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Fiscal credibility and disagreement in expectations about inflation: evidence for Brazil

Gabriel Caldas Montes
Fluminense Federal University and National Council for Scientific and Technological Development

Tatiana Acar
Fluminense Federal University

Abstract

The present paper analyzes the impact of fiscal credibility on the disagreement in expectations about inflation. We argue that when fiscal credibility is low (high), the uncertainty related to the future behavior of inflation (measured by the disagreement in expectations) is higher (lower). The contributions of our study are twofold. First, we use market expectations reported by the Central Bank of Brazil to build a new fiscal credibility index. This new index takes into account the expectations related to the fiscal effort required to keep gross public debt in a sustainable level. Second, we analyze the influence of fiscal credibility on the disagreement in expectations about inflation. Evidence suggests fiscal credibility is important to reduce the disagreement in expectations about inflation. Thus, the findings indicate that, since fiscal credibility helps reducing the disagreement in expectations, it helps in the process of anchoring inflation expectations, providing better results for the inflation targeting regime.

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Contact: Gabriel Caldas Montes - gabrielmontesuff@yahoo.com.br, Tatiana Acar - tatiana.acar@gmail.com.
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1. Introduction

Expectations may be divergent among agents at an instant of time, and the disagreement in expectations may vary over time (Mankiw et al., 2003). In this sense, studies about the process of expectation formation, especially in the field of macroeconomics and finance, seek to identify why agents differ about economy's future behavior. In general, the literature suggests the disagreement in expectations about a particular variable reflects the uncertainties related to the future behavior of this variable, and these uncertainties come from different factors.[1]

Regarding the disagreement in expectations about inflation in Brazil, Montes et al. (2016) analyze the effects of central bank transparency, monetary policy signaling (central bank communication), and the clarity of central bank communication on this disagreement. The results suggest transparency is important to reduce the disagreement in expectations about inflation, and both the signaling of monetary policy and the clarity of central bank communication affect the disagreement in Brazil. In another study for the Brazilian economy, Oliveira and Curi (2016) find evidence that the monetary policy credibility is important to reduce the disagreement in expectations about inflation.

In the present paper, unlike existing studies, we analyze the effect of fiscal credibility on the disagreement in expectations about inflation.

Brazil is an IT country and thus an interesting case study because under IT the coordination between monetary and fiscal policies is necessary. Besides, in countries adopting IT (such as Brazil), fiscal policy must be responsible so that it does not put pressure on inflation (Bernanke et al., 1999; Mishkin, 2007), and the regime does not suffer from fiscal dominance (Allsopp and Vines, 2005; de Mendonça and Silva, 2016). Thus, in order to avoid the deterioration of inflation expectations due to fiscal pressures, fiscal credibility is an aspect that should not be neglected (de Mendonça and Tostes, 2015; de Mendonça and Silva, 2016). Hence, in the present study, we empirically analyze whether the loss (gain) of fiscal credibility is capable of increasing (reducing) the uncertainties related to the future behavior of inflation, which is measured by the disagreement in expectations about inflation. Therefore, the focus of our analysis lies on the influence of fiscal credibility on the disagreement in expectations about inflation in Brazil.

Fiscal credibility is related to several factors. Among these factors, some authors suggest a close relation between fiscal credibility and expectations formed to public debt sustainability (de Mendonça and Machado, 2013; de Mendonça and Tostes, 2015; Montes and Acar, 2015). Hence, in order to avoid the deterioration of fiscal credibility, it is important the public debt to GDP ratio does not endanger the government's intertemporal fiscal solvency. In particular, the risk of public debt monetization cannot be neglected in emerging countries with history of fiscal imbalances and high inflation rates in the past, even if these countries adopt IT (Mishkin and Savastano, 2001). This is because the possibility of debt monetization can generate uncertainties about the future behavior of inflation, and thus it can initiate a new inflationary process. Thus, a low fiscal credibility can reduce agents' belief that inflation will converge to the target, increasing uncertainties regarding the future behavior of inflation. In the literature, there is empirical evidence for the Brazilian case indicating that the

[1] Among the possible factors, Oliveira and Curi (2016) identify studies that suggest the disagreement in agents' expectations can stem from a priori heterogeneous beliefs, differences in the models used by agents to assess the economic environment, differences in the information set that each agent uses to infer the current state of the economy, diversity of interpretations about new information revealed to the public and diversity of views about the nature of changes occurring in the economic system (temporary vs. permanent changes) (e.g., Lahiri and Sheng, 2008; Patton and Timmermann, 2010; Wieland and Wolters, 2011; Andrade et al., 2014; Montes et al., 2016).

government's commitment to both fiscal balance and fiscal credibility affect the expectations and confidence of private agents, as well as macroeconomic performance (e.g., de Mendonça and Machado, 2013; Montes And Acar, 2015), in particular, inflation expectations and the inflation rate (e.g., de Mendonça and Tostes, 2015; de Mendonça e Silva, 2016).

The literature devoted to create measures of fiscal credibility has evolved. Over the last few years, some studies have sought to find ways to build fiscal credibility indicators (e.g., de Mendonça and Machado, 2013; Kuncoro, 2015; de Mendonça and Silva, 2016). However, the task of accurately measuring fiscal credibility is not simple, as it is difficult to find an adequate indicator to assess fiscal sustainability and which reflects agents' evaluation about the fiscal situation of a country. For example, the fiscal credibility index developed by de Mendonça and Machado (2013) uses the expectation for the net public debt as a proportion of GDP as a solvency parameter. However, the expectation for the net public debt as a proportion of GDP is not an appropriate indicator for Brazil, because this variable overestimates the country's fiscal condition, thus generating an overestimated credibility as well. Hence, one of the goals of our study is to propose a new indicator of fiscal credibility in order to better suit it to the current requirements of the literature.

