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Toward the crisis: a Kaleckian-Keynesian interpretation of the instability of growth and capital accumulation in Brazil

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ABSTRACT

This article examines theoretically and empirically the instability of Brazilian investment and growth for the past couple of decades, highlighting the evolution that led to the current crisis. A theoretical discussion highlights the importance of Kaleckian and Keynesian approaches in understanding the semi-stagnation of the Brazilian economy since the 1990s. Empirical evidence shows that investment has increased until 2013, but not to the point of getting the economy back on the track of high growth rates and higher investment-GDP ratios. The econometric findings are compatible with the theoretical underpinnings of investment activity based on Keynes and Kalecki and suggest the existence of room for activist policies in Brazil in order to stimulate economic activity.

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1. Introduction

After the introduction of the Real Plan (RP) in 1994, when, after a chronic inflationary process that took place in Brazil in the 1980s and early 1990s, monetary stability was achieved,[1] the average growth rate of real GDP, between 1995 and 2014, remained around 3.0% a year, and its performance was characterized by a stop-and-go process. It should be noted that GDP performance has been even weaker and more volatile since the subprime mortgage crisis and the great recession that followed, despite the counter-cyclical macroeconomic policies implemented by the economic authorities to avoid a contagion of the Brazilian economy: between 2009 and 2014, the average real GDP growth was around 2.6% a year.

This leads us to the following question: Why, in the period 1994–2013, when average annual inflation had been around 7.2%, the performance of the Brazilian economy had been weak, especially when compared to other emerging countries, and fragile, turning into a full collapse in 2015–2016? This question becomes even more relevant if we analyze the growth rate of Brazilian economy from a long-term perspective: between 1950 and 2014, real GDP grew at an average rate of 4.9% per year. In the 1950s, 1960s, and 1970s, when the economic growth process was driven by the State and by Keynesian macroeconomic policies, real annual growth rates were higher than the historical average. In the 1980s and, especially, 1990s, when neoliberal reforms started to dictate the rules for economic policies,

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and also in the 2000s, when economic policy was slightly changed, annual average real growth rates were far below the average.[2]

In our view, the low and unstable GDP growth rates in the last two decades may be partly explained by the poor performance of gross fixed capital formation: between 1990 and 2014, the investment/GDP ratio hovered around 17.4%,[3] within a range between 15.3% and 19.5%. With this overall view in mind, the goal of this article is to show that the instability of investment, both public and private, has been a restrictive factor preventing a robust and consistent economic growth in Brazil. In order to do this, departing from Kaleckian and Keynesian approaches to investment, we analyze theoretically and empirically the relationship between capital accumulation and GDP and, after showing the key variables determining investment for the Brazilian economy, present some conclusions and reflections.

Besides this brief introduction, this article has three sections: the next section summarizes the investment theories of Kalecki and Keynes to identify the main important variables that affect investment and, as a result, economic growth in a capitalist economy, in order to inform the statistical exercises. The third section analyzes the question empirically, using statistics and a time series econometric model. It investigates the determinants of investment in Brazil for the 1994–2013 period. Finally, the last section presents the conclusions.

2. Kaleckian and Keynesian theories of investment

This section aims to present, in the light of Kaleckian and Keynesian theories, how investment is affected by other variables, that is, what are the determinants of investment,[4] so that we can sort out the variables for the empirical analysis in the next section.

2.1. Investment cycles and trends in the Kaleckian view

Kalecki (1969) developed an investment theory in two steps. In the first, he presented the investment theory for a static economy, assuming that it does not have a tendency for long-term growth. In Kalecki's conception, this is a short-term analysis.[5] The investment theory has the goal of simply to contribute to an explanation of cyclical fluctuations in output, that is, how instability is pervasive in capitalism. In the second step, he introduces 'development factors', thus including the tendency for economic growth. Thus, his investment theory seeks to explain cyclical fluctuations along a trajectory of economic growth. This subsection explores only the original Kalecki's investment theory, but there is a large literature that examines the theoretical and empirical considerations of his theory, usually providing support for its internal consistency.[6]

Initially, it is important to remember that, for Kalecki, the amount of entrepreneurial capital (i.e. equity capital) is the main factor determining the size of a firm. Kalecki acknowledges that firms also use capital provided by outside investors, but he shows that the borrowing power of a firm is limited by the amount of entrepreneurial capital. Therefore, the expansion of the firm depends, ultimately, on the internal accumulation of capital; that is, the accumulation financed from the firm's gross profits.[7] Another important aspect to be pointed out regarding the size of entrepreneurial capital, or why firms prefer retained profits, is related to the 'increasing risk' associated with investment expansion.

According to Kalecki (1969, 92), for a given amount of capital, the risk increases with additional investment, since it boosts the gearing ratios. Thus, the size of entrepreneurial

capital also imposes a limit to the investments through the principle of 'increasing risk' (Kalecki 1937). According to this principle that shows that greater indebtedness increases the possibility of the firm's bankruptcy, Kalecki assumed that investment is a function of the firm's retained profits. Moreover, the principle of 'increasing risk' means that when the uncertainty is high, the investment is low.

For Kalecki, it is important to make a clear distinction between investments in fixed capital and in inventories, since the factors that determine them are different. Moreover, considering the investment in fixed capital, Kalecki emphasizes that there is an essential distinction between the decision to invest and the investment itself. Given that and other considerations, according to Kalecki (1969), the final formula for total investment of the economy is the following:

$$I_{t+\theta} = a/(1+c)S_t + b'(\Delta P_t/\Delta t) + e(\Delta O_t/\Delta t) + d'_t, \quad (1)$$

where $I_{t+\theta}$ is the total investment in period $t+\theta$, S_t is the amount of gross current savings, $\Delta P_t/\Delta t$ is the rate of change in aggregate profits, $\Delta O_t/\Delta t$ is the growth rate of output, d'_t is a constant, even though it is subject to long-term variation, especially as a consequence of technological progress, and a, c, and e represent the coefficients of S_t, $\Delta P_t/\Delta t$, and $\Delta O_t/\Delta t$, respectively.[8]

In other words, the result obtained by Kalecki is that the total investment depends both on the level of economic activity and on the rate of variation in the level of economic activity, and it is clear that the incorporation of the determinants of investment in inventories does not fundamentally change the determinants of total investment.

