PONTIFÍCIA UNIVERSIDADE CATÓLICA
DO RIO DE JANEIRO

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The effects of fiscal credibility on monetary policy credibility: Brazil 2014-2016

Monografia de conclusão do curso

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Rio de Janeiro,

Março 2019

Summary

1. Introduction

Macroeconomics, as a scientific field of inquiry, is a product of the twentieth century, and as such, it has evolved with the questions presented. Subsequent innovations and developments of "schools of thought" have been, in many ways, responsive to the questions presented by reality, and as such, the treatment given to economic phenomena has been bounded by the theoretical and methodological innovations, but also, essentially, by the sequence of the ailments in history.

This basic consideration is important to settle the sequential propositions that serve as basis for this work. As Schumpeter has proposed in *The History of Economic Analysis*, the history of economic ideas does not advance smoothly but rather in jumps, with a succession of epochs of consolidation and revolutions (Screpanti & Zamagni, 2005). Many of the influences of this work comes from a period of revolution in the 1970's.

The revolution started by Robert Lucas in works such as *Expectations and The Neutrality of Money* (Lucas, 1972) that ushered a brand-new way to work in macroeconomics. Based on the rational expectations, initially proposed by John Muth in his seminal paper *Rational Expectations and the Theory of Price Movements* (Muth, 1961), Lucas questioned the dominant way of seeing macroeconomic policies based on the microfundaments of individual choices.

This revolution led to the both founding papers of the pathways here explored: *Rules Rather than Discretion: The Inconsistency of Optimal Plans* by Finn Kydland and Edward Prescott (Kydland & Prescott, 1972), *Are Government Bonds Net Wealth?* (Barro, 1972) and *On the Determinants of Public Debt* (Barro, 1974) by Robert Barro. This is to say that the study of Central Bank credibility and the modern theory of optimal fiscal policy come not only from the same intellectual movement, but from the same time period.

By mid-1970's the stagflation was in full force, only to be solved in Volcker years, and by mid-1980's, fiscal crisis erupted all over the world. The neokeyenesian orthodoxy wasn't enough, so the new classical revolution came to set new rules and then the new-keynesian wave was built upon its innovations. By the end of 1990's it was the consensus.

The great moderation was the golden age of the development of credibility as a policy goal.

The introduction of the Taylor Rule, inflation targets and Central Bank's autonomy all over the world has led to an era of relative monetary stability and overall belief that the times of unpredicted volatility were gone.

By mid-1990's, following the work of John Taylor, it became explicit the necessity of the adoption of rules as a fundamental method of anchoring expectations. In 1995, UK, Finland, New Zeeland, Canada and Sweden had adopted inflation targeting as the main policy of Central Bank (SVENSSON, 1995).

The introduction of inflation targeting in Brazil was concomitant with major macroeconomic reforms in the late 1990's

2. Analytical Model

In such spirit, this monograph aims to investigate whether high level of public debt may affect the Central Bank's credibility while conducting the monetary policy through the interest rates. Although, traditionally, monetary policy's credibility is associated institutionally only with central banks characteristics such as discretion, efficacy in rules and reputation[1], this experiment follows recent literature on the correlation between monetary policy efficacy and debt regimes.

The basic assumptions follow the notion that agents, investors, don't perceive ideally the public sector- here divided as *The Congress*[2], and *Central Bank*- as islands, with different levels of credibility, efficiency and independence; but rather as one whole body of bureaucracy, and risk. Secondly, we take the market agents as atomistic, and with a level of comprehension of the models used that, *in extremis*, satisfy the rational expectations hypothesis

This hypothesis is a result from the fact that the majority of Central Banks throughout the world use the interest rate as the *prima facie* instrument of policy. However, this interest rate is also used to determinate the premium on public debt.

This analysis is not new *per se*, as it follows a literature on political economy, game theory and empirical evaluation of credibility. Alberto Alesina and Nouriel Roubini with Gerald D. Cohen's book, *Political Cycles and the Macroeconomy*, published by MIT Press in 1997 evaluates the effects of different political parties and regimes on macroeconomic activities such as inflation, and, as such evaluates the different effectivities in disinflation considering different congressional configuration. Francisco J. Jorge-Murcia (1995) evaluates the credibility of monetary policy under different debt levels and use Israel in 1984 and 1985 as test subject.

Henceforth, this monograph considers the fiscal policy as not optimal, as it follows political intentions and cycles, but considers that the Central Bank tries to build and optimal monetary policy, as known for market agents. In section 4 we delve deeply into the literature on optimal

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[1] We reckon that there is a difference between the concepts of *credibility*, following the tradition of Kydland and Prescott, and *reputation*, but it isn't in the scope of this monograph. For a good review of the concepts, see Montes (2009).

[2] We consider *The Congress* as a Weberian kind of ideal type that represents the legislative power who controls the budget. Naturally, we reckon that different countries have different institutions with its idiosyncrasies, but, in most of the democracies, this type tends to fit well with each's characteristics.

fiscal policy and whether they hold empirical validity, specifically in the Brazilian case, but also in international literature.

Firstly, is important to understand the mechanisms of transmissions. The following shows that the interest rates in the economy follow a simple Fischer rule

$$i_t = r_t + E(\pi_{t+1}|\Omega)$$

Following Jurge-Murcia (1995) we must find the equilibrium between money demand and supply so that we can find the effect of optimal nominal interest rates on the expected inflation. Deriving a simple LM equation, we have:

$$\frac{M_t^d}{P_t} = L(Y_t, i_{t+1})$$

$$i_{t+1} = E(i_t|\Omega)$$

Where M_t^d is the money demand, P_t is the price level, Y_t the income and i_{t+1} is the expected nominal rate (assuming a rational expectations hypothesis). Rearranging and log-linearizing we have a simple Cagan money demand function[3] (JURGE-MURCIA, 1995):

$$m_t^d - p_t = y_t - \alpha i_t + \varepsilon_t$$

The basic assumption is that α is the semi-elasticity parameter of money demand and ε_t a disturbance, or an expectation shock to the interest rate. Jurge-Murcia (1995) assumes that ε_t follows a random walk. Using the first equation and first-differencing, we have the following process

$$m_t^d - p_t = y_t - \alpha[r_t + E(\pi_{t+1}|\Omega)] + \varepsilon_t$$

$$\mu_t^d - \pi_t = y_t - y_{t-1} - \alpha(r_t - r_{t-1}) + \alpha[E(\pi_t|\Omega_{t-1}) - E(\pi_{t+1}|\Omega)] + u_t$$

We assume that the evolution of the real interest growth rate follows a random walk as defined by Jurge-Murcia (1995), and simply define the growth rate of the economy as an exogenous variable.

$$(r_t - r_{t-1}) = \varrho_t + \xi_t;\ \xi_t\ i.i.d;\ \xi \sim N(0,1)$$

$$y_t - y_{t-1} = g_t$$

[3] We are, by hypothesis, assuming that the Cagan function is stable with unitary income elasticity (JURGE-MURCIA, 1995)

Hence, we have:

$$\mu_t^d - \pi_t = g_t - \alpha(\varrho_t) + \alpha[E(\pi_t|\Omega_{t-1}) - E(\pi_{t+1}|\Omega)] + u_t - \alpha(\xi_t)$$

Considering the semi-elasticity[4] as a near zero value, we can simplify the equation as:

$$\mu_t^d = g_t + \pi_t + u_t$$

So the money demand growth rate, in this simplification is fundamentally defined by the expected growth rate, the inflation rate and an error parameter.

Relaxing this restriction and rearranging in terms of the *ex-ante* expected inflation we have

$$\alpha E(\pi_{t+1}|\Omega) = g_t - \alpha(\varrho_t) + \alpha[E(\pi_t|\Omega_{t-1})] + u_t - \alpha(\xi_t) - (\mu_t^d + \pi_t)$$

$$E(\pi_{t+1}|\Omega) = \frac{g_t}{\alpha} - (\varrho_t) + E(\pi_t|\Omega_{t-1}) + \frac{u_t}{\alpha} - (\xi_t) - \frac{\mu_t^d}{\alpha} - \frac{\pi_t}{\alpha}$$

$$E(\pi_{t+1}|\Omega) = \frac{g_t}{\alpha} - \varrho_t + E(\pi_t|\Omega_{t-1}) - \frac{\pi_t}{\alpha} - \frac{\mu_t^d}{\alpha} + \frac{u_t}{\alpha} - \xi_t$$

Hence we have a function of expected inflation in line with the demand for money, that is, the market (firms and households) inflation expectation for t+1. Furthermore, the last equation reveals some interesting effects if we consider the following relation.

$$c_t = E(\pi_t|\Omega_{t-1}) - \pi_t$$

$$b_t = g_t - \varrho_t$$

Where c_t is the ex-ante credibility of the Central Bank and if $c_t \neq 0$ there is a level of non-credibility. If the Central Bank tries to cheat the market agents by promising a lower inflation and delivering a higher level sequentially, the government will lose credibility and agents will expect that inflation will be sequentially higher. This, of course, is the fundamental argument of the *time inconsistency* as famously espoused by Edward C. Prescott and Finn E. Kydland in its 1977 classic *Rules Rather than Discretion*.

On the other hand, b_t is the *expected* ability of the government to pay its public debt organically, which is to say that government will be able to pay its debt without raising taxes, issuing more bonds or raising taxes. In other terms is the business-as-usual evolution of the debt, if the country grows faster, its deficit shall reduce. While the relation between the real interest

[4] A semi elasticity represents a change in a parameter relative to an absolute value

rate and the GDP growth rate has experienced a rising concern in academia (BLANCHARD, 2019), we argue that is not the variable of interest for the Brazilian case, as the country does not experiences a *secular stagnation*[5].

However, this expected evolution of the debt does not account for the institutional deterioration of the fiscal environment. The Government may, by an array of reasons, raise unexpectedly the public debt or an external event may lead to an unexpected shock in public debt/ GDP ratio. Chapter 4 will dwell further extensively on the determinants of the evolution of public debt in contemporary literature and the management of the Brazilian public debt.