Thus, the contributions of our study are twofold. First, we use market expectations reported by the Central Bank of Brazil to build a new fiscal credibility index. Unlike other existing indicators (e.g., de Mendonça and Machado, 2013; Kuncoro, 2015; de Mendonça and Silva, 2016), this new index takes into account the expectations related to the fiscal effort required to keep gross public debt in a sustainable level. Second, while de Mendonça and Silva (2016) analyzed the effect of fiscal credibility on the levels of the inflation rate and inflation expectations, we analyze the influence of fiscal credibility on the disagreement in expectations about inflation (an analysis never done so far).

Using Brazil as a case study (since the country is an important emerging economy adopting IT, and one of the few in the world that provides a broad database of expectations about different macroeconomic variables), estimates are made in order to capture the effect of fiscal credibility on the disagreement in expectations about inflation. The findings indicate that fiscal credibility has been deteriorating since 2009, and it presents a considerable worsening from 2015. In addition, the results of the estimates indicate that fiscal credibility is inversely related to the disagreement in expectations about inflation, suggesting that fiscal credibility is important in the process of anchoring inflation expectations, and therefore it is an aspect that cannot be ignored by countries adopting IT.

2. Fiscal credibility

There is no consensus in the literature about a precise definition of the credibility concept. Blinder (2000) suggests that a policy is credible if people believe that the policymaker will make the announced policy. Baxter (1985) and Hauner et al. (2007) relate credibility to the public's belief about how close to results an announced policy is.

Regarding fiscal credibility, Blanchard and Cottarelli (2010) argue that fiscal solvency is crucial for earning fiscal credibility. Empirical studies on the credibility of fiscal policy are still incipient. The existence of few studies is due to the scarcity of indicators capable of measuring fiscal credibility. This is because, so far, no consensus has been reached on the definition of fiscal credibility and hence on how to accurately measure fiscal credibility through a single indicator. Despite the difficulties, some economists seek to develop indicators aimed at describing the behavior of fiscal credibility.

One of the first works to propose a fiscal credibility index was developed by de Mendonça and Machado (2013). Using data provided by the CBB, the indicator is built based on the deviations of expectations about net public debt-to-GDP from the prudential benchmark for the debt suggested by the International Monetary Fund and the Maastricht Treaty – 40% (lower limit) and 60% (upper limit), respectively. The indicator is continuous, and assumes values between zero (lack of credibility) and one (maximum credibility). The index, however, tends to overestimate credibility, since it takes into account the expectation about the net public debt. For example, the index assumes maximum value (equal to 1) between October 2008 and March 2016, even after the severe fiscal crisis that the country faced from 2015. In Brazil, the net debt is no longer adequate to evaluate the country's fiscal sustainability. One can observe that the Brazilian net debt-to-GDP has fallen significantly in recent years, despite of the increase in liabilities (gross debt-to-GDP). While net debt remained stable between September 2014 and September 2015 (32% of GDP), gross debt increased from 58% in September 2014 to 70% in September 2015. In addition, according to Greenlaw et al. (2013), there is the possibility of political manipulation of net debt in relation to gross debt. In Brazil there was a wide change in the structure of government assets and liabilities and, simultaneously, an increase in the differential between the net debt and gross debt.[2]

Kuncoro (2015) elaborates a measure of credibility related to the fiscal rules using the deviation from the current budget in relation to the planned one. However, once the measure considers past events, and not agents' expectations, it cannot be considered a foward-looking indicator that captures credibility in its strong version.

The index developed by de Mendonça and Silva (2016) uses the expectations for the primary surplus provided by the CBB, and the primary surplus targets as benchmarks. However, the tolerance intervals of the index are not well-defined (in fact, they are defined without a convincing rationale). In addition, some caveats deserve to be made regarding the use of the primary surplus targets as a parameter of sustainability. As pointed out by Bova et al. (2014), a fiscal rule, although rigid, cannot replace the commitment to comply with the rule, which is largely a political decision, and thus difficult to measure. In fact, the several revisions of the primary surplus targets in recent years in Brazil show that the targets do not represent a measure of sustainability, and thus do not represent a good parameter of confidence in the conduct of fiscal policy.[3]

3. A new fiscal credibility index

According to Clark (2011), fiscal credibility is built on a realistic, disciplined (responsible), prudent and transparent fiscal policy that ensures long-term fiscal sustainability. The index we propose in the present study is closely linked to Clark's (2011) proposal. In Brazil, the Fiscal Responsibility Law (FRL) establishes a set of rules on public finance focused on responsible fiscal management, by means of actions in order to prevent risks and correct deviations that might affect the balance of public accounts.[4] In this sense, the Treasury seeks to ensure the public debt sustainability. Based on this premise, the index we propose in this study captures how distant the public's belief is in relation to the fiscal effort required to keep gross debt at a sustainable level.

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[2] This situation is explained by the concomitant increase in assets, composed mainly of loans from the National Treasury to the National Bank for Economic and Social Development (BNDES), and repo operations of the CBB.

[3] In 2009, the government changed the surplus target from 2.8% to 2.5% of GDP. In 2010, it changed from 3.3% to 3.1%; in 2013, from 3.1% to 2.3%; in 2015, from 1.2% to 0.15%, and; in 2016, from a surplus target of 1.65% to a deficit of 2.64%.

[4] The FRL is a Complementary Law (No. 101), created in 2000, which establishes public finance standards for accountability in fiscal management and other measures (http://www.planalto.gov.br/ccivil_03/leis/LCP/Lcp101.htm).