Moreover, according to Kalecki, the explanation for the tendency for long-term growth in the level of investment and, consequently, of the output, is fundamentally associated with the 'development factors' (the constant d' above). If the specific parameter that measures the intensity of those factors is positive, then the economy will present a long-term growth trend. Absent those factors, the system converges to a stationary state. Therefore, the existence of a stable long-term growth trend depends on a constant expansion in the rate of innovations. If the intensity of 'development factors' decrease in the long term, this will determine, as a consequence, a tendency for deceleration of investment rate and, therefore, of economic growth over time.[9] In fact, Kalecki considers the following three factors to be important for determining the long-term investment level: innovations, rentier's savings, and population growth.

Regarding innovations, which is the most important factor for the long-term dynamics, he argues that their occurrence affects positively the decision to invest, and has a role that is similar to profit variations. That is, a positive rate of new inventions has a direct impact on investment decisions. It is worth noting that the conception of innovation in Kalecki is very broad, including not only technological development, but also the introduction of new products and access to new sources of raw materials, provided that these factors demand investments in new fixed capital goods. The two other factors pointed out above are seen as affecting the growth rate of a capitalist economy: negatively in the case of rentiers' savings, and positively in the case of population growth.

To sum up, the main variable affecting investment is '*expected* profitability that induces capital accumulation [and] […] which makes investment possible, partly through internally generated funds' (Arestis 1996, 25).

2.2. Institutionality of investment in the Keynesian view

In *The General Theory of Employment, Interest and Money* (GT), Keynes argues that fluctuations in effective demand and employment levels occur because, in a world in which the future is uncertain and unknown, individuals prefer to hold on money and, consequently, their decisions on expenditures, consumption and, especially, investment, are postponed. Thus, economic crises appear because money is an alternative form of wealth.[10]

If, according to the principle of effective demand (PED), the investment is the main variable that determines income and employment, a question arises: Which factors influence investment? In Chapter 11 of GT, Keynes formalizes his investment theory in terms of the 'marginal efficiency of capital' (MEC), which refers to the discount rate that equals the expected income stream (demand price) to the cost of investment (offer price). In other words, the MEC shows the volume of investment that can be expected for each interest rate. Therefore, for Keynes, investment is determined by the equality between MEC and the cost of capital. Furthermore, Keynes's investment theory was developed under the hypothesis that money matters for the performance of the economic activity.

This general idea is explored by post-Keynesian authors (Asimakopulos 1971; Carvalho 1988; Crotty 1992; Davidson 1972; Lavoie 2014; Minsky 1975) that show how financial and monetary conditions affect firms' investments. Keynes' arguments about uncertainty based on unknown and immeasurable probability is discussed by Carvalho (1988). Crotty (1992) argues that Keynes investment theory is superior to mainstream approaches. Davidson (1972) shows the relationship between money, financial institutions, and economic growth. Lavoie (2014) provides theoretical rigor to the model by showing its coherence, while Minsky (1975) develops, based on the idea of lender's risk and borrowers' risk, his financial fragility hypothesis.

Returning to Keynes, in a context of fundamental/radical uncertainty, in which is not possible to foresee the future, investment is unstable due to the weak/fragile expectations that form the MEC (since these are based on conventions). Furthermore, since liquidity preference by individuals is a form of hedging against uncertainty regarding their transaction and production plans, thus conditioning the dynamics of the productive process, investment instability (income and employment) is recurrent.

Chapter 12 presents the reasons to the volatility of investment. It shows that due to the fact that investment decision-making is based on weak/fragile long-term expectations, the volatility of investment occurs. In this context, the degree of confidence and conventions, or, more broadly, *institutions*, are crucial to induce the entrepreneurs' investment decisions. In Keynes' words (2007, 161), a substantial part of decision-making 'can only be taken as a result of animal spirits'. Eichner and Kregel (1975, 1301) reinforce that the rate of discretionary expenditures, that is, investment, depends 'on the "animal spirits" of entrepreneur and the volatility of their expectations'.

Keynes's approach is peculiar, because his investment theory has a dynamics of its own, since the process of investment financing, that is, the role of credit, and not only of the animal spirits, is essential for its execution. That investment-credit relationship became known as the *financing-investment-savings-funding* circuit.[11] On the other hand, Keynes's main argument was based on the limitations of monetary policy and credit to influence the demand for investment. Such limitations were due to the low elasticity of MEC, the impossibility of reducing the interest rate (faced with the 'liquidity trap') and to the liquidity

preference by the financial system, thus reducing the flow of credit. Finally, the lack of investment would generate an insufficiency of effective demand and recurrent economic fluctuations or crises. In short, from a Keynesian perspective, credit, expectations, and interest rate are the main variables that affect investment.

3. The dynamics of investment in Brazil: an empirical analysis

This section deals empirically with both the evolution of investment and the possible determinants suggested in the previous section. Despite the fact that the above theoretical analysis shows many variables to explain investment in fixed capital – such as entrepreneur' stock of capital, internal funds, debt, profits, aggregate economic activity or output, inventories, expectations, innovations, rentiers' savings, population, MEC, animal spirits, price of capital goods, interest rates, number of firms, money holdings, institutions, economic policies, and credit –, we select some of them that will be included in the statistical and econometric analysis. Those selected were GDP growth (as a proxy of realized investment in the past), profits, credit, interest rate, and expectations. The selection was based on two aspects: first, not all variables included in the model are available for the Brazilian economy. Second, even when they are, they may not be adequate for a statistical treatment.

The empirical analysis is first carried out by descriptive illustrations, without exhausting the analysis of all possible determinants, and then by means of an econometric vector error correction model (VECM) in order to deepen the understanding of the determinants of investment in Brazil. As a *caveat*, one should be aware that working with data about the Brazilian economy is another challenge, because of the frequent changes in methodology, different annual bases of comparison, incompleteness, and discontinuity of the series.[12] This limitation should be considered when evaluating the significance and robustness of the tests performed below. This is particularly important regarding variables used for applying the theoretical approaches, which are complex and not easily replicable even for databases that are more reliable. For example, the time lags discussed by Kalecki in his investment function are not fixed or determined, although in his statistical applications they vary between one year and one quarter, and this imposes a difficulty in the statistical treatment of his model for Brazilian data. Most data required for estimating the macroeconomic models are updated up to 2013, not capturing the descent into the 2014 stagnation and the 2015–2016 full-blown crisis. Moreover, even for the series with information for the entire period, a lapse of 20 years may be relatively short, given changes in data collection methodology and possible noises in the series, for estimating long-run relationships suggested by the VECM methodology.

