the 1st quarter of 2008 to the 4th quarter of 2017 and, for all selected variables, the causality test was applied in the sense of Granger, regarding the Brazilian GDP. Table 4 shows the test results. The test has as null hypothesis, the fact that X does not cause, in the Granger sense, the variable Z. In this sense, the first column of the table shows the variables that were tested for precedence over the country's GDP. Following, there is the number of observations used in the estimate, which ranged in front of the number of lags selected by the criteria and the fact that the original series or not stationary. The last two columns present the F-statistic and the p-value, respectively.

As can be seen from Table 4, we cannot reject the null hypothesis that the US GDP does not cause, in the Granger sense, Brazilian GDP. In other words, there is no evidence of precedence of US product on the Brazilian situation during the period. The same goes for the product in the euro zone, where the F-statistic also does not allow rejection of the null hypothesis. In the case of global GDP, however, the null hypothesis can be rejected, which means that there are indications that global GDP has preceded, in the Granger sense, the Brazilian GDP. Another variable that the test indicated as a precedent in relation to the Brazilian GDP was the US interest rate, which suggests that the end of the Quantitative Easing period and the reversal of the monetary policy by the Fed impacted the Brazilian GDP.

With respect to commodity prices, especially with regard to oil and iron ore prices, you can see that it was possible to reject the null hypothesis that the two commodities prices do not cause, in the sense of Granger, the Brazilian GDP. Thus, it is emphasized that both the price of oil and iron ore proved precedent in relation to the Brazilian production.

With regard to the US price level, the test results indicate that it is not possible to reject the null hypothesis of no causality, indicating therefore that US inflation had no effect on the Brazilian product. As for the exchange rate R \$ / US \$ the result is different. The exchange rate preceded it, in the sense of Granger, Brazil's GDP. The exchange rate includes both internal and external determinants. In internal terms, a more expansionary monetary policy than that established by the Taylor Rule may cause capital flight and further devaluation, as in the context of the New Economic Matrix presented previously. In external terms, the end of Quantitative Easing program promoted capital inflows from emerging countries to the developed economies or, more specifically, to the US.

For exports, the test suggests no precedence between exports and Brazil's GDP. As for imports, even at the 5% significance level it is not possible to reject the null hypothesis, one can consider import precedence for the Brazilian GDP at a 10% significance level, which suggests that the growth of imports checked in the period before the crisis is one of the determinants of Brazilian GDP.

Regarding the current account deficit as a proportion of GDP and, in addition, public debt to GDP, we can not reject the null hypothesis. In other words, it can be considered that the variables did not precede, in the Granger sense, the Brazilian GDP. This may be because the current account deficit has shown mild improvement with relative stability after 2010 until 2014. With regard to public debt, the deterioration occurred from 2015, after the start of the crisis, which may have contributed to the result of the Granger test.

In terms of domestic monetary policy, we can see that the Brazilian interest rate preceded the Brazilian GDP, since it is possible to note that the null hypothesis can be rejected at a 1% significance level, which means that monetary policy, now expansionary, now contractionary, was responsible for the Brazilian GDP behavior, especially after the minimum of 7.25% floor kept for a period than needed according to analysis based on the Taylor Rule, among others, that made the cycle high more intense, with the interest rate reaching the level of 14.25%.

Finally, the Gross Fixed Capital Formation, which is an internal nature variable, and capturing in advance any imbalances between aggregate supply and demand in the economy, as well as to relate to the expectations of the business sector, not preceded GDP, in the Granger sense, at the 5% of significance level, but at the 10% significance level it was possible to reject the null hypothesis of no causality in the Granger sense. It is possible to infer, therefore, that there is precedence of GFCF for the Brazilian GDP. These results go against those identified by Paula and Pires (2017), which showed the gross fixed capital formation as an important determinant of the slowdown of the Brazilian economy.

Based on the results of causality tests in the Granger sense, you can say that as the Brazilian product is preceded by both internal factors and by external factors, the Brazilian economic crisis of 2014 to 2016 was preceded not only the conduct of domestic macroeconomic policy and domestic variables, but also by the international environment variables. The domestic point of view, the basic interest rate of the economy, the exchange rate, Brazilian imports from the rest of the world and gross fixed capital formation preceded the Brazilian GDP. From the international point of view, commodity prices, such as oil and iron ore, the US interest rates and global GDP also showed precedent. The R \$ / US \$ exchange rate, which, to a certain extent, reflects both internal and external factors, also cannot be ignored.