The main difference of our index in relation to the other existing indicators lies in its ability to indirectly capture the agents' perceptions regarding the evolution of the gross debt, since it compares the expectation for the primary surplus with the primary surplus required to bring the gross debt to a value considered as ideal. In addition, the index is based on a sustainability parameter that is not subject to political wills: the primary surplus required to bring public debt to a sustainable (ideal) value. Thus, the fiscal credibility index (FCI) is constructed as follows:

$$FCI_t = \begin{cases} 1 & if \quad E_t(ps_{t+12}) \geq ps^{ideal} \\ 1 - \left\{\frac{[E_t(ps_{t+12}) - ps^{ideal}]}{ps^{toler} - ps^{ideal}}\right\} & if \quad ps^{ideal} > E_t(ps_{t+12}) > ps^{toler} \\ 0 & if \quad E_t(ps_{t+12}) \leq ps^{toler} \end{cases} \quad (1)$$

where, $E_t(ps_{t+12})$ represents the expected primary surplus formed at time t for $t + 12$ months; The term "ps^{ideal}"" is the required primary surplus throughout the year for gross public debt in relation to GDP reach 50% in 12 months (considered as the ideal value); "ps^{toler}" is the required primary surplus for gross public debt in relation to GDP reach 70% – the maximum tolerable amount for the public debt so that it does not become unsustainable. It is worth highlighting that the values of 50% and 70% have support in the literature for emerging economies (e.g., IMF, 2003; Manasse et al., 2003), and in particular for the Brazilian case (Alfaro and Kanczuk, 2007 and 2009). Using a dynamic equilibrium model, Alfaro and Kanczuk (2007 and 2009) calibrate a model for the Brazilian economy and solve it to find the best debt maturity and the optimal levels that keep the debt sustainable in the country. Based on a model which considers a debt economy of one period and also of two periods, and showing the regions of debt sustainability for Brazil, they find for both models (one period and two periods) – considering agency costs equal to zero – that a debt below 50% of GDP is sustainable, and the country does not get in default. Moreover, they find that for the two-period economy model – considering agency costs equal to zero – that a debt above 70% of GDP is likely to become unsustainable. Thus, ps^{ideal} and ps^{toler} are obtained as follows:

$$ps^{ideal} = (Debt_t - 50\%) + Debt_t \left[\frac{[E_t(r_{t+12}) - E_t(g_{t+12})]}{1 + E_t(g_{t+12})}\right] \quad (2)$$

$$ps^{toler} = (Debt_t - 70\%) + Debt_t \left[\frac{[E_t(r_{t+12}) - E_t(g_{t+12})]}{1 + E_t(g_{t+12})}\right] \quad (3)$$

where, $Debt_t$ represents the gross debt in relation to GDP at t, $E_t(r_{t+12})$ is the expected real interest rate 12 months ahead, and $E_t(g_{t+12})$ is the expected output growth rate 12 months ahead.

Expressions (2) and (3) are obtained from the government's basic intertemporal budget constraint equation, which equals the flow of revenues and expenditures to changes in the stock of the public debt (see derivation in Appendix A).[5] In general terms, equations 2 and 3 tell us that for the public debt to reach its considered sustainable value – for example, 50% of GDP – there must be a fiscal adjustment capable of taking the current public debt to 50% of GDP (see the first term on the right-hand side of equation 2), and, in addition, the fiscal adjustment must be capable of compensating the deleterious effect of the increase (or not) in

[5] As can be seen from the derivation of equations (2) and (3) in Appendix A, we seek an expression that reflects the required primary surplus that brings debt to a sustainable level, and not only the debt-stabilizing one, as in other approaches on the subject.

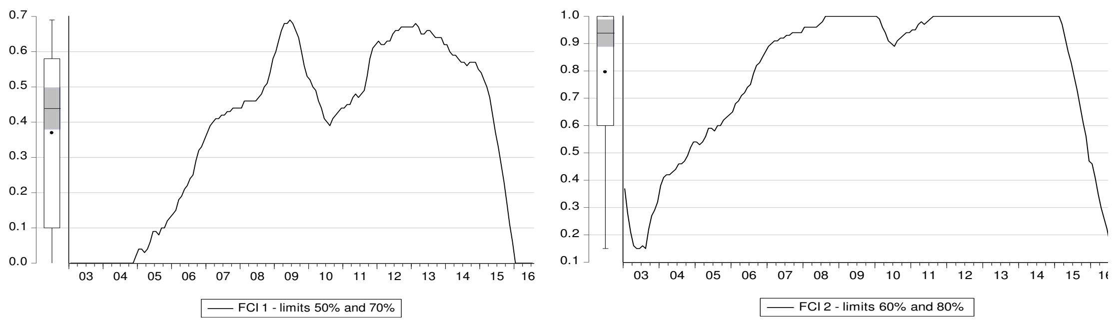
public indebtedness due to the increase in the interest rate and changes in output growth rate (the second term on the right-hand side).

Thus, if the primary surplus expectation is above the required primary surplus to bring the gross debt in relation to GDP to 50% in one year, the credibility is maximum (equal to 1). This means that financial market experts believe that the fiscal effort made by the government will be more than enough to make debt sustainable. If the primary surplus expectation is below the required surplus for a 70% debt, credibility is zero, meaning financial market experts expect that the government is not able to reach a primary surplus to make debt sustainable. In turn, if the primary surplus expectation is between these values (ps^{ideal} and ps^{toler}), we use the formula expressed in (1).

In addition to using the reference values of 50% (lower limit) and 70% (upper limit) for the public debt, we calculate a second indicator with more flexible parameters – 60% (lower limit) and 80% (upper limit) for the public debt – in order to avoid possible criticism concerning the definition of the limits.

Figure 1 shows the behavior of the fiscal credibility index (*FCI*), with the two possible tolerance intervals for the debt.