3.1. Descriptive empirical analysis

Figure 1 shows the real growth rate for Growth Fixed Capital Formation (GFCF). The contribution of GFCF to GDP growth, in percentage points, is also presented, showing a behavior similar to the real growth of GFCF (correlation coefficient of 0.99). As it would be expected from Kalecki, investment growth, excluding changes in inventories, has short and long-term fluctuations. There is a downward trend for both series until 2003, a resumption of real growth from then to 2008 and another decline until 2013, with a sharp drop during the global financial crisis, and a strong cyclical, short-term expansion in 2010.

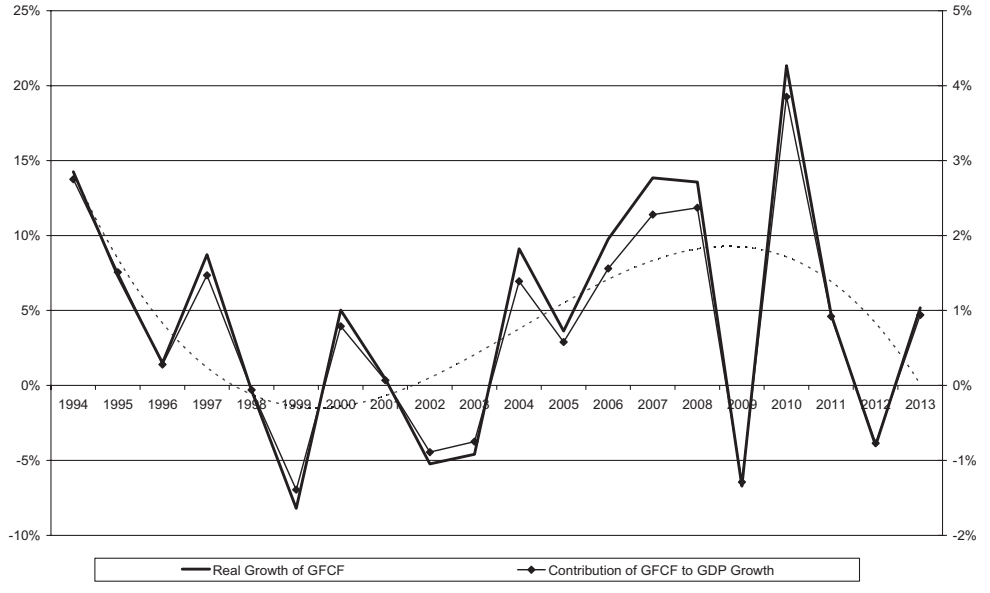

Figure 1. Real growth rate of GFCF (left axis) and GFCF's contribution to the GDP growth (right axis) in Brazil (% annual): 1994–2013. Source: Elaborated by the authors using data from IPEADATA (2016). Information on the base year for deflating nominal growth rates was not disclosed by the institute).
Note: The dotted line represents the best-fit polynomial (third degree) to the growth trend of GFCF.

The evolution of the real index (at 1980 prices) of the two main components of investment (machinery and equipment and structures) for the period is shown in Figure 2. Stagnation in the neoliberal period (1990–2002) was followed by a strong expansion in investment in machinery and equipment starting in 2003, and investment in structures shows a similar pattern, with a less intense rhythm in the post-neoliberal period. The small drop in investment in structures after the GFC suggests a positive effect of the counter-cyclical policies, mainly the Program for Accelerating Growth.

Figure 3 illustrates the evolution of the GFCF/GDP ratio and the strong positive correlation (coefficient equal to 0.96) between real GDP growth and the growth of real GFCF, as expected by the Kaleckian view, especially after the GFC and the GR. This relationship is also suggested by Figure 1, given the important contribution of investment to GDP growth. The GFCF/GDP ratio fluctuates between 15.3% and 20.7%, with a trend of gradual decline until 2003, and a slight increase thereafter, stagnating after the global crisis, and a falling trend after 2011.

In the Kaleckian investment model, there is a clear relationship between investment and GDP, albeit with lags. In the Keynesian theory, GDP depends on effective demand, and investment is the most important component of the latter in terms of the multiplier effects. The tight relationship between the variables in levels also suggests a strong relationship in terms of growth rates.

The relationship between real GFCF (at prices of 2013), credit outstanding to the private sector as a percentage of GDP, and the average annual real interest rate (SELIC) can be seen in Figure 4. There is a strong relationship (coefficient equal to 0.84) between the credit/GDP ratio and real investment as expected by Keynesian theory. Regarding the real interest rate, up to 2003 the sharp decline observed had not affected the actual level of investment. From then on, there is a clear inverse relationship between the two variables (correlation of −0.61).

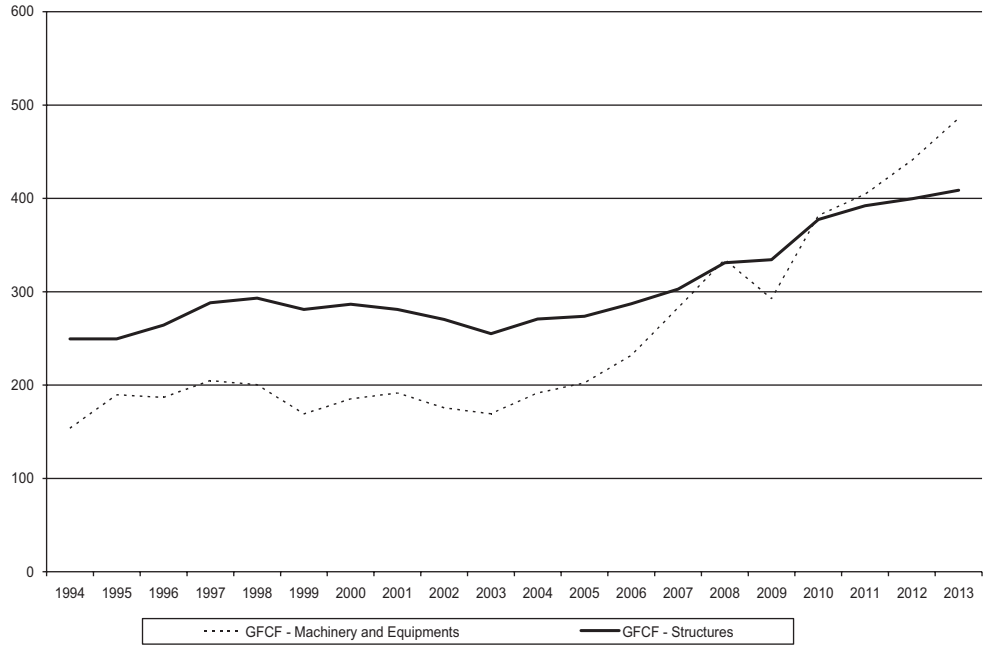

Figure 2. Index of real GFCF's main components in Brazil (1994–2013) (1980=100). Source: Elaborated by the authors using data from IPEADATA (2016).