Nevertheless, these hikes in the public debt may affect the other variables in the model. As it affects the public balance it may affect the real interest rate. The effect of a rising public debt on the real interest rate is not easy to identify. Testing for the American economy, "Despite a substantial body of empirical analysis, the answer based on the past two decades of research is mixed" (ENGEN & HUBBARD, 2004), which means that the intensity of the effect is different depending on the econometric method of choice. There is a positive correlation between the public debt to GDP ratio and the long-term interest rate[6], but this correlation is not easily quantified precisely.

As α is the semi-elasticity of the interest rate- inflation, the determination of the nominal interest rate may be affected by the variation in the government bond's risk, as it is a component of the bond premium. Lastly, there is evidence that the money demand is affected by the rapid growth of public debt (JURGE-MURCIA, 1995) (WOODFORD, 1996). In this case, it may be explained by the precaution of the agents to the *seigniorage* effect. Which is to say, as a narrative[7], agents expect that the government will simply print money to pay its debt.

Relaxing the neutrality of money hypothesis, the short term effect of a fiscal stimulus affects the money demand. As the government introduces a fiscal stimulus, the nominal GDP grows, this is explained initially by a monetary expansion as the government flows the market with new money, therefore private agents will adapt their demand, so that there is a new equilibrium in the money markets, and there will be a monetary component to the multiplier.

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[5] Mainly because in Brazil r>g.

[6] See the fourth chapter of this monograph for a extensive analysis on this correlation.

[7] The study of the narrative effect in economics is relatively new, even though the central idea is subtly implied in the majority of the informational processes. For a good review of the literature and an epidemiological analysis see Shiller (2017). For a good example of research of narratives in monetary policy, see Carvalho & Nechio (2014)

This assumption, in a graphical nature, is the same as to say that the LM curve is not vertical, which, on the other hand is to say that the *semi-elasticity of the money demand is different than zero*. Which would imply that, fiscal stimulus may affect the determination of the equilibrium in the money markets, even if marginally.

We know that the long-term semi-elasticity of money is historically low in some countries. Ball (1996) estimates that for the United States in the post war period, the semi-elasticity is -0.05[8], while in the prewar was close to -0.1[9]. However, taking countries with different inflationary and institutional histories, the values found are different. Pastore (1997) finds that the money demand function cost semi-elasticity for Brazil is between -5.992 and -6,005 for 1997. Assuming that the semi-elasticity has a constant value of -1, we can reinstate the model as:

$$E(\pi_{t+1}|\Omega) = [-g_t - \varrho_t] + [E(\pi_t|\Omega_{t-1}) - \pi_t] + \mu_t^d - u_t - \xi_t$$

Which leads to the introduction of c_t the model. Considering $E(\pi_{t+1}|\Omega) = \pi_t^e$.

$$\pi_t^e = -g_t + c_t + (\mu_t^d - u_t) - (\varrho_t + \xi_t)$$

Now we have an intertemporal relation between the expected inflation and the past credibility of the Central Bank. In multiple iterations, this model implies that agents have a backward look component when they assert the credibility of the monetary policy, because the expected inflation for the next year, in t+1, will be determinant of the *ex-ante* credibility, which leads to an autoregressive model.

This autoregressive component implies that past fiscal shocks are relevant to the credibility building process. Nevertheless, as previously stated these unexpected shocks have ambiguous effects on the variables. Endogeneity restrictions are necessary but, also, are "theoretically biased" as it requires narrative assumptions.

A simple interpretation of this model may explain the phenomenon of positive correlation between expected inflation and expected government debt in the data, especially in the observed spikes. If the agents believe that, institutionally, government is weak, and that the surge in debt

[8] If we raise the interest rate by 1%, or 100 basis points, the money demand should fall by 5%

[9] Inagaki (2008), using a money-in-the-utility-function model states that when interest rates fall to zero, the semi-elasticity raises exponentially to infinite. Naturally this non-linear effect emanates from his model of choice. Nevertheless, Inagaki (2008) found a negative correlation between the semi-elasticity and the interest rate, with an explosive effect when the interest rate is close to zero.

is unsustainable, they may expect that in the future government will have to resort to monetary expansion and therefore they change their expectations.

This sudden variation on public debt in relation to the expected budget status can be defined as fiscal credibility. If the government sequentially cheats the market by not attending its budget constraints or targets, there is an erosion of the Central Bank's credibility. This fiscal *intertemporal inconsistency* may lead to a relevant effect even if, as an institution, the Bank, whether independent or not, has nothing to do with the setting of the government budget.

Considering that we want to apply our model to an economy where the Central Bank uses the interest rate as the prime instrument of monetary policy, the money supply is an implicit function of the nominal interest rate. As espoused by Clarida, Galí and Gertler (1999) "the central bank adjusts the money supply to hit the interest rate target". Thus, the nominal interest rate used is the optimal rate of the equilibrium between the demand and the objective function of the Central Bank.

The idea here is that the Central Bank has a reactive action span to the determination of the public debt. This differs conceptually from the fiscal dominance and the fiscal theory of the price, as we are not making any assumption between the efficacy of the Central Bank's policies, but rather that even if agents firmly believe that the Central Bank is credible, if the Congress sets a budget that will not hold in t+1, there is an erosion effect in the credibility that the announced inflation target will be fulfilled, as there are expectation shocks.

There is a short-term benefit for the government to cheat the agents in the budget if there aren't any legal restrictions or fiscal rules. But if the government is not able to match fiscal expectations by the market, it will lose the efficacy of the monetary policy in addition to all the canonical effects on uncontrolled spending and deficit management. While this remains an open agenda in the literature regarding a scenario of relatively low inflation there is sound evidence and robust literature concerning the high-inflationary setting of many countries in the eighties (JURGE-MURCIA, 1995) (WOODFORD, 1996)[10].

In fact, beyond the model, there is a somewhat practical consensus that prolonged debt unsustainability affects the price stability, financial stability and, conseuquentially, central

[10] To a lesser extent, extrapolating this model to a rational expectation setting, in a fiscal dominance stance, one could argue that this argument would satisfy the conditions proposed by Sargent & Wallace (2001)

bank's credibility. To quote Masaaki Shirakawa, former governor of the Bank of Japan at the Banque de France Financial Stability Review Launch Event in Washington D.C.:

> Fiscal sustainability is an important element that has a fundamental impact on both. According to conventional wisdom, when the government loses its credibility with respect to the sustainability of government debt and does not make enough effort to regain it, this ultimately leads to either inflation or a default on the debt. (SHIRAKAWA, 2012)

Furthermore, there is a substantial body of literature that sees the fiscal sustainability as a condition for the implementation of inflation targets, which are an important tool for the establishment of Central Bank's credibility. When developing the convergence methods for EMU, fiscal convergence was fundamental for the establishment of a single, credible currency (GRAUWE, 1995).

It is important to remind, however that while fiscal responsibility is fundamental to inflation targeting, the inverse is not necessarily truthful. In fact, Mishkin (2017) shows that governments may pursue an irresponsible fiscal path even with inflation targets in place, so even if the Central Bank has a monetary policy rule, is committed to a conservative view on inflation in its objective function[11], fiscal credibility is still relevant.

In sum, we claim that in the Brazilian case there wasn't a case of fiscal dominance[12] and provide a different explanation for the apparent correlation between rising deficits and inflation during the first half of the 2014-2018 period. Any assertion of a fiscal cause of inflation emanates from restrictions in simple canonical macroeconomic models, such as the Fisher equation, we propose an institutional explanation for the risk that led to a high volatility in expectations and non-credibility of both fiscal and monetary policies in the period.

Our simple expectations model leads to this conclusion. Derived from a simple Cagan money demand function, stated in this chapter shows that if theoretical restrictions on the effects of a fiscal shock on macroeconomic variables aren't imposed, it is very hard to determinate the effect of such shock on the *ex-ante* inflation expectations. However, we show that fiscal inconsistency leads recursively on a deterioration of the credibility of the Central Bank to hit its goals, despite its reputation.

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[11] Loss function Svensson e Walsh

[12] See Appendix for a simple review of fiscal dominance models and DAG analysis

The following chapters aim to specify the historical and institutional drivers of credibility, and sequentially econometric tests. If there is a correlation between monetary and fiscal credibility, it is important to analyze the reasons behind it in order to propose policies that anchor agents' expectations, aiming to mitigate the dire welfare effects of non-credibility.

3. The political determinants of public debt

One of the major aims of macroeconomists in the twentieth century was to develop ways to program economic policy towards an equilibrium, and thus find optimal levels that fit the full employment. In the wake of the 1970's, with the critique espoused by Barro to the macroeconometric modelling's assumptions of fiscal policy used in the 60's, however, there was a renewal in interest in the development of newer optimal fiscal policies that could be based in modern microeconomic fundaments (DE VROEY, 2016).

However, a review of such models find that they do not suit data well, as they do not suit the data, which led to an intense development in political economy models to explain the behavior of fiscal policy (YARED, 2019). Such models tend to focus in partisan politics, with different parties whose views on fiscal policy follow different political beliefs.

Following a review of the literature of the subject, we sustain that fiscal policy, for institutional reasons, does not obey any notion of optimality, but rather immediate political interests, which may explain the secular growth of public debt of the developed economies. Thus, we aim to fundament the basic hypothesis that agents cannot fully predict the level of fiscal policy in t+1, and, as such, contaminates with uncertainty the credibility of the economic policy. Finally, we provide an analysis of the effects of fiscal rules, and the effect on public debt growth, as they restrict the policymakers.

3.1. Is fiscal policy optimal?

Since John Maynard Keynes famously postulated that fiscal policy has an active role on unemployment and the activity levels, there has been a quest in the nascent field of Macroeconomy to develop the perfect path to fiscal policy. Such quest drove the development of the majority of the first macroeconometric models in the Keynesian golden age, as there was this creed that, since there was this new science of macroeconomics and national accounts, it was now possible to "program" the business cycles with controlled interventions of monetary and fiscal policies whenever there was a recession.

In 1974, Robert Barro (BARRO, 1974) published the paper *On the Determinants of Public Debt* in the Journal of Political Economy that would establish the so-called *Ricardian Equivalence*. Such proposition basically states that the level of government debt is completely innocuous on the real economy's activity because agents are rational and anticipate that any

expansionist move or tax cuts by the government will be compensated in the future, henceforth agents operate through the bond market as saving and hedge mechanisms.