Figure 1
Fiscal Credibility FCI^1 and FCI^2 (2003M01to 2016M07)



The first index on the left (FCI^1), where the ideal debt ratio is 50% and the maximum tolerated debt is 70%, and the second index on the right (FCI^2), where the ideal debt ratio is 60%, and the maximum tolerated debt is 80%. Observing the FCI^1, we note that there is a period of credibility building, which occurs between early 2005 until 2009, when the index reaches 0.7. On the other hand, when we observe the FCI^2, there is also a period of credibility building, but it starts earlier and reaches its maximum value (equal to 1) at the end of 2008. Anyway, both indexes show similar statistical behavior. With the subprime crisis, both indexes have a fall (FCI^1 presents a higher drop), but after overcoming the crisis, both increase again. In 2015, due to the fiscal crisis that affected the country (which resulted in a downgrade of sovereign ratings and loss of the investment grade by the 3 largest credit rating agencies – S&P, Moody's and Fitch), fiscal credibility drops abruptly, evidencing the loss of confidence in the government's ability to make gross debt sustainable.

4. Data and methodology

The data comprise the period between January 2003 and July 2016. The macroeconomic and market expectations series used to build the variables were obtained from the CBB. The main variables of our study are the disagreement in expectation about inflation, the inflation rate, and the fiscal credibility.

The *fiscal credibility* (FCI) variable is described in section 2.1 and captures the expectations of financial market experts about the government's commitment to generate primary surpluses capable of making gross debt sustainable at the end of 12 months. It is named FCI^1 when the tolerance interval for the debt is set between 50 and 70% of GDP, and FCI^2 when the tolerance interval for the debt is set between 60 and 80% of GDP.

The *disagreement in expectation about inflation* ($D_t\pi^n$) is based on Montes *et al*. (2016) and Oliveira and Curi (2016). The series for the disagreement in expectations about inflation is built upon a survey of expectations provided by the CBB.[6] In order to better understand its construction, it is worth presenting the following notation: t is the instant of time the projection is made[7], i identifies the agent who releases the forecast ($i \in I$, where I is the set of agents surveyed[8]), π is the inflation rate, so, $E_{i,t}\pi^{a+j}$ represents the projection (expectation) that the *i-th* agent release at time t about the value the inflation rate will take in the end of year $(a+j)$ [9]. In turn, $E_t^{min}(\pi)^{a+j}=min(E_{i,t}(\pi)^{a+j},\ i \in I)$ and denotes the minimum value of the distribution, while, $E_t^{max}(\pi)^{a+j}=max(E_{i,t}(\pi)^{a+j},\ i \in I)$ denotes its maximum value.

The measure of disagreement that we use throughout this paper is $D_t\,\pi^{a+j}$,[10] computed by the range of the distribution defined as:

$$D_t\,\pi^{a+j} = E_t^{max}(\pi)^{a+j} - E_t^{min}(\pi)^{a+j} \qquad (4)$$

Forecasts such as $E_{i,t}\pi^{a+j}$ are known as fixed event ones because the forecasting horizon varies with the passage of time. Indeed, the prospective period of forecasts made at t for the value that the variable π will take in the end of the year $a + j$ decrease as t progress within a, the year in which expectations are made.[11] This pattern of decreasing forecasting horizons as t advances through the year brings about a seasonal behavior in disagreement measures based on fixed event forecasts because expectations dispersion tends to decrease as the forecasting horizon shrinks.[12]

[6] The CBB releases the maximum, minimum, median, mean, coefficient of variation and standard deviation statistics of the distribution of the daily forecast for the net public debt (ND) in fixed event for the end of the current year and four years ahead.

[7] This instant is characterized by a specific date, namely, a day d, a month m and a year a.

[8] The number of agents in I is I.

[9] $j=0$: current year; $j=1$: next year immediately after the current year; $j=2$: two years after the current year; $j=3$: three years after the current year; $j=4$: four years after the current year.

[10] Like Oliveira and Curi (2016), we use this measure of disagreement throughout the paper, as other measures require the knowledge of the entire distribution of expectations. Such information is not provided by the CBB. We are aware of the fact that papers on disagreement often use other measures, such as the inter-quartile range and Kulback-Liebler divergence measure. These two options, though, cannot be calculated without the entire distribution of individual forecasts. The standard deviation – $SD(\pi)$ – and the coefficient of variation – $CV(\pi)$ – are also frequently used as measures of disagreement. Nevertheless, although these alternative measures are released, the interpolation of the $SD(\pi)$ and $CV(\pi)$ to transform in fixed horizon is not appropriate for the analysis – see, for instance, Oliveira and Curi (2016). Thus, it is not possible to re-estimate the equations with such measures.

[11] An example could help to clarify this issue. Suppose that an agent, in March 2000, computes his expectation about the value of the inflation rate in the end of 2000. In this case we can say that the time horizon of the forecast is 10 months because the first 2 months of 2000 have already passed and inflation figures for January and February are known. By the same line of reasoning, when this agent computes his inflation expectation in September 2000 about the value of the inflation rate at the closing of 2000, the time horizon of his forecast decreases to only 4 months.

[12] Indeed, the disagreement measure observed in March 2000 for the value that the inflation rate will take in the end of 2000 tends to be greater than the disagreement measure observed in September 2000 for the value that the same variable will take at the closing of 2000. The divergence measure tends to increase again in March 2001, since the current year becomes 2001 and the time horizon of the forecast becomes 9 months.