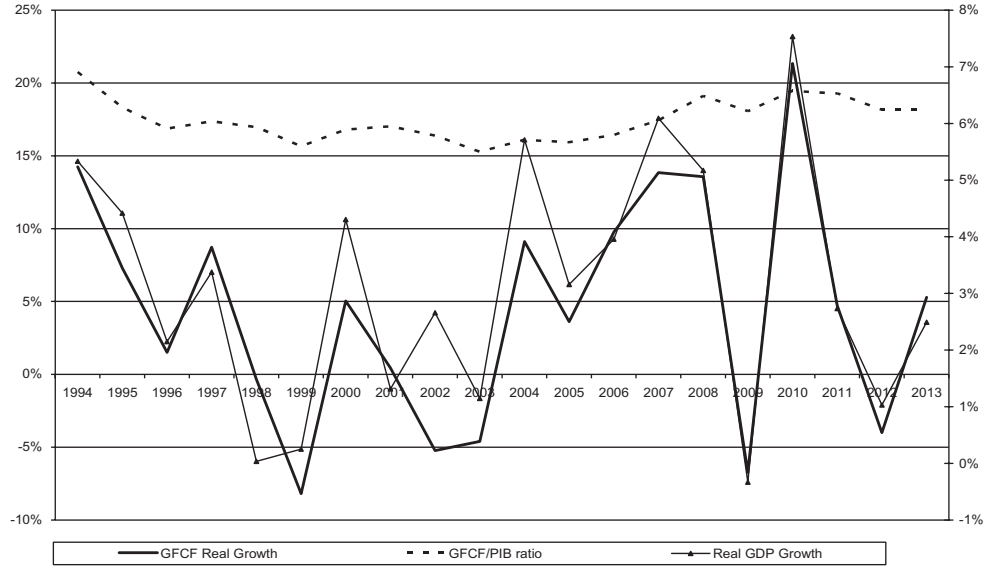

Figure 3. Real GDP growth rate (right axis), Real growth of GFCF (left axis), and GFCF/GDP ratio (left axis) in Brazil (1994–2013). Source: Elaborated by the authors using data from IPEADATA (2016).

Figure 5 shows the relationship between the Index of Industrial Entrepreneur Confidence (IIEC) – a proxy for entrepreneur 'expectations' in which figures above and below 50 represent, respectively, optimism and pessimism, and real GFCF (at prices of 2013). The index

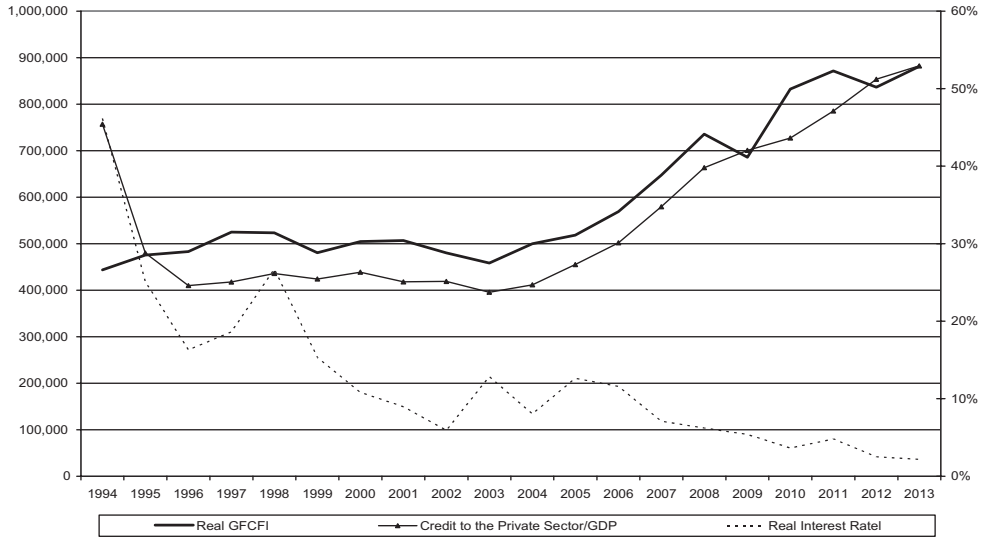

Figure 4. Real GFCF (left axis, R$ million), credit to the private sector as % of GDP (right axis) and real average annual interest rate (right axis) in Brazil (1994–2013). Source: Elaborated by the authors using data from IPEADATA (2016) and BCB (2016).

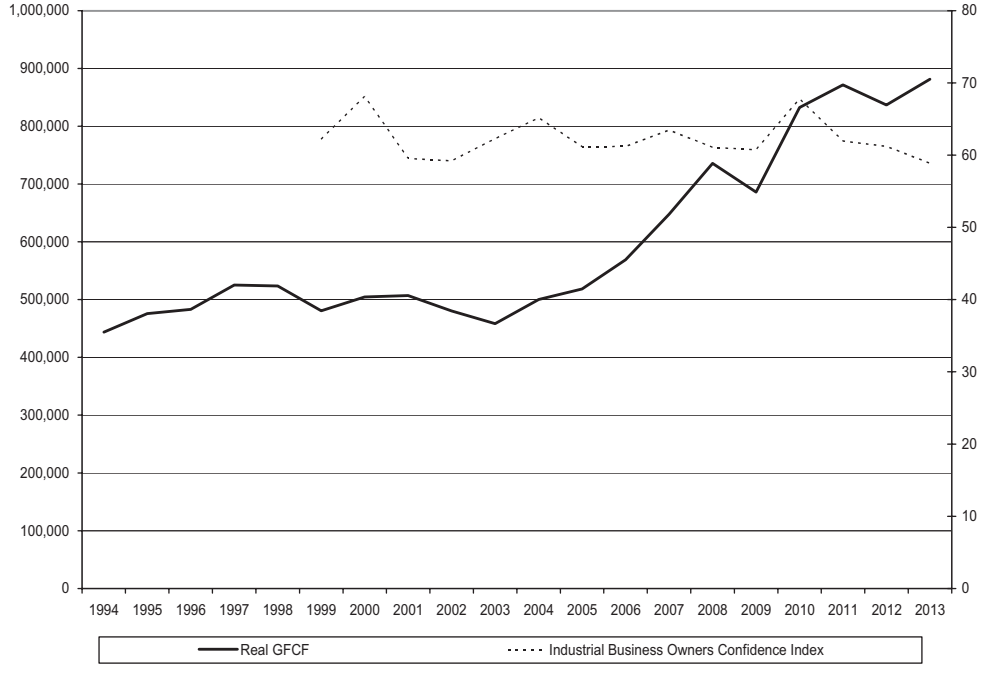

Figure 5. Real GFCF (left axis, R$ million) and IIEC/CNI (1994–2013). Source: Elaborated by the authors using data from IPEADATA (2016).