Naturally, the Ricardian Equivalence operates on three strong, unrealistic assumptions: contractionist fiscal policies involve no deadweight loss in welfare, that firms and families have the same lending power as the government and are financially unconstrained, and, lastly, households and companies are able to forecast the tax level *ad infintum*. Nertheless, it was sufficient to stir the intellectual community towards new theories of optimal fiscal policy, with major characteristics and references outlined below following Yared (2019).

Theory	**Hypothesis**	**Major characteristics**	**References**
Tax-Smoothing (1)	When the government raises revenue, there is a deadweight loss in the economy	Unanticipated fiscal needs	Barro, 1979
		Anticipated fiscal needs	Lucas & Stokey, 1983
Safe asset provision (2)	Companies and families are financially constrained and cannot operate in the credit market as freely as government	Financial constraints	Woodford, 1990
		Precautionary private savings	Ayigari & McGrattan, 1998
		Global capital flows and interest rates	Holmström & Tirole, 1998
Dynamic Efficiency (3)	Private sector does not internalize fiscal policies' consequences infinitely into the future and beyond	Dynamic inefficiencies in the economy and over accumulated capital can lead to an optimal increase in government debt	Diamond, 1965 Blanchard, 1985

The first theory (1) is the most commonly used to explain government debt management. It is based on the notion that government may use debt to smooth deadweight loss from raising revenue (YARED, 2018, as raising revenue distorts economic decisions, on the other hand debt does not. (BARRO, 1979, LUCAS & STOKEY, 1983, YARED, 2018).

The first situation that could sustain such hypothesis is whenever there are *unanticipated fiscal shocks*. If facing unanticipated fiscal and temporary fiscal needs, the government should raise debt as optimal fiscal policy, rather than raise taxes, as taxes may distort prices and allocations in the economy, also they have direct effect on agents' income. Therefore, a sudden

tax raise distorts economic allocation of resources, but debt does not as agents internalize it in their optimal intertemporal allocation as wealth[13].

Yared (2019) evaluates whether this hypothesis sustains itself empirically by testing the debt management in the wake of the 2008 financial crisis and military spending during wars for developed countries. These unexpected fiscal needs can account for the increase in the level of debt in specific periods, but not in the long run.

Another possible option is anticipated fiscal needs. If the government expects a reduction in future spending, debt should be raised in the present, as it would be more easily payed over in the future. The long-term anticipated fiscal needs in developed countries- and in Brazil- has, in fact, risen exponentially mainly due to the pression of ageing population in pension funds and the reduction of the fertility rate. If tax-smoothing theory held empirical validity, governments were to be reducing debt presently, and they aren't.

According to the *safe asset provision theory* (2), as proposed by Woodford (1990), Aiyagari and McGrattan (1998), Holmstrom and Tirole (1998), Mankiw (2000), etc... the private sector does not have the same financial potency as the government, which is to say that "[the] private sector is financially constrained and cannot borrow or lend in the same terms as the government" (YARED, 2018).

This theory is especially attractive for some developing countries such as Brazil. Not only there is a large parcel of public debt in the global debt of the Brazilian economy, which is used as asset by private agents who want to mitigate their portfolio risk, as the government is a major lender in the economy[14], going as far as using a lower interest rate than the market benchmark[15].

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[13] This satisfies the rational agents hypothesis.

[14] As a good example, see the Brazilian National Confederation of Industry (Confederação Nacional da Industria – CNI) presidential report on infrastructure funding, which shows that the proportion of bank credit in the global credit is much larger than in selected countries. However, the majority of the issuing of such bank credit, as debentures in general, was under the guise of the BNDES, which lent at an interest rate bellow the market benchmark and with public resources. The report is available at https://bucket-gw-cni-static-cms-si.s3.amazonaws.com/media/filer_public/94/ca/94ca6a97-fc91-4b85-a96a-2f66181ee17d/financiamento_privado_web.pdf and its executive summary in English is available at https://bucket-gw-cni-static-cms-si.s3.amazonaws.com/media/filer_public/97/08/9708c93b-eb12-4ede-9007-d29f11d0b573/8_-_financiamento_privado_de_longo_prazo_ingles_atualizado_24-08_web.pdf

[15] The BNDES own long-term interest rate, called TJLP, which was eventually abolished on January first, 2018.

It is based on the idea that government debt is less risky than private debt[16]. Government has a safer revenue than corporations as its income is basically originated in taxes, which the government can always coercively "harvest" from individuals[17]. In this sense government bonds mitigate the risk in investor portfolios, especially in the Brazilian case where some classes of government bonds are considered risk-free assets, such as the NTN-B and the LTF.

Thus, if the private agents are facing financial constraints, it would be optimal to government to raise debt. As the financial constraints become tighter, by issuing more debt, the government supplies the market with safe assets, and provide more liquidity for the agents, who are increasingly constrained, if facing a financial crisis (AZZIMONTI & YARED, 2018).

According to Yared (2019), this perspective explains the surge in public debt to counter react the 2008 Financial Crisis, however, it is not consistent with the secular growth in debt. Considering the Brazilian case, as showed in *Figure I*, the growth of public debt was accelerated during the 2015 recession but has not changed its course after the return of growth.

Regarding income risk, the theoretical prevision is similar to the financial constraint, which means a positive correlation between income risk and government debt growth. If households and firms are facing higher income risk, there is a tendency for the agents to allocate their resources in portfolios with less return volatility (AZZIMONTI et al, 2014).

However, Yared (2019) using the findings of Sablehaus and Song (2010), and Guvenem, et al. (2014), concludes that, while U.S. household income risk has decayed since 1980, debt has risen[18]. In *Figure II* we use the EMBI+ index on a daily basis as a proxy for income risk in Brazilian economy and show that while there is a clear drop between 2015 and 2016, there is still a growing trend in public debt.

Both the cases: *financial constraints* and *precautionary private savings* were argued in a closed economy context. Regarding *global capital flows*, the reduction of international barriers to capital has presented itself as a challenge, as shown in the 1990's emerging countries crisis such as the Asian Financial Crisis of 1997 and the Russian Financial Crisis of 1998, both

[16] Yared (2019) uses the term private defaultable debt.

[17] Of course, historically, taxation is not exactly taken as passively by population, as both the American Revolution and the French Revolution show. In our analytical model, stated in the previous chapter, we show that the possibility of a sudden raise of taxes, or seignouriage, which can be perceived as taxation through inflation, distorts inflation expectation and, sequentially, credibility.

[18] Yared (2019) adverts that, according to Campbell et al. (2001) and Brandt et al. (2010), there are mixed findings in trends on business-level risk.

of them showcasing the financial fragilities of countries and had dire effects of sustainability of many economies[19]. As such, the *safe asset provision* theory may help to develop a framework on optimal fiscal policy in a globalization scenario. This proposition is not in the scope of our analysis, for a good exposition of the effects of globalization on optimal debt provision and its effects on interest rate, see Yared (2019), who also shows that these array of transmission channels don't hold empirical value in advanced economies.

The last tradition is the *dynamic efficiency theory* (3) as proposed by Diamond (1965) and Blanchard (1985). This theory is concerned with the intergenerational effect, when the private sector does not internalize in its optimal decision process the effect of raising debt infinitely in the future. This imposes an impasse between older and younger households, as the cost of issuing public debt affects differently these heterogeneous agents.

Older generations prefer the issuing of present debt as they won't face the burden of paying the taxes in the future, which will be responsibility of younger generations. Agents know this, and, therefore, the issuing of present debt alters the decisions of agents, "tilting the lifetime consumption towards older generations, while also increasing interest rates and crowding out capital investment" (YARED, 2018). There is also an even direr consequence of raising debt in this context. If the bonds become a sufficiently attractive investment, there is a possible debt bubble situation, in which the agents will hold debt bonds simply because the next generation will, expectably, also do so.

Considering such overlapping generations model, raising debt can be optimal if there is over accumulated capital in the economy. In this picture, the overaccumulated capital is not invested, thus reducing the economy growth, and as such it may be optimal for the government to raise debt. This policy is optimal because it dilutes the household savings and increases lifetime consumption, as previously explained, thus reducing dynamic inefficiencies and promoting welfare.

Yared (2019) concludes that there are mixed evidences for dynamic inefficiencies in OECD countries, using the findings of Abel et al. (1989) and his own analysis of the U.S. economy. Any attempt to do test the Brazilian economy would be distorted by institutional idiosyncrasies, such as the difference between the public pension between government officials, public servants and private sector members.

[19] For instance, Russia has defaulted on its debt during the 1998 crisis.

In sum, we may safely claim that the debt management in the world and, more specifically in Brazil does not follow any optimal fiscal policy model, evaluating long-term data. There are a sort of political economy models that attempt to explain rising government debt, as we will present some sequentially, also in the next session we will discuss the debt management in Brazil during the 2014-2018 period, aiming to show why there was a surge in non-credibility of the fiscal policy.

Political models in general stress the notion that governments are short-sighted and tend to prefer short-term goals to maximize their gains during their mandates, in exchange of long-term goals that may be more beneficial for society. These models of spending based on short-term goals are important because the effects of raising debt and fiscal unsustainability are perennial.

The literature on political economy models of debt is immense and canonical in economic mainstream. This kind of models is becoming a focus of attention in Brazil, as Brazilian economists are slowly adopting *neoinstitutionalist*[20] tools and using inputs from political science in their analysis. We claim that this adoption is due to the more expound fracture of the political *status quo* after the 2014 election.

Yared (2019) proposes that these models, in general, deal with "ageing population, political polarization and electoral uncertainty". Regarding Brazil, these three questions have become the primary focus of diatribes in political and economic debate, which can be easily confirmed by a quick analysis of newspapers between 2014 and 2018. In sum, ageing population is directly related to the Brazilian pension fund weight on the deficit, political polarization may be clearly expressed in the congressional and executive results in the 2018 election and electoral uncertainty is clearly expressed not only in the 2014 and 2018 elections, but also during Dilma Rousseff's impeachment process and sequentially the Michel Temer's attempts to do macroeconomic reforms.

On a theoretical level, to claim that governments are short-sighted is the same as to claim that they behave as agents with "present-biased and dynamically inconsistent preferences" (YARED, 2019). While we could derivate models in the line of Phelps and Pollak (1968), Laibson (1997), and successor works with hyperbolic preferences, it suffices to say, considering

[20] Some good examples of how the influence of *neoinstitutionalim* in Brazilian economy has spread, outside of macroeconomics are the books *Brazil in Transition: Beiliefs, Leadership and Institutional Change* by Alston et al (2016) and *História da Riqueza no Brasil* by Caldeira (2017).

the scope of this monograph that, if we use this models, that if any of the previously motives are amplified, there is a tendency for the government present bias to grow and to sustain larger deficits.