It is to avoid this seasonal behavior inherent to disagreement measures based on fixed event forecasts that most articles in the literature (e.g., Mankiw *et al.* (2003); Patton and Timmermann (2010); Dovern *et al.* (2012)) recur to fixed horizon forecasts, in which the forecasting horizon does not vary with the passage of time. As proposed in Dovern *et al.* (2012), the conversion of fixed event forecasts into fixed horizon ones is accomplished by applying the formula below:

$$E_t X^{12(j+1)} = \frac{12-(m-1)}{12} E_t X^{a+j} + \frac{m-1}{12} E_t X^{a+j+1}, \quad j = 0,1,2,3,\text{K} \qquad (5)$$

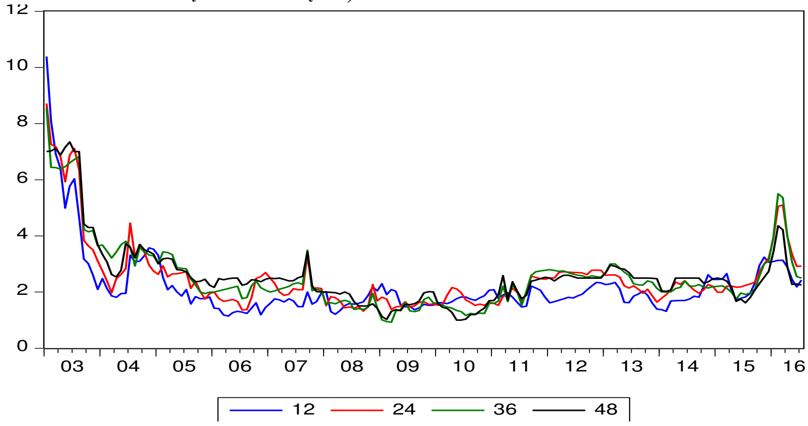
Where m represents the month in which the projection is made (or the month containing period t) and $E_t X^{12(j+1)}$ denotes the average of agents' expectations about the value that the variable X (which is π) will take at the end of the next $12(j+1)$ months. The same formula is used to interpolate minimum and maximum projections in order to calculate the disagreement in expectation (as well the average expectations). In the end of the process, we derive a term structure of disagreement in expectations, which is comprised by the "vertices" $D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$, $D_t\pi^{48}$. As the CBB discloses forecasts for the current and the next four years, the formula above can be applied by taking j = 0,1,2,3,4. Therefore, we can always interpolate forecasts for the fixed time horizons of 12, 24, 36 and 48 months.

The procedure described above is performed daily, allowing us to study the term structures of disagreement for each business day. Time series comprised of daily observations are converted to the monthly frequency by monthly averages. The conversion of fixed event forecasts into fixed horizon and the monthly frequency were applied to compute the disagreement in expectations about inflation ($D_t\pi^m$).

Figure 2 shows the behavior of the disagreement in expectations about inflation for the different forecasting horizons, $D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$ e $D_t\pi^{48}$, between January 2003 and July 2016. The four series follow similar paths. One can observe that high levels of disagreement in expectations about inflation occurred at the beginning of 2003. This period coincides with the so-called "Lula effect", in which the presidential elections of 2002 generated great uncertainty with the possibility of victory of the candidate Luiz Inácio Lula da Silva. However, after Lula's victory and with his demonstration of continuing with the policies previously adopted, the disagreement reduces. Between 2004 and 2015, the disagreement ranged from 1 to 4, indicating that it was a period of greater convergence of expectations. From 2015, we observe an increase in disagreement, period that coincides with the deepening of the Brazilian fiscal crisis and with credibility deterioration.

Figure 2

Disagreement in expectations about inflation for different forecasting horizons ($D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$ and $D_t\pi^{48}$) - 2003M01to 2016M07



Following Montes et al. (2016) and Oliveira and Curi (2016), after computing the four maturities of the disagreement in expectations about inflation ($D_t\pi^m$), we also extract the first principal component of the series with four maturities ($D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$ and $D_t\pi^{48}$). The first principal component of the series is a good proxy for their common trend. The application of this technique has a long tradition in the study of conventional yield curves (Litterman and Scheinkmann, 1991), which justifies its application to the term structures that we study here. As the monthly averages, it also allows filtering out erratic shifts on a given disagreement measure that do not reflect upon the others. Such movements can be regarded as outliers, thus, they should be ignored from the economic point of view. Hence, extracting the first principal component of the series, we obtain the series of the general level of disagreement in expectations about inflation ($D_t\pi^L$), which we use in our analysis. Table B.1 in the Appendix presents the principal component analysis. One can see that the first principal component is the most appropriate (the proportion of the first principal component is approximately 0.93).

Table 1 presents the correlation between the main variables of the study. We observe that the correlations between fiscal credibility and the disagreements are negative and tend to increase as the forecasting horizon increases. Moreover, the correlations are greater for the FCI^2. Regarding the correlations between fiscal credibility and inflation, we observe negative correlations.

Table 1

Correlation between variables

	FCI^1	FCI^2
$D_t\pi^{12}$	-0.47	-0.63
$D_t\pi^{24}$	-0.51	-0.70
$D_t\pi^{36}$	-0.58	-0.77
$D_t\pi^{48}$	-0.57	-0.76
$D_t\pi^L$	-0.55	-0.74

In terms of control variables, we follow the literature and make use of the following variables described below.

Inflation rate (π_t): The inflation rate is used as an explanatory variable of the disagreement in expectations about inflation. The series is the inflation accumulated over the next 12 months measured by the Consumer Price Index (IPCA) (obtained from the CBB website – code 13522).

Inflation volatility ($vol(\pi_t)$): Based on Montes et al. (2016) and Oliveira and Curi (2016), this variable is obtained as follows: $vol(\pi_t) = (\pi_t - \pi_{t-1})^2$.

Output gap (gap_t): this variable corresponds to the difference between the index of economic activity obtained from the CBB (code 24363) and its long-run trend obtained through the Hodrick-Prescott filter.

Dummy subprime (d^s_t): following Montes et al. (2016) and Oliveira and Curi (2016), this dummy variable captures the effect of the Subprime Crisis on the Brazilian economy. The variable assumes value 1 from September 2008 to December 2009, and zero otherwise.