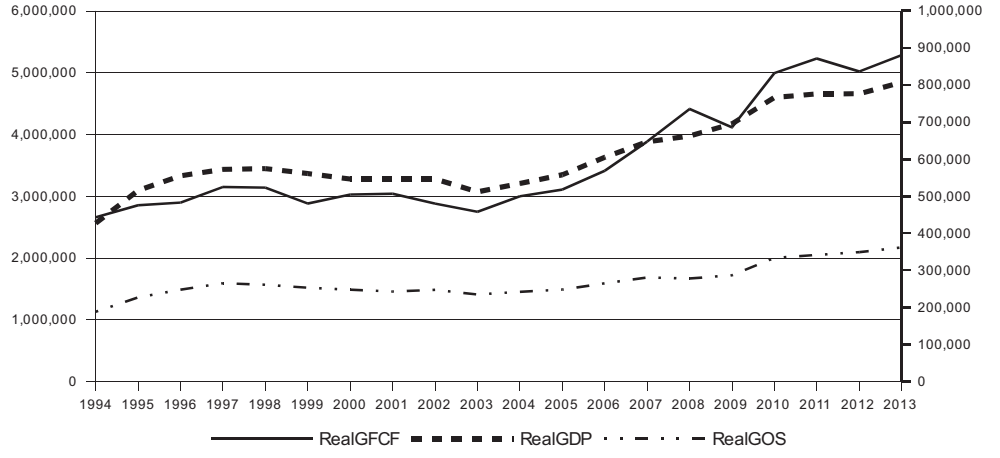

Figure 6. Real GFCF, real GOS (right axis) and real GDP (1994–2013) (R$ million). Source: Elaborated by the authors using data from IPEADATA (2016).

series is relatively constant, with optimistic entrepreneurs throughout the period, and a negligible fall in the index at the end of the period, but without any significant impact on real investment. The variable IIEC is not likely to capture the complexity of Keynesian degree of confidence on expectations. Surveys can measure a given state of confidence, but real investment decisions are carried out in a context of true uncertainty, that cannot be measured in any meaningful way. The figure shows a growing investment for 2003 on, but the index is more or less stable, and from 2011 to 2013 investment grows when the confidence index falls. So, this is not a good measure of Keynesian expectations and will not be used in the econometric analysis.

Finally, Figure 6 displays the trends for real GFCF, real GDP (correlation between them equal to 0.97) and real Gross Operating Surplus (correlation with real GFCF equal to 0.94). These descriptive findings suggest that Kalecki's view has something to say about investment behavior in Brazil. We further investigate these issues by means of an econometric model.

3.2. Econometric analysis

The econometric literature regarding models based on the theories of Kalecki and Keynes is meager, given the problems associated with collecting data faithful to the theories outlined above. A book that seeks to estimate these relationships was put together by Baddeley (2003). Among many different applied approaches to investment, she compares the conventional model of Tobin's Q with a Keynesian-Kaleckian model (or Post-Keynesian), emphasizing the role of uncertainty and cyclical factors. For the estimated model of Tobin, investment depends on current and lagged values of the stock of capital, Tobin's Q, the price of capital goods, capacity utilization, the volatility of the price of capital goods and the turnover of the stock exchange. For the Keynesian-Kaleckian model, investment depends on current and lagged values of profits' growth, capital stock growth, corporate savings, a time trend, capacity utilization, the volatility of the price of capital goods, and the turnover of stock exchange. Annual data from the US economy for the period 1970–1998 were used, a short horizon considering the high number of estimated parameters. She found that the combined

Keynesian-Kaleckian model is superior to the Tobin's Q model, lending empirical support to the former theoretical view.

Other econometric studies include Fazzari and Mott (1986–87), Holt and Pressman (eds.) (2007) e Alexiou (2010). Fazzari and Mott (1986–87) use a panel data of 835 US manufacturing firms to identify the determinants of investment for the 1970–1982 period. They found that internal liquidity matters for investment. They also found that capacity utilization and the level of interest commitments matter for capital accumulation. The second part of the book edited by Holt and Pressman (2007) is dedicated to the empirical analysis of business investment, containing four chapters that discuss R&D investment in Australia, using Kalecki's link between innovation and investment, a susceptibility model of investment, related to the work of Courvisanos, the effects of speculation and bubbles on investment based on Keynes and Kalecki (and confirming the validity of their approach), and the role of equity supply for firms in the US. The studies reject the neoclassical perspective on investment and show the relevance of Kalecki and Keynes for understanding capital accumulation patterns. Alexiou (2010) uses a panel data comprising G-7 firms for the period 1972–2005. The author found out that profits, capital stocks (with a positive signal, what is contrary to Kalecki's view), GDP, and capacity utilization are statistically significant variables for investment, validating the Keynesian and Kaleckian theories.

The approach adopted in this study is similar to Baddeley's, estimating a modified and combined linear Kaleckian-Keynesian model, but introducing only a small number of explanatory variables in logs of levels and parameters to be estimated.[13] The purpose of this specification is to provide a theoretical convergence, testing the combined power of the most important variables in each macro theory, but with adjustments imposed by data availability. From the Kaleckian side, the model includes, besides the dependent variable real GFCF[14] (deflated by the price index of capital goods) and real GDP (including GFCF on the expenditure side) for the period and real profits (Gross Operational Surplus – GOS).[15] The problem with specifications inspired by the work of Kalecki is that the theory combines variables in levels and differentiated (rates of change). The latter tend to behave as stationary processes, potentially changing the order of integration of the variables in the model. And they can have negative values, making it impossible to perform logarithmic transformation of the data. Important variables traditionally included in neo-Kaleckian models of investment such as capacity utilization, were left out to simplify the discussion, the same happening to fiscal policy indicators (deficits and public debt), exchange rates, capital flows, depreciation, expectations, and autoregressive terms for investment.