The methodology used in the study does not allow us to quantify the relative share of internal and / or external factors in the Brazilian crisis, but the results are close and they complete the analyses presented in studies with similar objectives. Balassiano (2018), for example, found that the rate of investment to GDP had a steeper fall than it should, according to the method of synthetic control, even with the limitations already mentioned the use of the Chilean economy as placebo research. Thus, in the view of Balassiano (2018), it is most likely that internal determinants were responsible for the crisis.

The current survey also found results observed in studies with the opposite view, showing that the determinants of the crisis were predominantly internal in nature. Borges (2017) pointed out that the collapse of oil prices in the international market from 2014, in addition to issues related to corruption that influenced sovereign risk before the possible need for financial support to possible state of insolvency of Petrobras, were important determinants of the Brazilian crisis. It is clear to say that Borges (2017) also finds responsible domestic economic policies, especially fiscal, as causes of the crisis, in addition to the policy and governance crisis that marked the year 2014. However, the point made by the author is that the international nature of factors was dominant. Another highlight from the international perspective, according to the author, is that, after a boom in commodity prices, the exchange rates of commodity-exporting countries tend to appreciate, which causes sectoral allocative changes in the economy, from the tradables sector to the non-tradables, which has lower average productivity, constituting an additional determining factor for the crisis of 2014-2016.

6. Concluding Remarks

The Brazilian economy faced one of the worst recessions in history, which began in 2014 and had a total duration of 11 quarters, equaling in duration and approaching in intensity, the scenario experienced in the early 1980s. Changes in the conduct of domestic macroeconomic policy and the exchange of the Macroeconomic Tripod for New Economic Matrix were identified by many authors as the main cause of the recessive scenario that Brazil experienced. At the same time, there were changes in the international scenario, with falling prices of major commodities, the end of the monetary stimulus program by the Federal Reserve and changes in the growth dynamics of the world economy, slowing growth in many emerging countries. The unfavorable international scenario was pointed out by the official discourse of the government and the defenders in the New Economic Matrix as the main cause of the crisis, exempting the excess of interventionism in the economy through excess of expenses and maintenance of interest in excessively low levels with expansion of credit as main determinants.

In this context, this study aimed to assess whether determinants of an internal or external nature precede the Brazilian GDP and thus evaluate the main causes of the Brazilian economic crisis, so it is possible to anticipate, prevent and mitigate future crises of this nature. Based on the theoretical framework and the econometric methodology used, it can be said that the combination of internal and external elements resulted in the recessionary environment of 2014 to 2016. It is noteworthy, then, that there is evidence that the Brazilian economic crisis was caused by both the international and national scene.

The impacts of economic crises can be distinguished according to the characteristics of each country, with their dependence on the international market, their level of indebtedness and macroeconomic policies adopted, among other things. In Brazil, changes in the conduct of monetary and fiscal policies were important determinants of the recession, since the reversion of monetary and fiscal expansion causes, of course, fall in aggregate demand and output, at least in the short term.

Based on the results of causality tests in the Granger sense, you can say that as the Brazilian product was preceded by both internal factors and by external factors, the Brazilian economic crisis of 2014 to 2016 was caused not only by conduction of domestic macroeconomic policy and the behavior of domestic variables, such as variables of the international economic situation. The domestic point of view, the basic rate of interest of the economy, the exchange rate, Brazilian imports from the rest of the world and gross fixed capital formation preceded the Brazilian GDP. From the international point of view, commodity prices, such as oil and iron ore, the US interest rates and global GDP are shown as preceding the Gross Domestic Product of Brazil. The precedence of the R \$ / US \$ exchange rate, which in a way reflects both internal and external factors, cannot be overemphasized. The methodology used in the study does not allow us to quantify the relative share of internal and / or external factors in the Brazilian crisis, but the results are close and complete the analyses presented in studies with similar objectives, as presented over the course of the article. There was then convergence of this research with studies that indicate internal factors as being responsible for the crisis. At the same time, there is an approximation of the results of Granger causality tests with variables of the international scene. In addition, research has importantly contributed to the pointing out of the presence of both domestic factors and international ones in the Brazilian GDP behavior, and hence in recent Brazilian economic crisis.

The research shows, however, some limitations. In addition to the inability to numerically quantify the combined effect of internal determinants and the combined effect of external factors on the proportion of the responsibility for the crisis, not all possible interference variables were incorporated into precedence tests. We're not included in the domestic perspective, expectations of variables both consumers and producers, as well as the effects of corruption, just as an example. From the international perspective, the behavior of emerging countries was also not properly captured in the variables used in the research. Other methods, in addition to those used in this study and in other studies included in the literature review, could be applied.