In fact, Yared (2019) claims that one of his work's objectives is to "describe the political factor that provide microfoundations for the present bias and dynamic inconsistency of government preferences". That is the main reason for this chapter to be so heavily based on his framework and to provide a dialogue in the Brazilian context with his findings.

We firmly believe that Brazilian governments have inconsistent preferences and that is quite clear especially after the Real Plan in 1994. There are a number of institutional settings that resonate this claim, some of them previously mentioned in this monograph, and widely reflected and soundly proofed in the bibliography.

Yared (2019) claim that "since a government at any date would prefer to commit future governments to constraining the growth of debt, debt accumulation in this context reflects a political failure" is a perfect explanation for the fiscal policy dynamics of the Lula II, Dilma I and Dilma II[21] governments. We claim that this inconsistency of preferences is perceived by the market, and *in extremis* leads to the erosion of fiscal credibility as it was perceived in Brazil between 2014 and 2016. The goal of the next session is to provide an analysis of Brazilian debt management in the period and to make intersections to the major micro fundaments espoused in Yared (2019).

3.2. Debt Management in Brazil

By the end of the millennium, during the first Cardoso government, it was settled the role of the federal government in setting the fiscal policy. In 1999, with the political showdown between Fernando Henrique Cardoso and Itamar Franco, respectively the President of the Republic and the Governor of the State of Minas Gerais, regarding the State's debt, it was reasserted the fiscal authority of the presidency (ALSTON et al. 2014).

It became clear that the federal government would rule over States's debts, an historical source of financial risk in the country. The showdown on whether the States could default was a major victory for the presidency in reasserting its institutional power and pushing through the agenda of macroeconomic responsibility. By the beginning of 1999, the federal government had

[21] This kind of classification is canonical in Brazilian political literature, and furthermore, comprises the heyday of the so-called "New Economic Matrix" period.

"withheld constitutionally mandated transfers in the full amount of default payments" and constrained the States power to issue debt, in May, it passed the Fiscal Responsibility Law (ALSTON et al. 2014).

This was a major part of the reform agenda in the first Cardoso government and established the new setting of public debt management where the federal sphere had the dominance in conducting the fiscal policy. Thus, it sustains the *Congress* social type settled in the analytical model, as the federal entity who is ultimately responsible for the budget approval is the congress, divided in a Lower Chamber and a Senate, as defined by the 1985 Constitution.

The following table summarizes the major fiscal reforms developed in the Cardoso's government.

By default, the Brazilian public debt started the millennium on high levels. Between 1995 and 2000, which comprehends the stabilization period after the Real Plan, there was an eruption on public level, driven mostly by high interest rates. Until 1998, the interest rates were driven mostly by the weak fiscal stance and the quasi-fixed exchange rate[22] and afterwards by the Real devaluation (the majority of the public debt was dollar indexed at the time), but also by the accumulation of assets with doubtful valuation (such as the States debt incorporation in 1999) (BEVILACQUA & GARCIA, 2002).

This presence of such high interest rate and hidden liabilities led to a challenge in setting an asset that could provide liquidity, low risk and real returns. The fear of a default in the next administration coupled with the previous components and the hyperinflation memory has had put the market in a very stressful situation (GARCIA, 2002). This can explain the difficulties faced by the Central Bank in the efficacy of the interest rate facing Lula's election risk in 2002, which led to the proposition of a Fiscal Dominance period. The next decade was marked by an intense effort to develop a market with liquidity and enough size to absorb the external debt and fund the domestic debt, especially in the government transition period and the first Lula mandate.

By the second Lula mandate there was a clear change in the government's view on the role of macroprudential policies and public spending on the development model adopted.

[22] For a good review of the exchange rate regimes after the Real Plan, see Werneck (2014)

4. Credibility

There is no universal measure of credibility, however, the simplest way to define is that a central bank is credible if people believe it will do what it says (Issler & Soares, 2019). Therefore, the simplest way to measure credibility is the deviation of the expected inflation rate in the first period from the actual inflation in the second period. If the Central Bank is credible, then the equation below is valid, where $\pi_t{}^e$ is the expected inflation rate at any given period, π_{t+1} is the inflation rate in the subsequent period, and ε is an error measure, that should fall in a zone accepted by the market: σ^2.

$$\pi_t^e = \pi_{t+1} + \varepsilon,\ \varepsilon \leq \sigma^2$$

However, it is not easy to achieve a universal measure of expectations. While some central banks adopt instruments to measure and propagate the market expectations, such as Brazilian Central Bank (BCB), with its Focus report, in many other countries, there is a necessity to analyzes financial reports by banks and other agents and/or track the media.

Furthermore, in many ways, different Central Banks have different institutional characteristics. They may have different objectives, whether is just to maintain the price level or to maintain the price level and to achieve the natural unemployment rate, for instance. They may have different structures. Therefore, to achieve anything close to similar parameters to build a scale or index for comparing, on an international level, it is required to develop some proxies and instruments as strategies, which, of course, means some level of discordance in the literature.

As explained previously, the literature on the ***concept*** of credibility dates from, at least, the first half of the 1970's, but the efforts to measure it started to show developments by the late 1980's. There are many reasons or that, but in general terms, it is necessary to highlight that in 1980's there was a process of stability in the monetary policy being ignited in the developed economies. The so-called great moderation was marked by the slowly trimming of the volatility of the inflation rates, and by further communication of the central banks as globalization advanced.

With institutional improvements, the amount of empirical works on Central Bank's performance increased, with the majority showing that independent, accountable, transparent and credible central banks are more efficient (Issler & Soares, 2019). And of these characteristics, transparence is the most important one for our analysis, as credibility derivates

from expectations and expectations are better formed if Central Banks is as transparent as possible (Rudebusch & Williams, 2008).

Many authors have tried to develop their own credibility index, such as Svensson (1993, 2000), Cukierman & Meltzer (1986), Bomfim & Rudebusch (2000) and Issler Soares (2018). A good comparative analysis of the international literature is reflected on the efforts of Michael D. Bordo and Pierre L. Siklos (Bordo & Siklos, 2015a) (Bordo & Siklos 2015b) (Bordo & Siklos 2015c) because they follow the simple definition aforementioned in the beginning of the section and because the try to evaluate on a cross country, perspective, thus generating a reliable database for the empirical analysis.

In *Central Bank Credibility: An Historical and Quantitative Exploration*, the authors provide empirical measures of central bank credibility, based on institutional, financial and monetary parameters for eleven countries. In *Central Bank Credibility, Reputation and Inflation Targeting in Historical Perspective,* the authors focus on the historical evolution of central banks for 16 countries, going as far as before 1914, using both empirics and historical narratives. Finally, in *Central Bank Credibility Before and After the Crisis* the authors evaluate the credibility of 86 countries and try to measure the effects of financial crisis upon the central bank.

In regard to Brazil, there is a wide range of literature that aims to develop an index of Central Bank's Credibility. There are historical, institutional and political reasons for such interest in academia and policy makers: Brazil has faced a struggle with high levels of inflation for the majority of the second half of the twentieth century and while the Real Plan developed a virtuous path towards a rational monetary policy, the introduction of *efficient rules* for the Central Bank were met with political difficulties[23]. Furthermore, there a debate in the public sphere on whether the level of the interest rates is correct, as the real interest rates in Brazil are relatively high.

There is a methodological reason as well. Brazil has developed a consistent database of market expectations in its FOCUS survey. The Survey was established in 1999 as part of the transition towards the implementation of the inflation targeting system and

[23] There are many examples of said reactions, mainly by politicians in the left wing who were in the opposition aisle during the introduction of the so called "Tripé Macroeconômico" and inflation targets. It is important to remind that Brazilian Central Bank is not politically independent, nor institutionally, at least formally.

The following table illustrates an outline of credibility indexes developed in the last 20 years for the Brazilian Central Bank.

Ceccheti & Krauze (2002)	$CI_{CK} = \begin{cases} 1; \quad if\ E(\pi) \leq \pi_t \\ 1 - \frac{E(\pi) - \pi_t}{0{,}2 - \pi_t}; if\ E(\pi) < \pi_t < 20\% \\ 0\ ; if E(\pi) \geq \pi_t \end{cases}$	
Sicsú (2002)	$CI_S = 100 - \left(100 \cdot \frac{\lvert E(\pi) - \pi_t \rvert}{\pi_t^{MAX}}\right)$	
Mendonça (2004)	$\boldsymbol{CI_M = \begin{cases} 1; \quad if\ E(\pi_t) = \pi_t \\ 1 - \frac{E(\pi) - \pi_t}{\pi_t^* - \pi_t}; if\ \pi_t^{MIN} < E(\pi_t) < \pi_t^{MAX} \\ 0, \quad if E(\pi_t) \geq \pi_t^{MAX}\ or\ E(\pi_t) \leq \pi_t^{MIN} \end{cases}}$	
Nahon & Mauer (2005)	$\boldsymbol{CI_{NMa} = \begin{cases} 1; if\ E(\pi_t) < \pi_t^{MAX} \\ 1 - \frac{E(\pi) - \pi_t^{MAX}}{\pi_t^{MAX} - \pi_t}\ ; if\ \pi_t^{MAX} < E(\pi_t) < 20\% \\ 0; if\ E(\pi_t) \geq 20\% \end{cases}}$	$\boldsymbol{CI_{NMb} = \frac{\pi_t^{MAX}}{E(\pi)}}$
Mendonça & Souza (2009)	$\boldsymbol{R = \begin{cases} 1; \quad if\ \pi_t^{MIN} < \pi_t^{obs} < \pi_t^{MAX} \\ 1 - \frac{\pi_t^{obs} - \pi_t^{MAX}}{0,2 - \pi_t^{MAX}}; if\ \pi_t^{MAX} < \pi_t^{obs} < 20\% \\ 1 - \frac{\pi_t^{obs} - \pi_t^{MIN}}{-\pi_t^{MIN}}; if\ 0\% < \pi_t^{obs} < \pi_t^{MIN} \\ 0\ if \pi_t^{obs} \geq 20\%\ or\ \pi_t^{obs} \leq 0\% \end{cases}}$	$\boldsymbol{CI_{Mean} = \frac{\sum_{i=1}^{n} R_i}{n}}$ $\boldsymbol{CI_{weighted} = \frac{\sum_{i=1}^{n}(R_i \cdot p_i)}{\sum_{i=1}^{n} p_i}}$
Garcia & Guillen (2014)	$CI_{GG} = \sum_{j=1}^{3} \lvert \sum_{i=1}^{3} \lvert p_{ijt} - \bar{p}_{ijt} \rvert \rvert$	$CI_t^N = \frac{CI_t - CI_{min}}{CI_{max} - CI_{min}}$
Val et al. (2017)	Kalman Filter in two measures of inflation expectations (breakeven inflation and Focus survey) with a medium/long-term forecast horizon	
Issler & Soares (2019)	$CI_{IS} = \begin{cases} 1 - \frac{\left\lvert F\left(\hat{E}_{t-h}(y_t)\right) - F(\pi^*) \right\rvert}{\frac{1}{2}}; if -\infty < \pi^* < \infty \end{cases}$	