From the Keynesian approach, we left out variables suggested by Davidson (1994),[16] such as the deflator for prices of capital goods, the industrial entrepreneurs confidence index (IIEC/CNI) as a proxy for expectations regarding quasi-rents,[17] and the number of firms. The model includes, besides real GFCF, the short-term real interest rate and the credit to the private sector/GDP ratio. The latter is a way to incorporate the initial stage proposed by the theory of the circuit finance–investment–savings–funding. Just like the Kaleckian approach, despite the differences between the two theories in terms of dynamics, the institutional determinations of investment in Keynes are difficult to measure and were not treated in this work. So, the model is given by:

$$I_t = a + b_O Y_t + b_1 P_t + b_2 R_t + b_3 C_t + \varepsilon_t, \tag{2}$$

where I is real GFCF, Y is the real GDP, P is the real GOS, R is real interest rate (SELIC) and C is the credit to private sector to GDP ratio.

The econometric analysis of time series involves the identification of the stationary of the data to avoid spurious OLS regressions. The visual inspection of the figures above suggests that the selected variables, except growth of investment and growth of GDP, are non-stationary, that is, they have a unit root, or at least they are stationary around a deterministic time trend. Dickey-Fuller DF-GLS unit root tests with data adjustment for trends were implemented, including variables in levels and with and without a lag. The number of lags used in the tests was suggested by the Minimum AIC (MAIC) developed by Ng and Perron. Table A2, in annex, summarizes the results. The variables used in the Kaleckian-Keynesian model in levels are not stationary in all specifications considering the time trend and with one lag, suggesting estimation using VECM.

Then the number of lags was determined based on FPE, AIC, SBIC, HQIC, and LR statistics. The statistical tests suggest the use of four lags for determining the existence of a cointegrated vector, with or without a constant, for some statistics, and two lags for others. The next step involves the cointegration analysis. The specification of the equation was chosen based on the existence of at least one cointegration relationship and the adherence to the theoretical combined model. Using the multiple-trace test method proposed by Johansen (1995), the models with an unrestricted constant, restricted constant, linear trend, restricted trend and no trend, lagged four or three years, yielded no statistical result. Reducing the lags to two years, there were 4 cointegrating equations, except for the specification with no constant and no trend, which yielded 3 cointegrating equations.[18]

Finally, we proceeded to the estimation of the VECM.[19] The analysis below considers only the cointegrating vector for the long-term relationship, with two lags for the independent variables, not the coefficients that measure short-term adjustments to restore 'equilibrium' when the relationship between the variables is disturbed by random shocks. The five different specifications (respectively with an unrestricted constraint, with a restricted constrains, with a linear trend, with a restricted trend, and with no constant nor trend) are presented below:

(i) $I_t - 1.14Y_t - 0.78P_t + 0.03R_t - 0.03C_t + 15.04 = \varepsilon_t$;
(ii) $I_t - 0.67Y_t - 0.81P_t + 0.02R_t - 0.22C_t + 8.06 = \varepsilon_t$;
(iii) $I_t - 0.09Y_t - 0.61P_t + 0.03R_t - 0.55C_t + 0.00T - 3.84 = \varepsilon_t$;
(iv) $I_t - 0.20Y_t - 0.62P_t + 0.03R_t - 0.49C_t + 0.00T - 1.92 = \varepsilon_t$;
(v) $I_t - 0.07Y_t - 0.89P_t - 0.00R_t - 0.46C_t = \varepsilon_t$.

The coefficients for real GDP and the credit-to-GDP ratio show a wide variance between the specifications. In the first specification for the cointegrating equation, all signs are as expected, but the credit-to-GDP ratio coefficient was not statistically significant at 10%. In the second specification, all the signs were the expected and all coefficients were significant. In the third specification, the signs were as expected, but the real GDP coefficient was not significant. The fourth specification had all the coefficients with the expected sign and statistically significant. Since the coefficient for the time trend is zero, it seems that the second specification is the best one. Finally, the fifth specification had an unexpected sign for the coefficient interest rate, but it was not significant, like the coefficient for real GDP.

Since the variables are cointegrated, there must be a joint causality relationship between them, possibly according to the theories of Kalecki and Keynes. But since the cointegration treatment creates statistical problems for testing for Granger non-causality, a VAR with

differentiated variables was estimated. The Phillips–Perron test was implemented, and all differentiated variables were stationary. The Augmented Dickey–Fuller test equally rejected the null of unit root for the differentiated variables. Yet, the modified Dickey–Fuller test failed to reject the null for the differentiated variables, with or without a trend. The visual inspection also suggests that the differentiated variables are stationary. The VAR results are not reported here, since the goal is to perform the Granger non-causality test. The results were as follows. Using two lags in the VAR with all five variables in the order of the Equation (2) above, at 10% we fail to reject all Granger non-causality tests but the ones for the real interest rate, meaning that the coefficients on the lags of all variables are not jointly zero in the equation for the real interest rate. This suggests that all variables Granger-cause the real interest rate (investment and output on the demand side, and profits and credit on the supply side). The fact that real interest rates do not affect investment is a claim made by Kalecki, although he discussed the long-run interest rate. On the other hand, Arestis (1996) argues that the interest rate matters for the Kaleckian view.

Using one lag in the VAR with all five variables in the order of the Equation (2), at 10% we reject the null of Granger-non causality for the coefficients on the lag of the credit to GDP ratio to predict real GFCF, that is, credit Granger-causes investment, as predicted by the circuit finance–investment–saving–funding. The same was found for the coefficients on the lag of real GFCF and real GDP to predict real GOS, confirming the Kaleckian view. This was also confirmed by bivariate VARs with two lags. There is no Granger-causality relationship between real GFCF and real GDP, but we reject that real GFCF does not Granger-cause real GOS. Real GFCF also Granger-causes the real interest rate, and credit to GDP ratio Granger-causes real GFCF. It is worth mentioning that those results were obtained by differentiated variables, so the relationships are between the changes in the variables, unlike the VECM results, that are reported for the levels of the variables.

There are not many econometric studies dealing with the relationship between investment instability and growth instability. Ramey and Ramey (1995), from a conventional perspective, find that output volatility causes lower output growth, but investment is not relevant for output instability. To the best of our knowledge, there are no studies about this relationship for Brazil. In this study, since there is a long-run relationship between capital accumulation and real GDP in levels, the same must be true for the variables in differences (as approximations for rates of change). The Granger-non causality tests are not conclusive, but Figure 1 suggests that investment has been unstable in Brazil, and that its contribution to GDP fits this volatility. Furthermore, Figure 3 shows that real GDP and real investment growth move together over their cycles and their trends. Therefore, instability in capital accumulation is likely to feed output instability.