Thus, it may be relevant to apply cointegration tests between relevant variables and the Brazilian GDP in order to identify the presence of a long-term relationship between the variables. Another possibility relates to the application of an autoregressive vector (VAR) model or a model of autoregressive vector error correction (VEC). In such cases it would be possible to analyze the variance decomposition of forecast errors in order to try to estimate the relative contribution of each of the internal or external nature of variables in determining the GDP and hence the responsibility of domestic policies or the international scene in terms of relative share. Given the importance of the issue and the possibilities of a wealth of understanding of the issues raised, such possibilities should be included as relevant topics in the future research agenda.

Endnotes

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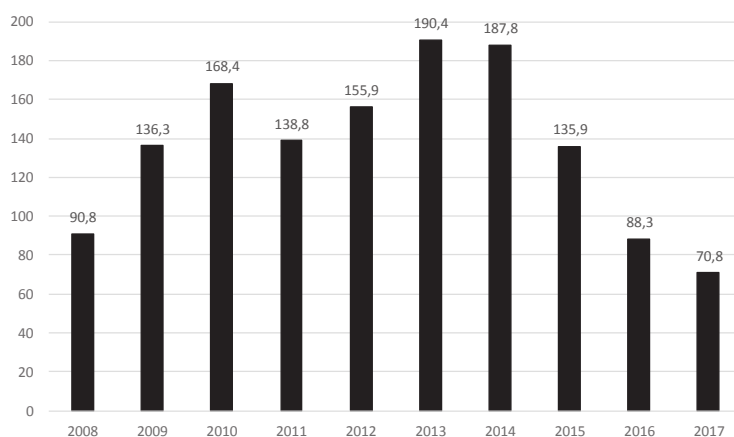
1. This work has been supported by grants from the Mackenzie Research Fund (MackPesquisa)

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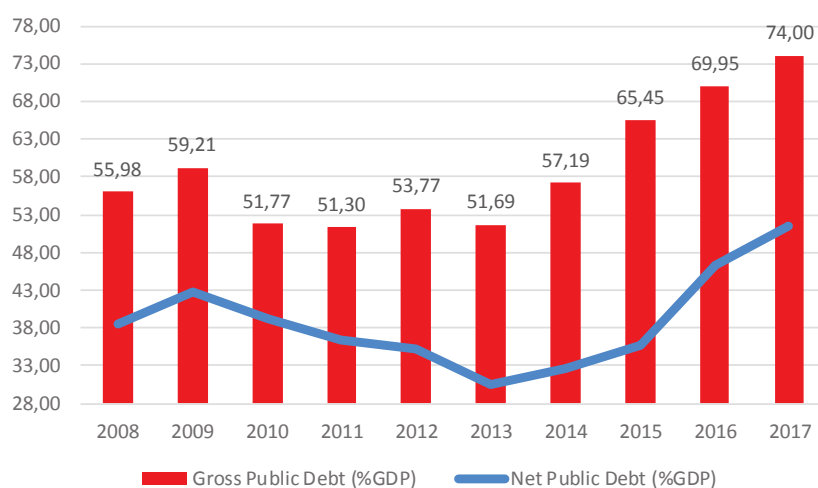
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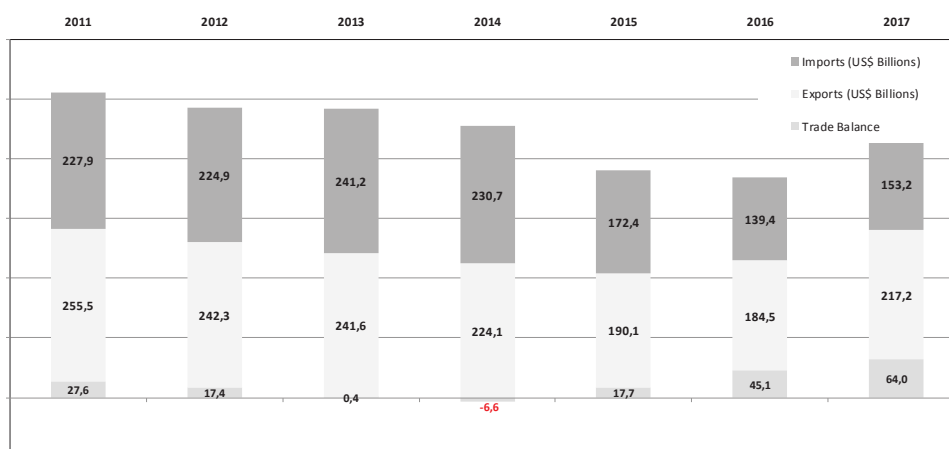
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Figure 1. Evolution of BNDES disbursements in the period 2008-2017 (in R\$ Billions)