It becomes clear, that credibility indexes are clearly based on market expectations, however, how the authors perceive the behavior of such expectations and the institutional parameters are different. Furthermore, there are methodological differences between the first generation indexes developed after the introduction of the inflation target system, but before the demise of

the Brazilian economy with the so called “New Economic Matrix”, and the second generation indexes developed in a period of credibility erosion and further rebound between 2014-2018.

While Cechetti & Krauze (2002) wasn’t developed specifically for the Brazilian case, it was the original mold for the first generation. It is basically a normalized index (between zero and one) for the divergence of the inflation expectations from the target, therefore it was consistent with the time, as it was the beginning of Brazilian experiment with inflation targets. In this tradition, Sicsú (2002) developed his index based on

5. Empirical findings for Brazil, 2014- 2018

5.1. Correlation

In the previous chapters, we aimed to develop a model that could explain, using the fundaments of macroeconomic theory, how fiscal credibility could affect monetary credibility. Also, we demonstrate that there isn't an optimal conduction of fiscal policy in Brazil and that there is not a consensus in measuring credibility. We now will try to show that there is an empirical relation between monetary policy and fiscal policy for Brazil between 2014 and 2018.

Using Blinder (2000), we firstly will define the concept of a *credibility gap*. A Central Bank is credible if:

$$\pi_t^e = \pi_{t+1} + \varepsilon,\ \varepsilon \leq \sigma^2$$

Then, we can rearrange this equation as:

$$\varepsilon = \pi_t^e - \pi_{t+1},\ \varepsilon \leq \sigma^2$$

Thankfully, this equation is easily measurable using the Focus Survey data available in the Brazilian Central Bank system [24] and the BCB Consolidated statistical series system [25]. Sequentially, we call this deviation term as *credibility gap*. Naturally, we extend Blinder (2000) definition of credibility of the Central Bank to the fiscal policy with the analogous model, using φ as the primary result of the consolidated government to GDP ratio. We use this fiscal indicator not only because of the Brazilian Central Bank's definition of expected fiscal result, but also because since the Real Plan, it has been the primary indicator for debt sustainability analysis (GIAMBIAGGI, 2016)

$$\varepsilon = \varphi_t^e - \varphi_{t+1},\ \varepsilon \leq \sigma^2$$

The next step is to settle a *threshold* for the variance to define whether the institutions are credible or not. We now determinate two possible scenarios, the *conservative hypothesis* where the agents have as threshold a 20% deviation from their expectations and a *lenient hypothesis* where agents have as threshold a 20% deviation from their expectations.

[24] Available at https://www3.bcb.gov.br/expectativas/publico/consulta/serieestatisticas
[25] Available at https://www3.bcb.gov.br/expectativas/publico/en/serieestatisticas

To calibrate our decision model, we first will calculate the credibility gap of the monthly variation in the inflation. For that we use the previous year average expected monthly variation of the IPCA and the monthly variation of the IPCA. *Figure V* shows the evolution of the credibility gap function.

Then we proceed to do a simple credibility test. Assuming that agents believe the acceptable credibility deviation threshold to be 0.20 for conservative individuals and 0.30 for lenient agents, we can test whether each month the BCB was credible or not. The test is described below:

$$conservative\ agents \begin{cases} H_0 = if\ \pi_t^e - \pi_{t+1} \leq |0{,}20|\ , credible \\ H_1 = if\ \pi_t^e - \pi_{t+1} > |0{,}20|\ , non - credible \end{cases}$$

Table 1 shows that. regarding this test, BCB was credible 45% in the eyes of conservative agents, and 63,33% in the eyes of lenient agents. We can now test for institutions credibility in general. For that, we will define the thresholds for conservative agents as a 20% variation of their expectations in credibility gap, and a 30% variation in the credibility gap for lenient agents.

$$conservative\ agents \begin{cases} H_0 = if\ x_t^e - x_{t+1} \leq |0{,}20 * E(x)|\ , credible \\ H_1 = if\ x_t^e - x_{t+1} > |0{,}20 * E(x)|\ , non - credible \end{cases}$$

$$lenient\ agents \begin{cases} H_0 = if\ x_t^e - x_{t+1} \leq |0{,}30 * E(x)|\ , credible \\ H_1 = if\ x_t^e - x_{t+1} > |0{,}30 * E(x)|\ , non - credible \end{cases}$$

We the proceed to extend these tests to the inflation and fiscal policy in the period. Using monthly data, the accumulated inflation in the last 12 months and the expected accumulated inflation for the next 12 months in the previous year, we can establish a credibility gap for monetary policy. *Table 1* shows that for conservative agents the BCB was credible 36,36% of the period and 43,33% credible in the eyes of the lenient agents.

In regard to fiscal policy, results paint a dire context. For conservative agents, fiscal policy was credible 18.33% of the time and for lenient agents, the period marked by credibility amounts for 21.67%. This analysis confirms the hypothesis that fiscal policy conduct in Brazil is far from optimal, as conceptually exposed in the Chapter 4.

A final simple test is the test for simultaneity. We aim to test whether there are periods when fiscal and monetary policies were both credible or non-credible at the same time. We run a simple binary hypothesis test: we set as 1 the periods of credibility and 0 as periods of non-credibility. Then we run the test as described below:

$$\begin{cases} H_0 = \delta_{fiscal} - \delta_{monetary} = 0, credible \\ H_1 = \delta_{fiscal} - \delta_{monetary} \neq 0, non - credible \end{cases}$$

As shown in *Table 1*, the simultaneous concentration of credibility amounts for 61.67% and 48.33% of the period for the conservative and the lenient agents respectively. This coupled with *Figure VIII*, where we plot the fiscal credibility gap and the monetary policy gap, may lead to an illusion of correlation, and some pundits may even call for preliminary conclusion of causality.

However, these tests alone do not account for statistical validity. To test if there is a correlation between the credibility of fiscal and monetary policies, we will use the literature background in credibility indexes. For further tests, it will be used two first generation type of indexes, one based in Sicsú (2002) and one based in Mendonça (2004). The first ones are described as below.

$$MCI\_S = 1 - \left(\frac{|E(\pi) - \pi_t|}{\pi_t^{MAX}} \right)$$

$$FCI\_S = 1 - \left(\frac{|E(r) - r_t|}{E(r)} \right)$$

Where π is inflation, measured by the IPCA accumulated in the last 12 months and r is the primary result to GDP ratio. It is important here to introduce a major problem in analyzing fiscal credibility, there is not a consensual coherent target for fiscal policy. The first index describes monetary policy credibility and is almost identical to Sicsú (2002), the second index on the other hand describes fiscal policy, anchored to the very own expectations. The basic idea here is, since we are using average, that agents base their individual expectations on the market expectations as well[26].

The second indexes are described as below:

$$MCI\_M = \begin{cases} 1; \ if \ E(\pi_t) = \pi_t \\ 1 - \dfrac{E(\pi) - \pi_t}{\pi_t^* - \pi_t}; if \ \pi_t^{MIN} < E(\pi_t) < \pi_t^{MAX} \\ 0, \ if E(\pi_t) \geq \pi_t^{MAX} \ or \ E(\pi_t) \leq \pi_t^{MIN} \end{cases}$$

[26] This hypothesis is not that incredible if we consider the previously mentioned narrative effect, there is a component in agents' expectations that includes other agents' opinions and specialists' analysis

$$FCI\_M = \begin{cases} 1; \ if\ E(r_t) = r_t \\ 1 - \dfrac{E(r) - r_t}{r_t^* - r_t}; if\ r_t^{MIN} < E(r_t) < r_t^{MAX} \\ 0, \ if E(r_t) \geq r_t^{MAX}\ or\ E(r_t) \leq r_t^{MIN} \end{cases}$$

This kind of index is based not only on deviations from expectations but also in deviations from thresholds. Defining thresholds for monetary policy is easy, we simply use the target system: the central threshold is the target π_t^*, and it is intuitive to use the upper target and the lower target as π_t^{MAX} and π_t^{MIN}. However, setting thresholds for fiscal policy it is not easy.

The Brazilian government, when setting the budget for the next year, sets a target for the primary result/GDP ratio. This target is usually present in the fourth annex[27] of the "Lei de Diretrizes Orçamentárias", which is the bill that the executive power sends to the Congress to approve as the next year budget. We use these targets as equivalents for the inflation targets in our model, setting the target defined in the bill as r_t^* and the thresholds as a 20% variation from the central target. *Table II* shows the thresholds of the model used in each year.

We reckon that this decision is not optimal as these primary result targets are not as easily accepted by the market, mostly because, as previously shown, fiscal policy is not perceived as optimal and fiscal policy is rife with non-credibility. However, these thresholds are better than others in the sparse literature on fiscal credibility[28] because they are the ones that, at least on paper, the government is committed to achieve.

With the results of these indexes, as described in *Figure IX*, *Figure X*, *Figure XI* and *Figure XII* we can start to develop correlation tests. Firstly, we run Augmented Dickey-Fuller tests on each series so that we can find unit roots. The test results, described in *Table III* show that all indexes have a unit root, which allows to test for cointegration.