Overall, in terms of the VECM results, profits and the real interest rate had significant coefficients and the expected sign in all specifications, vindicating both Kalecki and Keynes for the long-run equilibrium of capital accumulation in Brazil. This means that when a positive shock occurs, there is an increase in profits, a decrease in the real interest rate, and a simultaneous increase in investment to restore the long-run equilibrium. Real GDP is not always significant for the long-run equilibrium, like the credit-to-GDP ratio, but they behave as expected respectively by the Kaleckian and the Keynesian theories. So, overall the two approaches suggest good analytical elements to understand the empirical behavior of investment in Brazil. The Granger non-causality tests suggest different results, with interest rates being preceded by decisions of investment, production, credit, and realization

of profits. Credit relative to GDP can forecast investment spending, and spending and production help predicting profits.

The results suggest, and visual inspection of Figures 1 and 3 is clear, that the instability of output growth in Brazil cannot be separated from instability of investment, since both change in the same direction in the long run. The same is true for capital accumulation and profits. Profits grow when investment grows, creating the internal funds for the next round of accumulation. So, investment is self-financed in the long run. However, credit seems to play an important role, closing the gap between the time of investment and the time of earning profits. And real interest rates represent a drag on the investment in the long run, perhaps less in terms of financing costs than in terms of providing another source of income in financialized economies. This means that the current crisis in Brazil is a result of the substantial reduction of investment that took place in 2014 and 2015. Output could not grow in such a situation. Despite the rapid growth of credit to the private sector relative to the growth of the output in the previous years, it is possibly still insufficient to foster a sustained level of investment. At the same time, falling but still high real interest rates are another source of dismal investment levels.

The scarcity of data for a longer period and the lack of variables that capture the key aspects of theories of investment in the tradition of Kalecki and Keynes, such as expectations, prevent a dynamic treatment appropriate to completely understand the determinants of investment in Brazil. Additional research is therefore needed in order to better measure and develop the variables consistent with the theories of investment. Similarly, even with these limitations, other statistical tests could illuminate different dimensions of research and show the key constraints to dynamic and sustainable growth of the Brazilian economy.

4. Concluding remarks

The paper presented theoretical and empirical evidence to interpret the weak performance of the Brazilian economy from 1994 to 2013. In short, the result can be explained by the aggregate investment behavior and the macroeconomic environment. The weak performance can be explained by a structural lack of investment, with a cyclical pattern consistent with high levels of instability. Thus, it seems to be in accordance with the investment theories of Kalecki and Keynes and their emphasis on the role of output, profits, credit, and interest rates. Of course, their theories are complex and cannot be fully captured by existing data and econometric techniques.

The econometric results provide additional support to the conclusion that the trend of a volatile and sluggish growth in Brazil over the past 20 years is related to a volatile investment that cannot be sustained at high levels. The expansion of credit and the reduction in real interest rates were insufficient to sustain the expansion of capital accumulation in Brazil. The findings point to the fact that high real short-term interest rates in Brazil, albeit showing a downward trend, appear as a possible constraint to sustained expansion of the accumulation, especially when high short-term rates index the longer term rates. Also, there are limits to the expansion of credit as a driver of GFCF if profits (internal funds or savings) do not generate the funding necessary for closing the circuit. And profits depend on capital accumulation according to VAR results, and both move together in the long run according to the VECM estimated. Thus, finance and funding problems may also help explain the problems of capital accumulation and growth in Brazil. These trends ultimately points to

low levels of economic activity caused by a lack of adequate levels of effective demand, since both capital accumulation and production move in the same direction in the long run. If investment falters, the economy must stagnate or collapse, as has happened during the 2015–2016 crisis. The Brazilian economy in the past decades in general and during the current crisis in particular is just the proof of that.

Notes

1. Between July 1994, when the *Real* was created as a legal tender currency, and December 2014, the average inflation rate was 7.9% per year. Authors' calculations based on statistical information from IPEADATA (2016).
2. In the 1950s, 1960s, 1970s, 1980s, 1990s and 2000s, the average annual growth rates of GDP were, respectively, 7.1, 6.1, 8.8, 3.0, 1.9 and 3.4%. Authors' calculations based on statistical information from IBGE (2016).
3. Authors' calculations based on Table A1, in the annex.
4. Based on both theoretical models, this section shows that the main variables that affect investment and should be dealt with in an empirical analysis are capitalist savings or retained profits, changes in profits, output growth, technical progress, expectations, credit (or debt) and interest rates.
5. We must emphasize that the concepts of 'short' and 'long' term used by Kalecki are different from the Marshallian concepts. The separation by Kalecki of short and long term seems to be related to the difference between an analysis that ignores the factors that influence long-term behavior (therefore, an analysis of short term considers only cyclical fluctuations in a static economy), and a long-term analysis that takes into account the factors that influence economic growth.
6. For additional details, see, for instance, Arestis (1996), Sawyer (1985), Duménil and Lévy (2012), Lavoie (2014), and Skott (2012). Arestis (1996) highlights the importance of profits and interest rates for investment in Kalecki's view. Sawyer (1985) presents the main features of the different Kaleckian theories of investment, business cycles, and growth. Duménil and Lévy (2012) and Lavoie (2014) develop formal models for Kaleckian investment theory, adding mathematical rigor to the analysis, and confirming its theoretical relevance. Finally, Skott (2012) presents a few shortcomings in the Kaleckian theory. He challenges a few behavioral aspects of Post-Kaleckian investment theories (more than Kalecki's proper), mainly the ones related to the role of capacity utilization. He also criticizes the lack of empirical support for investiment functions with specific results regarding capacity utilization.
7. Thus, for Kalecki (1969, 91) 'the variety in the size of enterprises in the same industry at a given time can be easily explained in terms of differences in entrepreneurial capital'. Obviously, this does not answer the question of why the amount of entrepreneurial capital differs between firms in the same sector. In other words, why do some firms have a larger entrepreneurial capital than others?
8. He assumes that $a/(1+c) < 1$.
9. It should be noted that, in Kalecki's theory, the trend for decreasing intensity of 'development factors' implies the decrease of profit rate and an increase of idle capacity level. However, it is important to highlight that the direction of causality is different from that proposed by Marx. For Marx, it is the decreasing trend of profit rate that results from technical progress (or, in Kalecki's terminology, from the increase of 'development factors intensity'), which, in turn, determines the deceleration of the capital accumulation process (and therefore of economic growth) and ultimately causes the periodical crisis of the capitalist system.
10. Keynes (2007, Chapter 17) shows that there is an insufficiency of effective demand – and, therefore, of investment – due to the fact that individuals allocate income in the form of non-reproducible wealth instead of allocating it for the acquisition of goods produced by work.
11. For additional details, see Studart (1993).
12. For a specific discussion about the data on investment in Brazil, see Santos et al. (2015).