The main goal of the study is to analyze the effect of fiscal credibility on the disagreement in expectations about inflation for different maturities (12, 24, 36 and 48 months ahead), and also on the general level of the disagreement in expectations about inflation ($D_t\pi^L$). Thus, in order to verify the effect of fiscal credibility on the disagreement in expectations about inflation, we estimate equation (6) for the different maturities (12, 24, 36 and 48 months ahead) and for the general level $D_t\pi^L$. Regarding control variables, we followed Mankiw et al. (2003), Montes et al. (2016) and Oliveira and Curi (2016). Hence, in addition to fiscal credibility, the specification also uses the inflation rate, inflation volatility, the output gap and the dummy variable for the subprime crisis.

$$D_t\pi^m = \beta_0 + \beta_1 \pi_t + \beta_2 vol(\pi_t) + \beta_3\ gap_t + \beta_4 d^s{}_t + \beta_5 FCI^x{}_t + \xi_t \qquad (6)$$

where, m = 12, 24, 36, 48 months ahead, and "L" for the general level of the disagreement in expectations about inflation. The term ξ_t represents the error term (white noise). In turn, x is equal to 1 or 2, i.e., FCI^1 or FCI^2. Thus, five models are estimated considering FCI^1, one to each different maturity and also for $D_t\pi^L$, and then, five other models are estimated considering FCI^2. Therefore, each model has as dependent variable one of the four different maturities of the disagreement and also the general level of the disagreement ($D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$, $D_t\pi^{48}$ and $D_t\pi^L$). In this sense, our study differs from other existing studies (e.g., Montes et al. 2016; Oliveira and Curi 2016) once we analyze the effect of fiscal credibility on the disagreement in expectations about inflation, and also because the estimations are made for all the maturities and not only for the general level of the disagreement.

In order to obtain robust evidences, we provide estimates through different methods: ordinary least squares (OLS), one-step generalized method of moments (GMM) with Newey-West covariance matrix (Newey and West, 1987), and two-step generalized method of moments (GMM 2S) with Windmeijer covariance matrix. GMM is used to deal with endogeneity and identification problems (Wooldridge, 2001; Hall, 2005). Besides, GMM presents robust estimators even in the presence of serial autocorrelation and heteroskedasticity of unknown form, or non-linearity, which is typical in macroeconomic time series models (Hansen, 1982).[13] We follow the methodology of Johnston (1984) to select the instruments on GMM estimation, i.e., the instruments were dated to the period t-1 or earlier to assure the exogeneity.[14] Cragg (1983) point out that overidentification has an important role in the selection of instrumental variables to improve the efficiency of the estimators. Hence, a standard J-test was performed with the objective of testing this property for the validity of the overidentifying restrictions, i.e., the J-statistic indicates whether the orthogonality condition is satisfied. The two-step GMM estimations use Windmeijer (2005) correction to address small-sample downward biases on standard errors.

Before proceeding with the analysis, we made the following unit root tests: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The tests are reported in table B.2 in the Appendix B. The results show that all series are stationary.

5. Results

Tables 2 and 3 present the results of the estimations of equation (6). The results reported in table 2 are related to the effect of fiscal credibility measured by FCI^1, while the results reported in table 3 are related to the effect of fiscal credibility measured by FCI^2.

In relation to the effect of the main variable of the study, the results reported in tables 2 and 3 indicate that an increase in fiscal credibility reduces the disagreement in expectations about inflation for all maturities. All estimated coefficients for FCI^1 and FCI^2 are negative, and most of them present statistical significance. It is worth noting that the effect of fiscal

[13] As Wooldridge (2001, p.95) points out: "*to obtain a more efficient estimator than two-stage least squares (or ordinary least squares), one must have overriding restrictions*".

[14] In addition to the lagged independent variables used as instrumental variables in the GMM, we also use the expected exchange rate for the next 12 months, the primary surplus, the Credit Default Swap (CDS) and the country risk measured by the EMBI.

credibility on the disagreement in expectations about inflation is stronger for longer maturities ($D_t\pi^{36}$ and $D_t\pi^{48}$) – in these maturities the coefficients present greater magnitudes. In general, the estimates point out that when fiscal credibility is higher (i.e., the level of confidence of financial markets experts regarding public debt stability is higher), the uncertainty about inflation in the future is lower.

With respect to the control variables, tables 2 and 3 indicate that the results for the effects of the inflation rate, inflation volatility and the output gap are in line with the findings presented by Mankiw et al. (2003), Montes et al. (2016) and Oliveira and Curi (2016). In all specifications, both inflation and inflation volatility have positive signals, and most of the coefficients are statistically significant. In turn, we find a negative relation between the disagreement in expectations about inflation and the GAP. This evidence is in line with the results found in Dovern et al. (2012), Oliveira and Curi (2016) and Montes et al. (2016), which demonstrate that a more robust economic activity has a negative effect on the dispersion of expectations in relation to future inflation.

Table 2

OLS, GMM and GMM2S estimates of the effect of fiscal credibility (*FCI^1*) on the disagreements in expectations about inflation ($D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$ e $D_t\pi^{48}$ e $D_t\pi^L$)