Using an Engle-Granger Test, we test for cointegration between the series. *Table IV* shows that MCI_S and FCI_S are cointegrated, and *Table V* shows that MCI_M and FCI_M are cointegrated. So, considering the statistical limitations of the sample and the potency of the tests, we can attest for long term correlation between fiscal and monetary credibility. This validates the first hypothesis of this model, that fiscal and monetary credibility are linked by some sort of macroeconomic force. We have proposed in the introduction and in Chapter 2 that

[27] As an example, see the 2019 LDO Annex IV which describes the fiscal targets to be achieved by the end of the year: https://www.camara.leg.br/internet/comissao/index/mista/orca/ldo/LDO2019/Lei_13707/anexo.pdf

[28] Montes (2019) uses the limits set in Maastricht treaty for fiscal sustainability, for instance.

this is due to expectational shocks. Since credibility is defined by deviations from expectations, we can test for causality using an OLS model described in the next session.

6.2. Causality?

7. Conclusion

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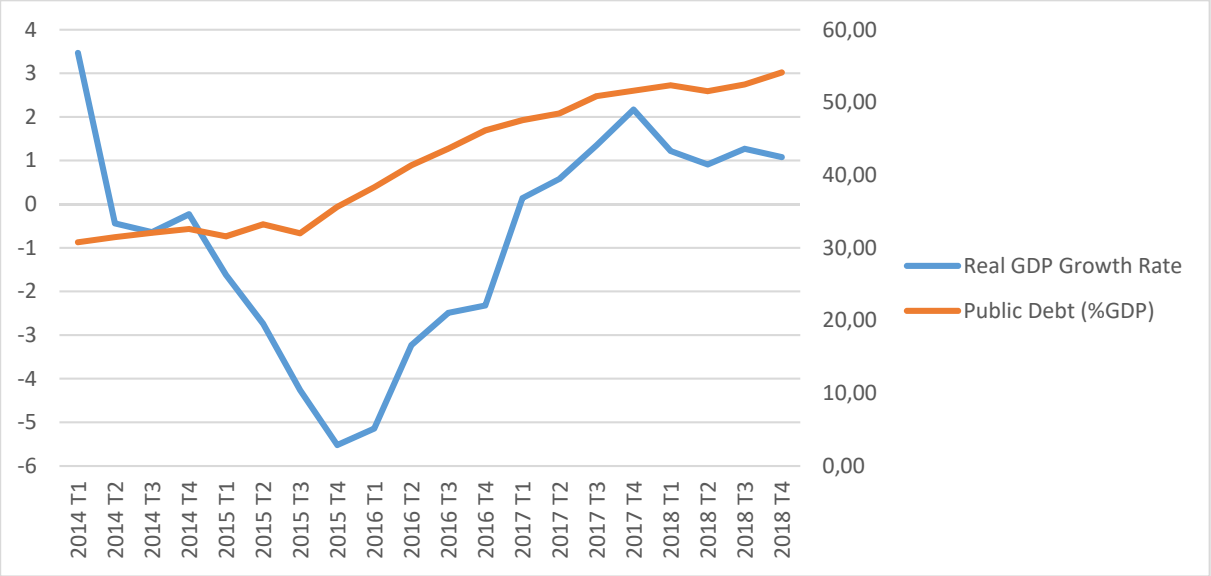
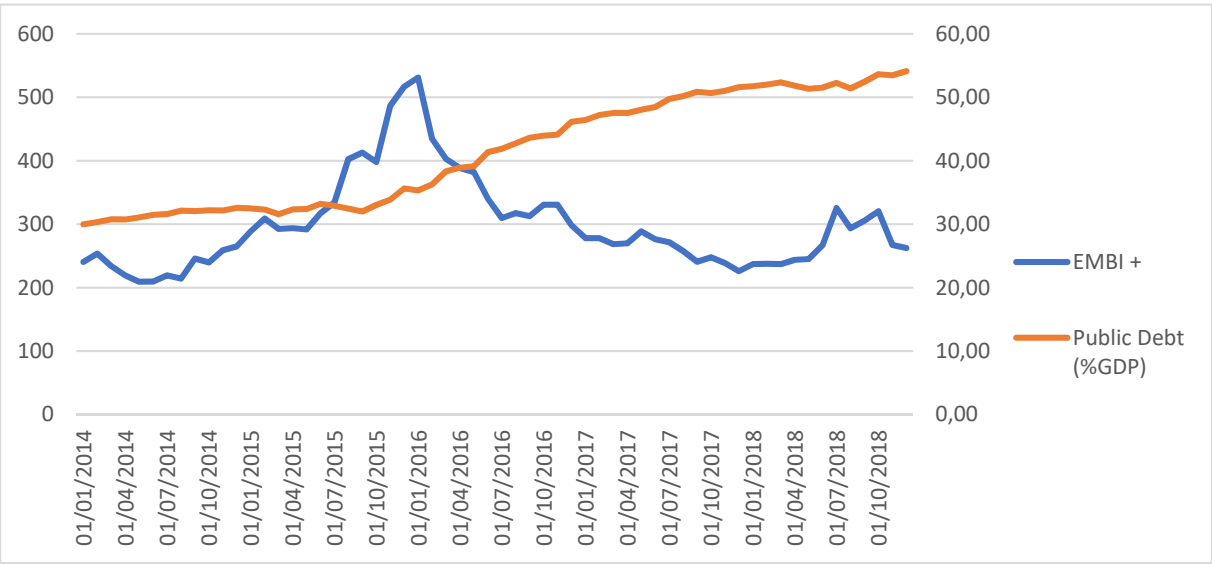
Appendix

Figure I: Real GDP growth rate and Nominal Public Debt (%GDP)



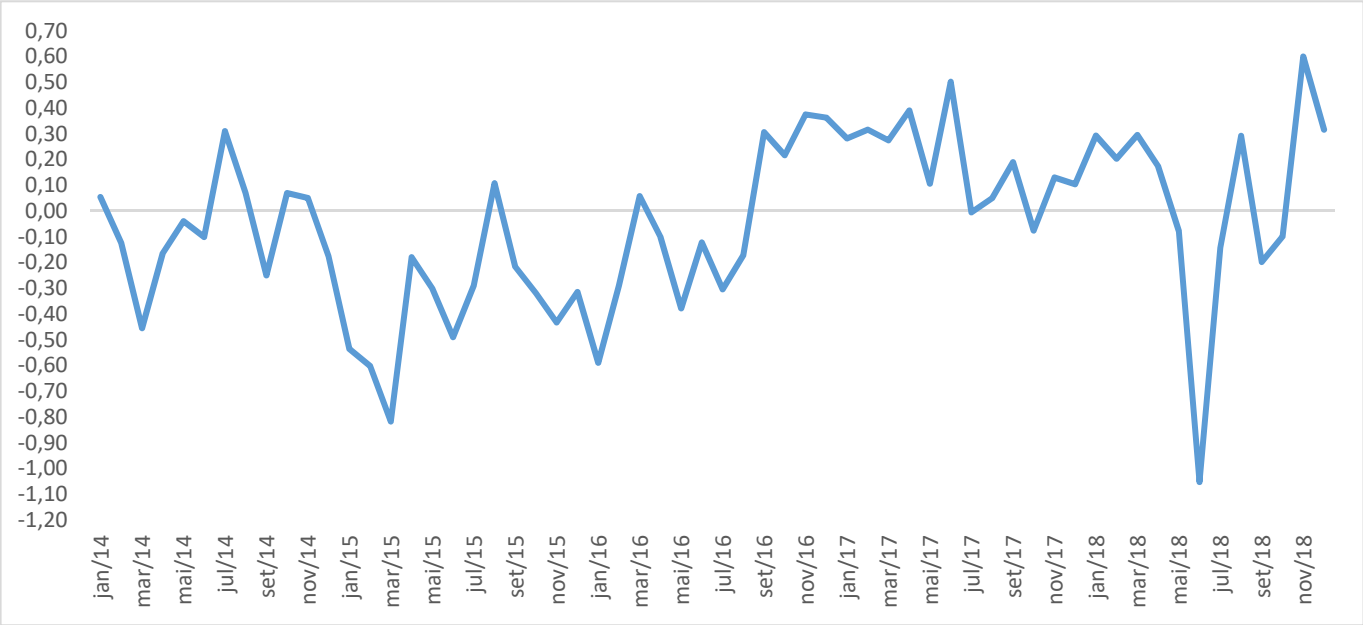
Source: BCB and IPEA-Data; using Brazilian Central Bank methodology for liquid debt

Figure II: Real GDP growth rate and Nominal Public Debt (%GDP)



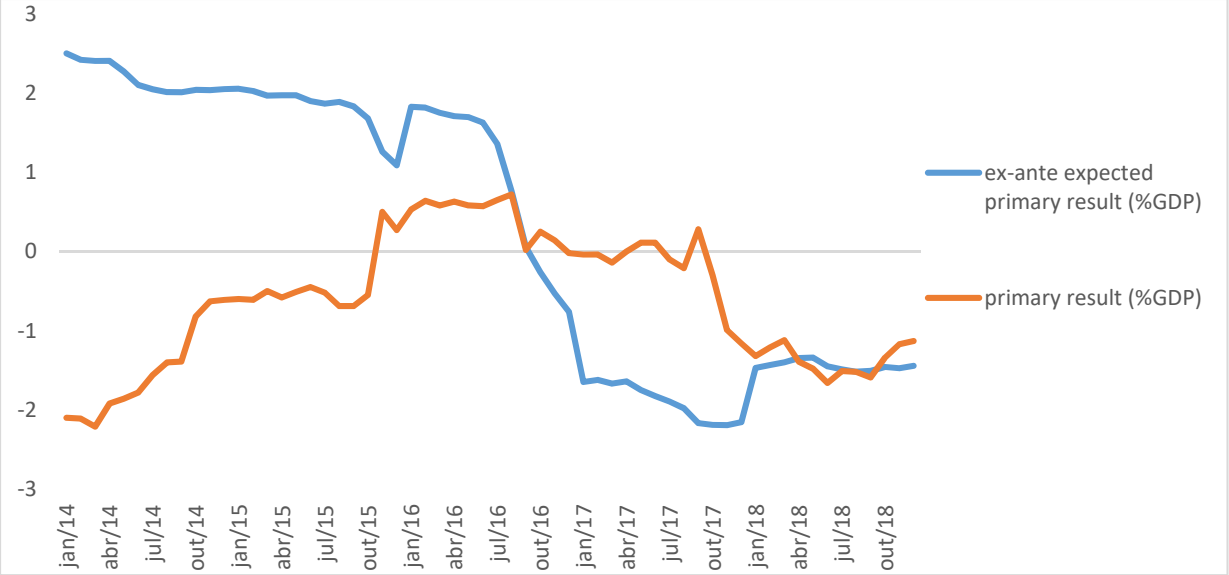
Source: BCB and IPEA-Data; using Brazilian Central Bank methodology for liquid debt and filtering by monthly average the EMBI+ index, using a 10^{-1} representation.