13. Another study on the determinants of investment in Brazil, but focusing on private investment for the period 1970–2005, with a different econometric methodology, is provided by Luporini and Alves (2010). The use of variables in levels in our model shows the limits of statistics and econometrics to accommodate more complex macroeconomic models that incorporate changes in the variables considered by capitalists in their decisions to invest.
14. This study does not split the GFCF into residential fixed investment and business fixed investment, which would allow us to isolate and focus on the capitalists' accumulation decisions. For a detailed study segregating investment by sectors, see Bielschowsky, Squeff, and Vasconcellos (2015).
15. The institute responsible for supplying the series, IBGE, uses two different methodologies for calculating gross operational surplus. There is therefore one series with data from 1990 to 2009 and another one with data ranging from 2000 to 2013. We used the first one for the period 1994–2009 and the second one for the period 2010–2013, since the difference between the series is not large. Profits were adjusted based on the GDP deflator for year 2013 prices, the GFCF was corrected by the deflator for prices of capital goods, and the real value of capital stock at 2013 prices is supplied directly by IPEADATA (2016).
16. According to Davidson (1994), investment (or the maximum amount of capital goods desired by the firms) depends on the market price of capital goods, quasi-rent expectations, interest rates, and the number of firms in the economy. Analytically, $D_I = f(p_I, i, \alpha, \beta)$, where p_I = market price, i = quasi-rent expectations, α = interest rate and β = number of firms, where $f_{pI} < 0, f_i > 0, f_\alpha < 0$ and $f_\beta > 0$.
17. IPEADATA (2016) provides data about the confidence index since 1999, which increases the difficulty of estimation by reducing the degrees of freedom. Moreover, the way the index is constructed makes the variable stationary because it fluctuates around a reference point. Anyway, it is unclear to what extent this type of indicator captures expectations as theorized by Keynes, since radical Keynesian uncertainty cannot be measured, as discussed above.
18. The specific statistics of trace and eigenvalues are not reported here. The complete set of auxiliary statistics can be obtained from the authors upon request.
19. The model assumes a long-term stationary equilibrium relationship (cointegration) between non-stationary variables, with the trajectory of the variables having corrections or adjustments in the short term. The discussion regarding the extent to which this traditional concept of equilibrium and adjustment process can be consistently applied to the theory of Kalecki and Keynes is beyond the scope of this work.

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Annex: Macroeconomic data and stationary tests

Table A1. Selected macroeconomic indicators for the brazilian economy.

Indicators/years	1995	1996	1997	1998	1999	2000	2001	2002	2003
Inflation rate (%)	22.41	9.56	5.22	1.66	8.94	5.97	7.67	12.53	9.3
Growth rate (GDP) (%)	4.2	2.1	3.4	0.0	0.3	4.3	1.3	3.1	1.2
Average interest rate (SELIC) (%)	54.5	27.5	25.0	29.4	26.1	17.6	17.5	19.1	23.3
Average exchange rate (R$/USD)	0.92	10	1.08	1.16	1.81	1.83	2.35	2.93	3.08
Trade balance (USD Billion)	−3.5	−5.6	−6.8	−6.6	−1.2	−0.7	2.6	13.1	24.8
Current account (USD Billion)	−18.4	−23.5	−30.5	−33.4	−25.3	−24.2	−23.2	−7.6	4.2
Foreign reserves (USD Billion)	51.8	60.1	52.2	44.6	36.3	33.0	35.9	37.8	49.3
Fiscal surplus/GDP (%)	0.2	−0.1	−0.9	0.0	3.2	3.5	3.6	3.9	4.3
Net public debt/GDP (%)	29.1	29.6	30.4	35.4	44.5	45.5	48.4	50.5	52.4

Indicators/years	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Inflation rate (%)	7.6	5.69	3.14	4.46	5.9	4.31	5.91	6.5	5.84	5.91	6.41
Growth rate (GDP) (%)	5.7	3.1	4.0	6.0	5.2	−0.2	7.6	3.9	1.8	2.7	0.1
Average interest rate (SELIC) (%)	16.2	19.1	15.3	12.0	12.7	10.1	9.9	11.75	8.63	8.29	10.96
Average exchange rate (R$/USD)	2.92	2.43	2.17	1.92	1.83	2.0	1.76	1.67	1.95	2.16	2.36
Trade balance (USD Billion)	33.6	44.7	46.5	40.0	24.7	24.6	20.3	29.8	19.4	2.6	−3.9
Current account (USD Billion)	11.7	14.0	13.6	1.5	−28.3	−24.3	−47.5	−52.6	−54.2	−81.4	−90.9
Foreign reserves (USD Billion)	52.9	53.8	85.8	180.3	193.8	238.5	288.6	352.0	373.1	358.8	363.8
Fiscal surplus/GDP (%)	4.8	4.3	4.0	3.91	4.1	2.1	2.8	3.1	2.4	1.9	−0.6
Net public debt/GDP (%)	47.0	46.5	44.7	43.0	36.0	43.0	39.1	36.5	35.1	33.8	35.3

Source: BCB (2016), IBGE (2016) and IPEADATA (2016).

Table A2. Stationarity tests.

Variable (period)	DF-GLS test with linear trend (number of lags in parenthesis)	DF-GLS without linear trend (number of lags in parenthesis)	Stationary?
Ln real GFCF (1994–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Ln real $GFCF_{-1}$ (1995–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Ln real GDP (1994–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Ln real GDP_{-1} (1995–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Ln real profits (1994–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Ln real $profits_{-1}$ (1995–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Ln real interest rate (1994–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Real $interest\ rate_{-1}$ (1995–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
Credit to the private sector/GDP (1994–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No
$(Credit\ to\ the\ private\ sector/GDP)_{-1}$ (1995–2013)	Fail to reject H0 at 10% (1)	Fail to reject H0 at 10% (1)	No