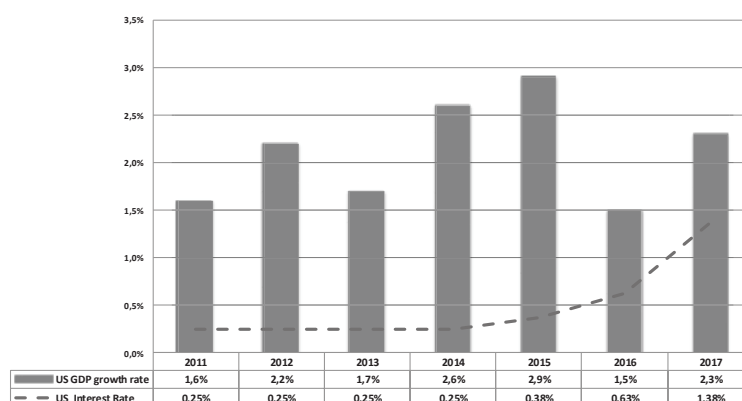
Source: BNDES

Figure 2. Gross and Net Government Debt-to-GDP in the period 2008-2017

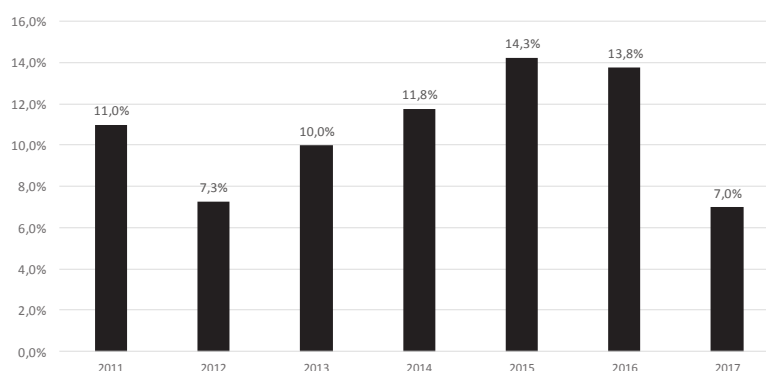
Source: Central Bank of Brazil

Figure 3. Exports, imports and balance of the Brazilian trade balance in the period 2011-2017

Source: Central Bank of Brazil

Figure 4. GDP and interest rate (end of period) in the US in the period 2011-2017

Source: Bloomberg

Figure 5. Selic interest rate / over (end of period) in the period 2011-2017

Source: Central Bank of Brazil

Table 1. Descriptive statistics of variables

Variables	Average	median	Maximum	Minimum	Standard deviation
GDP_BR	0.003	0.002	0.025	-0.041	0.013
GDP_US	0.003	0.005	0.013	-0.021	0.006
GDP_EUR	0.006	0.016	0.038	-0.112	0.027
GDP_W	0.032	0.036	0.061	-0.063	0.025
IR_US	0.41	0.16	2.60	0.07	0.59
IRONORE_P	95.92	78.91	177.23	38.49	41.27
OIL_P	82.52	79.51	134.44	39.35	27.64
PUS	0.004	0.005	0.019	-0.034	0.007
ER	2.40	2.20	3.90	1.59	0.71
X	270 159	274 336	328 652	192 544	305 774
M	242 836	241 276	301 084	154 035	375 326
CA_GDP	-2.48	-2.90	-0.50	-4.30	1.10
DEBT_GDP	39.34	39.05	51.57	30.59	5.16
IR_BR	2.61	2.61	3.47	1.65	0.51
GFCF	1.25	2.02	29.00	-18.71	10.77

Source: Bloomberg, IBGE, Eurostat, Central Bank of Brazil, BEA, Macrodados.

Figure 6. Variables in the period 2008-2017

Source: Bloomberg, IBGE, Eurostat, Central Bank of Brazil, BEA, Macrodados.