Figure III: Monthly inflation credibility gap



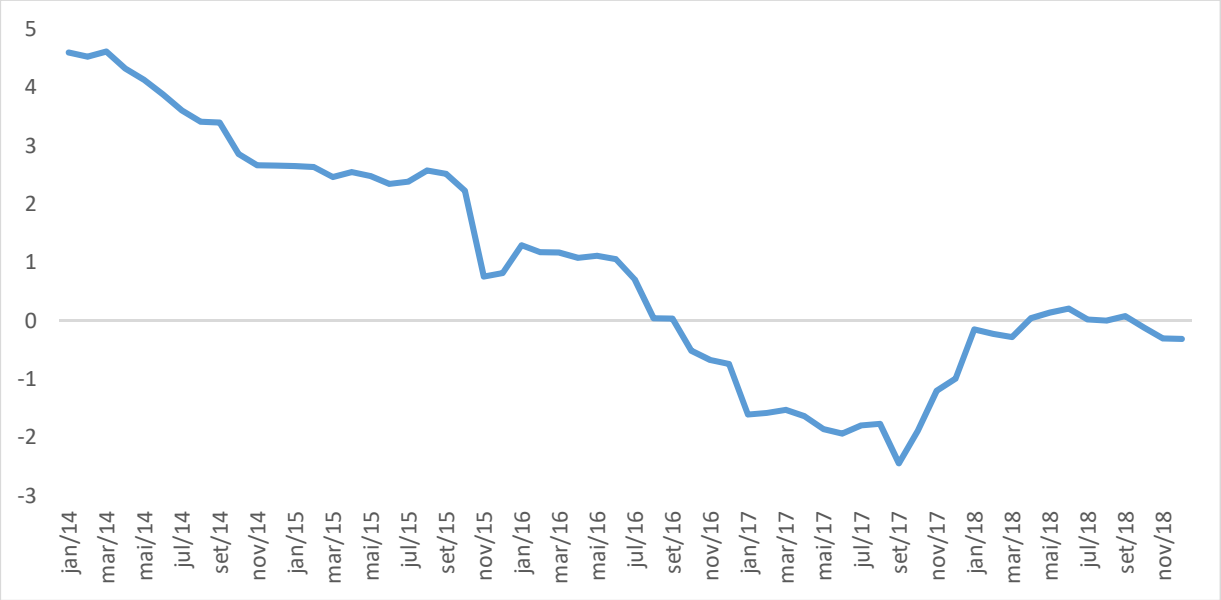
Source: Author's own calculation

Figure IV: Ex-ante expected primary result and the primary result (%GDP)