$D_t\pi^{12}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^1	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N. instr.
OLS	**0.19**	**0.32*****	**0.08**	**-0.01**	**0.09**	**-0.41**	0.65	77.06	0.00			
	(0.45)	(0.05)	(0.25)	(0.00)	(0.11)	(0.37)						
	[0.42]	[5.56]	[0.35]	[-1.18]	[0.82]	[-1.08]						
GMM	**0.82*****	**0.20*****	**0.03**	**-0.02*****	**0.18**	**-0.34****	0.51			10.37	0.85	22
	(0.18)	(0.03)	(0.05)	(0.00)	(0.15)	(0.16)						
	[4.42]	[6.32]	[0.60]	[-3.09]	[1.21]	[-2.07]						
GMM2S	**1.11*****	**0.15*****	**0.00**	**-0.02****	**0.25**	**-0.49****	0.44			11.49	0.90	25
	(0.22)	(0.03)	(0.06)	(0.00)	(0.17)	(0.228)						
	[4.92]	[4.68]	[0.10]	[-2.26]	[1.47]	[-2.14]						
$D_t\pi^{24}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^1	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**0.61**	**0.31*****	**0.08**	**-0.01**	**-0.38***	**-0.48**	0.67	65.59	0.00			
	(0.44)	(0.05)	(0.16)	(0.01)	(0.19)	(0.41)						
	[1.36]	[5.39]	[0.51]	[-0.97]	[-1.94]	[-1.17]						
GMM	**1.95*****	**0.08*****	**0.08***	**-0.02***	**-0.41***	**-0.58*****	0.36			10.87	0.45	17
	(0.20)	(0.03)	(0.04)	(0.01)	(0.24)	(0.20)						
	[9.75]	[2.92]	[1.94]	[-1.66]	[-1.6]	[-2.89]						
GMM2S	**2.11*****	**0.06***	**0.08***	**-0.03***	**-0.56*****	**-0.64****	0.31			7.05	0.9	19
	(0.27)	(0.03)	(0.04)	(0.02)	(0.17)	(0.29)						
	[7.76]	[1.96]	[1.71]	[-1.70]	[-3.21]	[-2.19]						
$D_t\pi^{36}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^1	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**1.06****	**0.27*****	**0.15**	**-0.01**	**-0.57****	**-0.93****	0.69	70.50	0.00			
	(0.41)	(0.05)	(0.15)	(0.01)	(0.24)	(0.45)						
	[2.57]	[5.42]	[1.00]	[-0.89]	[-2.38]	[-2.06]						
GMM	**2.05*****	**0.09****	**0.15****	**-0.06***	**-1.27*****	**-0.64***	0.32			19.56	0.49	26
	(0.32)	(0.04)	(0.06)	(0.03)	(0.32)	(0.38)						
	[6.27]	[2.44]	[2.42]	[-1.71]	[-3.89]	[-1.70]						
GMM2S	**2.21*****	**0.08***	**0.19***	**-0.03***	**-1.00*****	**-0.85***	0.38			20.82	0.87	35
	(0.36)	(0.04)	(0.10)	(0.02)	(0.35)	(0.50)						
	[6.04]	[1.68]	[1.82]	[-1.79]	[-2.85]	[-1.70]						
$D_t\pi^{48}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^1	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**1.06****	**0.28*****	**0.09**	**-0.00**	**-0.50***	**-0.90****	0.67	65.71	0.00			
	(0.45)	(0.06)	(0.10)	(0.01)	(0.27)	(0.35)						
	[2.35]	[4.29]	[0.89]	[-0.38]	[-1.82]	[-2.53]						
GMM	**1.95*****	**0.13*****	**0.07***	**-0.03***	**-1.26*****	**-0.57*****	0.38			15.84	0.54	23
	(0.25)	(0.03)	(0.03)	(0.02)	(0.25)	(0.21)						
	[7.81]	[3.41]	[1.84]	[-1.65]	[-4.91]	[-2.66]						
GMM2S	**2.11*****	**0.11****	**0.07***	**-0.03***	**-1.16*****	**-0.68*****	0.36			17.92	0.91	33
	(0.26)	(0.04)	(0.04)	(0.02)	(0.32)	(0.25)						
	[7.87]	[2.57]	[1.74]	[-1.68]	[-3.60]	[-2.68]						
$D_t\pi^L$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^1	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**-2.81*****	**0.48*****	**0.17**	**-0.01**	**-0.56***	**-1.11***	0.71	79.0	0.00			
	(0.66)	(0.08)	(0.27)	(0.01)	(0.30)	(0.58)						
	[-4.25]	[5.50]	[0.64]	[-0.92]	[-1.81]	[-1.91]						
GMM	**-0.96*****	**0.15*****	**0.17****	**-0.04*****	**-1.32*****	**-0.83*****	0.40			18.93	0.65	28
	(0.29)	(0.04)	(0.08)	(0.01)	(0.24)	(0.31)						
	[-3.28]	[3.52]	[1.98]	[-2.64]	[-5.38]	[-2.63]						
GMM2S	**-0.93****	**0.16*****	**0.11***	**-0.05****	**-1.25*****	**-0.99*****	0.38			17.61	0.78	29
	(0.36)	(0.05)	(0.06)	(0.02)	(0.32)	(0.37)						
	[-2.58]	[3.07]	[1.70]	[-2.30]	[-3.8]	[-2.62]						

Notes: Marginal Significance Levels: *** denotes 0.01, ** denotes 0.05 and * denotes 0.1. Coefficients are in bold, standard errors in parentheses, and *t*-statistics in square brackets. Regarding OLS estimates, due to the problems of autocorrelation and heteroskedasticity, the reported t-statistics in the OLS estimates are based on the estimator of Newey and West (1987).