Table 2 – Results of Dickey-Fuller (ADF) Unit Root Tests

Variable	lags	Constant	Trend	ADF	Critical Value 10%	Critical Value 5%	Critical Value 1%
GDP_BR	0	yes	not	-3.991044 *	-2.607932	-2.938987	-3.610453
GDP_US	0	yes	not	-3.894424 *	-2.607932	-2.938987	-3.610453
GDP_EUR	7	yes	yes	-5.685048 *	-3.212361	-3.557759	-4.273277
GDP_W	0	yes	not	-2.965702 **	-2.607932	-2.938987	-3.610453
IR_US	2	yes	not	-4.569287 *	-2.610263	-2.943427	-3.621023
IRON_P	3	yes	not	-2.088930	-2.611531	-2.945842	-3.626784
ΔIRON_P	2	not	not	-2.355690 **	-1.611202	-1.950394	-2.630762
OIL_P	0	yes	not	-1.870537	-2.607932	-2.938987	-3.610453
ΔOIL_P	0	not	not	-6.568614 *	-1.611469	-1.949856	-2.627238
PUS	0	yes	not	-6.100196 *	-2.607932	-2.938987	-3.610453
ER	0	yes	not	-0.818320	-2.607932	-2.938987	-3.610453
ΔER	0	not	not	-5.249030 *	-1.611469	-1.949856	-2.627238
X	4	yes	yes	-3.161063	-3.204699	-3.544284	-4.243644
Δ X	2	yes	not	-11.61946 *	-2.611531	-2.945842	-3.626784
M	4	yes	not	-3.212719 **	-2.612874	-2.948404	-3.632900
CA_GDP	1	not	not	-0.972924	-1.611469	-1.949856	-2.627238
ΔCA_GDP	0	not	not	-2.888660 *	-1.611469	-1.949856	-2.627238
DEBT_GDP	0	not	not	-0.590658	-1.611593	-1.949609	-2.625606
ΔDEBT_GDP	0	not	not	-5.342004 *	-1.611469	-1.949856	-2.627238
IR_BR	1	yes	not	-2.64793 ***	-2.609066	-2.941145	-3.615588
GFCF	0	not	not	-2.01408 **	-1.611593	-1.949609	-2.625606

Source: Prepared based on the calculations made in econometric package Eviews 9.0.

Notes: * reject the null hypothesis of the presence of a unit root at a significance level of 1%. ** rejection of the null hypothesis of the presence of unit root level of significance of 5%. *** reject the null hypothesis of the presence of a unit root at the 10% significance level. Critical values as Mackinnon (1996).

Table 3. Number of lags selected by criteria

Variables pairs	lags	criteria
GDP_BR and GDP_US	3	LR, FPE, AIC, HQ
GDP_BR and GDP_EUR	1	LR, FPE, AIC, SC, HQ
GDP_BR and GDP_W	3	LR, FPE, AIC
GDP_BR and IR_US	4	FPE, AIC, HQ
GDP_BR and ΔIRON_P	4	LR, FPE, AIC
GDP_BR and ΔOIL_P	1	LR SC HQ
GDP_BR and P_US	1	LR, FPE, AIC, SC, HQ
GDP_BR and ΔER	1	LR, FPE, AIC, SC, HQ
GDP_BR and ΔX	3	LR, FPE, AIC, SC, HQ
GDP_BR and M	4	LR, FPE, AIC, HQ
GDP_BR and ΔCA_GDP	1	LR, FPE, AIC, SC, HQ
GDP_BR and ΔDEBT_GDP	1	LR, FPE, AIC, SC, HQ
GDP_BR and IR_BR	2	LR, FPE, AIC, SC, HQ
GDP_BR and GFCF	5	FPE, AIC, HQ

Source: Authors' calculations.

Table 4. Granger causality test results in relation to the Brazilian GDP

Variable		Num. Obs.	Statistical f	P value
GDP_US	does not Granger cause GDP_BR	37	2.03234	0.1305
GDP_EUR	does not Granger cause GDP_BR	39	2.05165	0.1607
GDP_W	does not Granger cause GDP_BR	37	3.80914	0.0200
IR_US	does not Granger cause GDP_BR	36	4.34139	0.0077
Δ IRON_P	does not Granger cause GDP_BR	35	3.21382	0.0286
Δ OIL_P	does not Granger cause GDP_BR	38	8.47916	0.0062
PUS	does not Granger cause GDP_BR	39	1.19706	0.2812
Δ ER	does not Granger cause GDP_BR	38	6.79322	0.0134
Δ X	does not Granger cause GDP_BR	36	0.71437	0.5514
M	does not Granger cause GDP_BR	36	2.53407	0.0634
Δ CA_GDP	does not Granger cause GDP_BR	38	0.01342	0.9085
Δ DEBT_GDP	does not Granger cause GDP_BR	38	1.33600	0.2556
Δ IR_BR	does not Granger cause GDP_BR	38	6.60919	0.0039
GFCF	does not Granger cause GDP_BR	35	2.34263	0.0724

Source: Prepared based on the calculations made in econometric package Eviews 9.0.