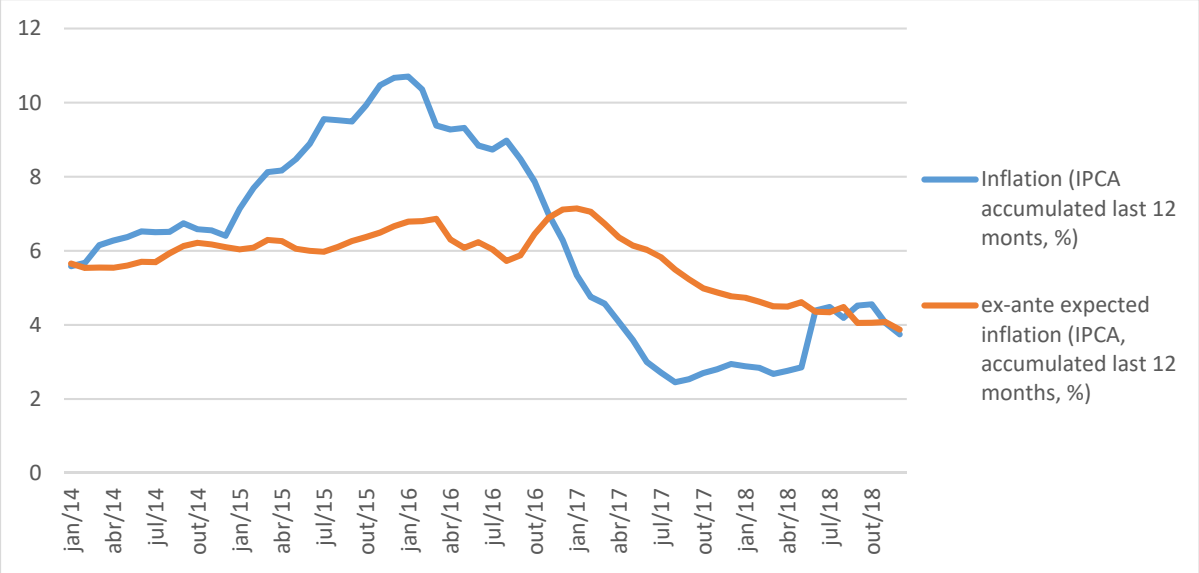
Source: Brazilian Central Bank

Figure V: Fiscal credibility gap



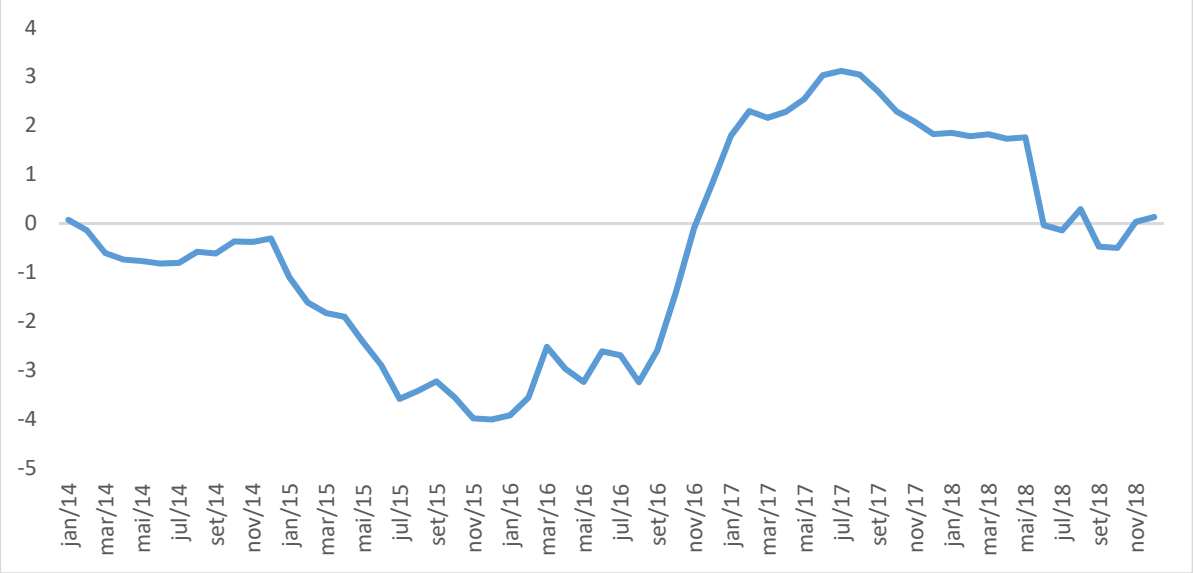
Source: Brazilian Central Bank

Figure VI: Ex-ante expected inflation and inflation rate



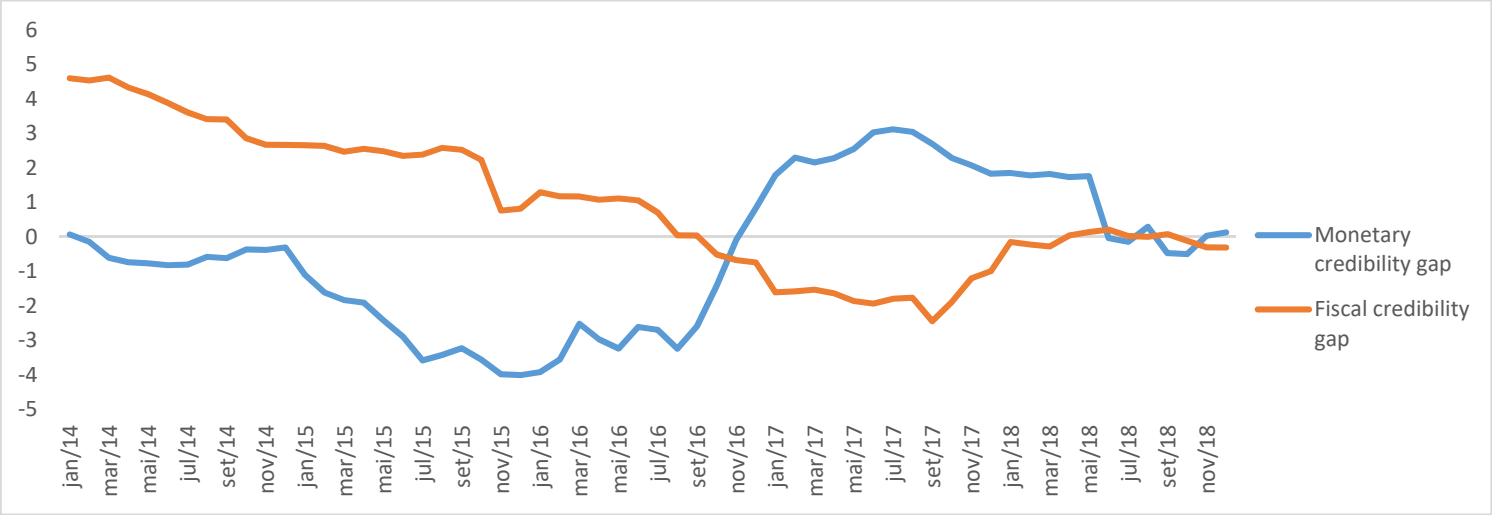
Source: Brazilian Central Bank

Figure VII: Monetary credibility gap



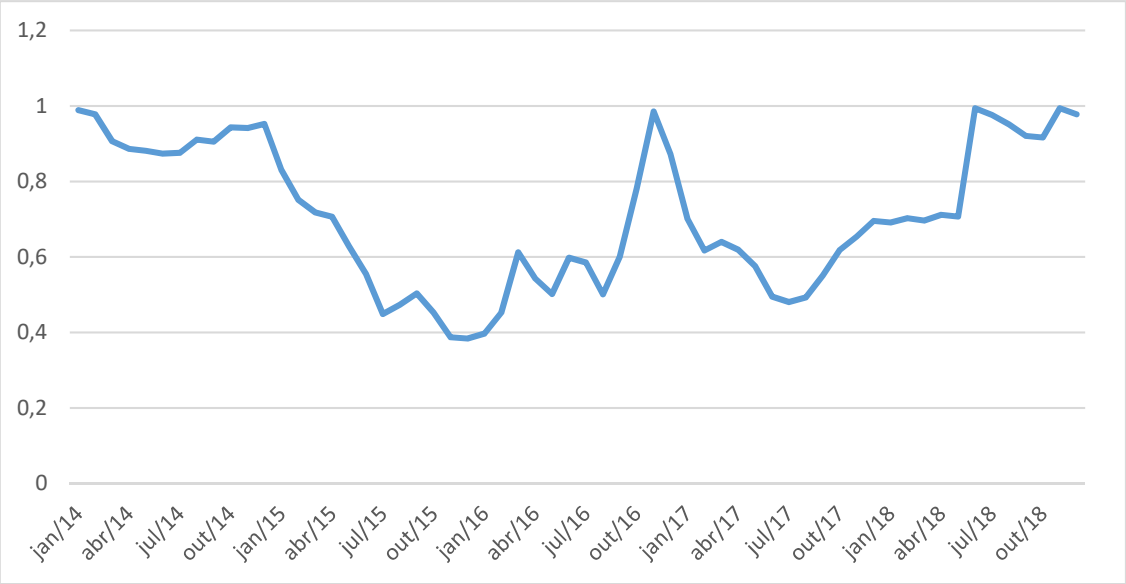
Source: Author's own calculation

Figure VIII: Monetary and fiscal credibility gap



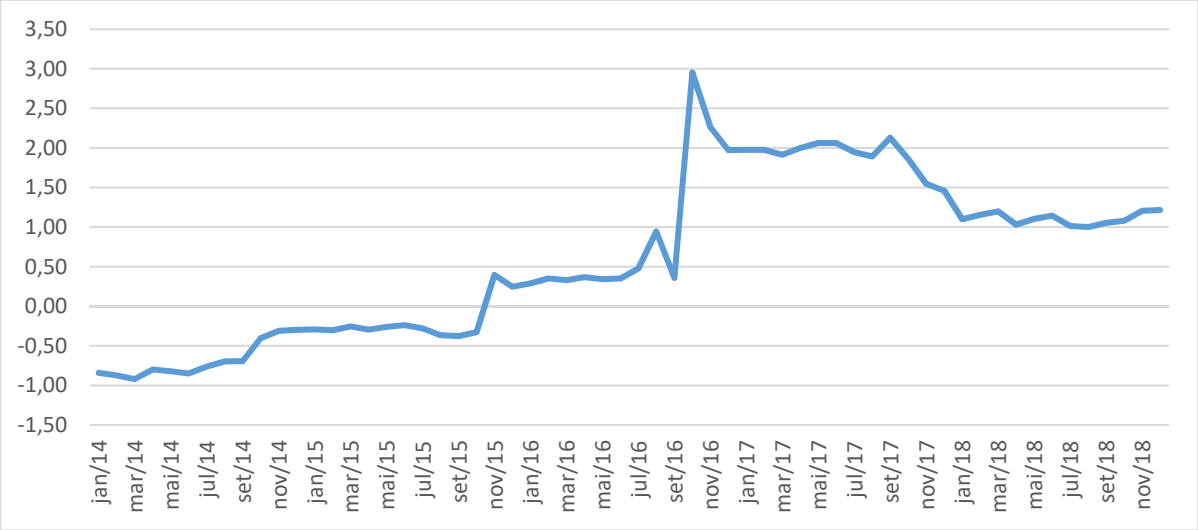
Source: Author's own calculation

Figure IX: MCI_S credibility index



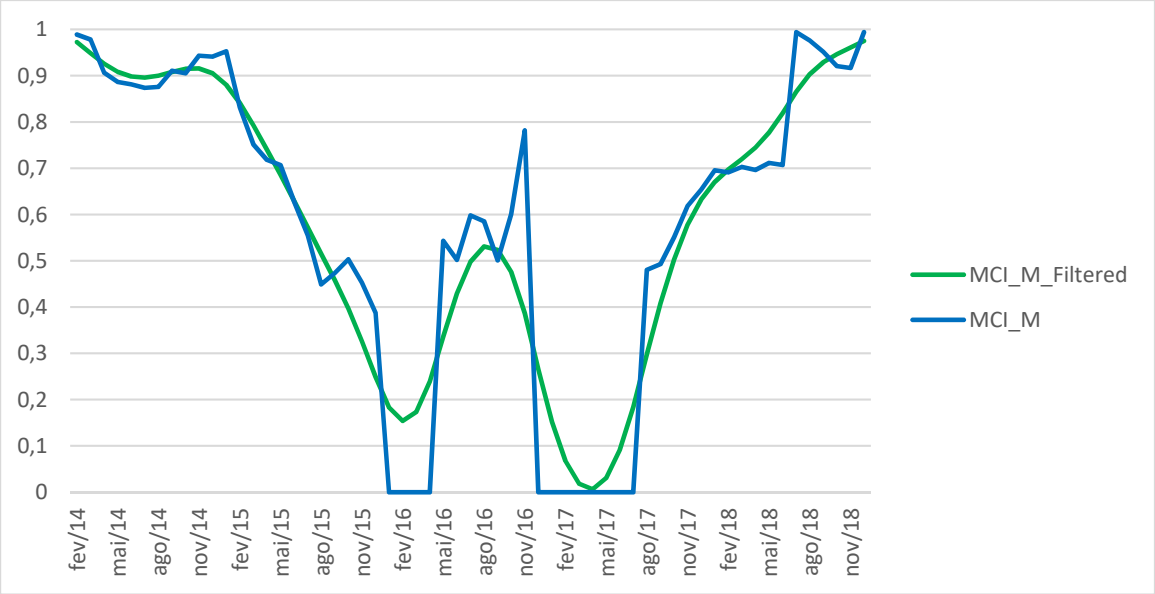
Source: Author's own calculation

Figure X: FCI_S credibility index



Source: Author's own calculation

Figure XI: MCI_S credibility index



Source: Author's own calculation

Figure XII: MCI_S credibility index

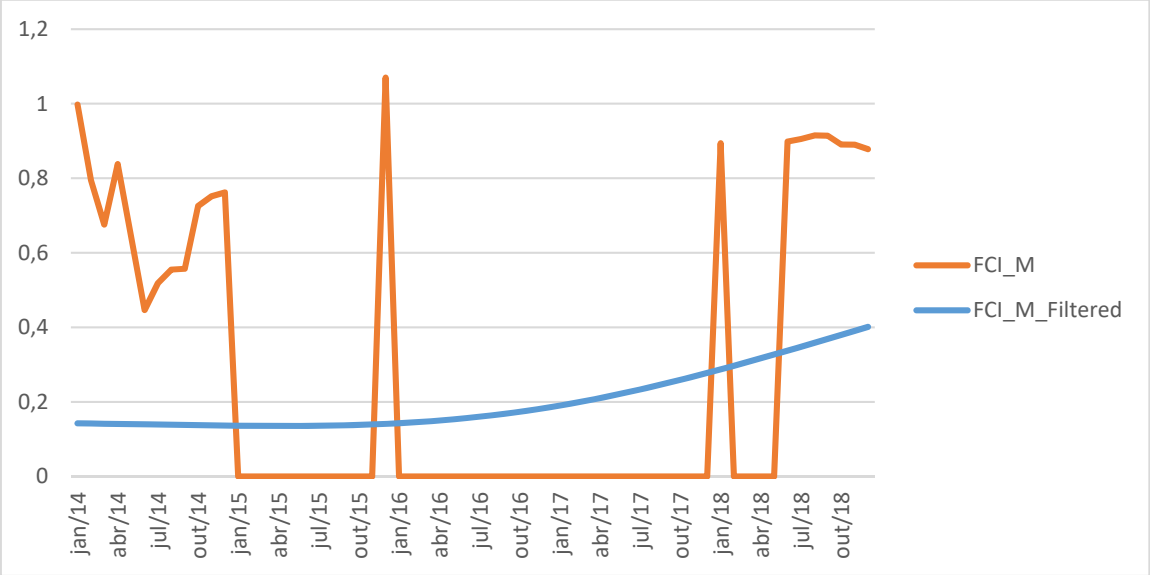


Table 1: Credibility persistance

	Conservative hypothesis	Lenient Hypothesis
IPCA (%, monthly) credibility	45.00%	63.33%
IPCA (%, accumulated last 12 months) credibility	36,67%	43,33%
Primary result (% of GDP) credibility	18.33%	21.67%
Simultainty between monetary and fiscal credibility	61.67%	48.33%

Table 2: Target as thresholds

	Lower inflation target	Inflation Target	Higher Inflation Target	Lower fiscal target	LDO target	Higher fiscal target
2014	2.5	4.5	6.5	2.0	2.5	3.0
2015	2.5	4.5	6.5	0.8	1.0	1.2
2016	2.5	4.5	6.5	0.3	0.4	0.5
2017	3.0	4.5	6.0	0.1	0.1	0.1
2018	3.0	4.5	6.0	-1.4	-1.8	-2.2

Table 3: Indexes unit root tests

	Unit root test value (ADF test)
MCI_M	-1.66
FCI_M	-1.6793
MCI_S	-1.3054
FCI_S	-1.305