Table 3

OLS, GMM and GMM2S estimates of the effect of fiscal credibility (*FCI^2*) on the disagreements in expectations about inflation ($D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$ e $D_t\pi^{48}$ e $D_t\pi^{L}$)

$D_t\pi^{12}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^2	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N. instr.
OLS	**0.56**	**0.30*****	**0.08**	**-0.01**	**0.07**	**-0.53**	0.65	59.41	0.00			
	(0.78)	(0.06)	(0.25)	(0.00)	(0.10)	(0.48)						
	[0.71]	[4.40]	[0.31]	[-1.10]	[0.76]	[-1.08]						
GMM	**1.04*****	**0.19*****	**0.00**	**-0.01****	**0.18**	**-0.41****	0.54			9.88	0.83	21
	(0.23)	(0.02)	(0.04)	(0.00)	(0.13)	(0.19)						
	[4.38]	[8.10]	[0.10]	[-1.83]	[1.37]	[-2.14]						
GMM2S	**1.22*****	**0.16*****	**0.012**	**-0.01****	**0.149**	**-0.42****	0.47			12.26	0.93	27
	(0.26)	(0.03)	(0.05)	(0.00)	(0.19)	(0.21)						
	[4.60]	[5.42]	[0.22]	[-2.03]	[0.76]	[-2.03]						
$D_t\pi^{24}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^2	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**1.61****	**0.26*****	**0.05**	**-0.01**	**-0.34****	**-1.10****	0.69	71.06	0.00			
	(0.70)	(0.06)	(0.16)	(0.01)	(0.16)	(0.47)						
	[2.27]	[4.27]	[0.29]	[-0.85]	[-2.01]	[-2.34]						
GMM	**2.38*****	**0.06****	**0.08***	**-0.01***	**-0.46*****	**-0.70*****	0.39			7.35	0.98	23
	(0.18)	(0.02)	(0.04)	(0.01)	(0.14)	(0.17)						
	[12.6]	[2.39]	[1.91]	[-1.68]	[-3.23]	[-4.01]						
GMM2S	**2.41*****	**0.05*****	**0.07***	**-0.02****	**-0.55*****	**-0.65****	0.38			7.7	0.99	25
	(0.25)	(0.02)	(0.04)	(0.01)	(0.15)	(0.25)						
	[9.54]	[2.79]	[1.71]	[-2.10]	[-3.64]	[-2.58]						
$D_t\pi^{36}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^2	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**2.57*****	**0.21*****	**0.10**	**-0.00**	**-0.54*****	**-1.77*****	0.73	84.30	0.00			
	(0.61)	(0.05)	(0.15)	(0.01)	(0.20)	(0.45)						
	[4.16]	[4.08]	[0.68]	[-0.68]	[-2.61]	[-3.91]						
GMM	**2.13*****	**0.09****	**0.16****	**-0.05***	**-1.15*****	**-0.82****	0.37			19.72	0.48	26
	(0.32)	(0.04)	(0.06)	(0.03)	(0.29)	(0.39)						
	[6.58]	[2.18]	[2.48]	[-1.66]	[-3.95]	[-2.08]						
GMM2S	**2.14*****	**0.09***	**0.18***	**-0.03***	**-1.27*****	**-0.72***	0.35			21.39	0.90	27
	(0.33)	(0.05)	(0.10)	(0.02)	(0.37)	(0.39)						
	[6.34]	[1.75]	[1.71]	[-1.73]	[-3.40]	[-1.83]						
$D_t\pi^{48}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^2	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**2.56*****	**0.22*****	**0.04**	**-0.00**	**-0.46***	**-1.74*****	0.71	78.03	0.00			
	(0.59)	(0.06)	(0.10)	(0.01)	(0.24)	(0.40)						
	[4.28]	[3.48]	[0.44]	[-0.13]	[-1.92]	[-4.28]						
GMM	**2.94*****	**0.07***	**0.10****	**-0.04****	**-1.27*****	**-1.01*****	0.39			13.84	0.68	23
	(0.31)	(0.03)	(0.04)	(0.02)	(0.22)	(0.23)						
	[9.40]	[1.96]	[2.25]	[-1.99]	[-5.62]	[-4.33]						
GMM2S	**2.80*****	**0.08***	**0.09***	**-0.02***	**-1.08*****	**-0.92*****	0.42			19.51	0.81	32
	(0.40)	(0.04)	(0.05)	(0.01)	(0.32)	(0.33)						
	[7.00]	[1.70]	[1.67]	[-1.87]	[-3.39]	[-2.76]						
$D_t\pi^{L}$	C	π_t	$vol(\pi_t)$	gap_t	d^s_t	FCI_t^2	Adjust. R²	F stat	F stat (Prob)	J stat	J stat (Prob)	N° instr.
OLS	**-1.02**	**0.41*****	**0.11**	**-0.01**	**-0.51****	**-2.10*****	0.74	87.7	0.00			
	(1.01)	(0.09)	(0.27)	(0.01)	(0.26)	(0.64)						
	[-1.00]	[4.32]	[0.42]	[-0.75]	[-1.97]	[-3.25]						
GMM	**0.12**	**0.12*****	**0.11***	**-0.03****	**-1.24*****	**-1.42*****	0.47			18.99	0.65	28
	(0.39)	(0.04)	(0.07)	(0.01)	(0.23)	(0.29)						
	[0.31]	[2.94]	[1.67]	[-2.08]	[-5.31]	[-4.80]						
GMM2S	**0.17**	**0.10***	**0.12***	**-0.08****	**-1.68*****	**-1.21*****	0.33			18.12	0.75	29
	(0.53)	(0.05)	(0.07)	(0.03)	(0.47)	(0.41)						
	[0.32]	[1.95]	[1.66]	[-2.44]	[-3.58]	[-2.92]						

Notes: Marginal Significance Levels: *** denotes 0.01, ** denotes 0.05 and * denotes 0.1. Coefficients are in bold, standard errors in parentheses, and *t*-statistics in square brackets. Regarding OLS estimates, due to the problems of autocorrelation and heteroskedasticity, the reported t-statistics in the OLS estimates are based on the estimator of Newey and West (1987).

Once the principal component analysis may deteriorate the interpretability of the model results, we checked the robustness of the results using filtered series of the disagreements in expectations about inflation for different maturities. The results for the effect of fiscal credibility (*FCI^1 and FCI^2*) on the disagreements remain the same. The results are available upon request.

6. Robustness analysis

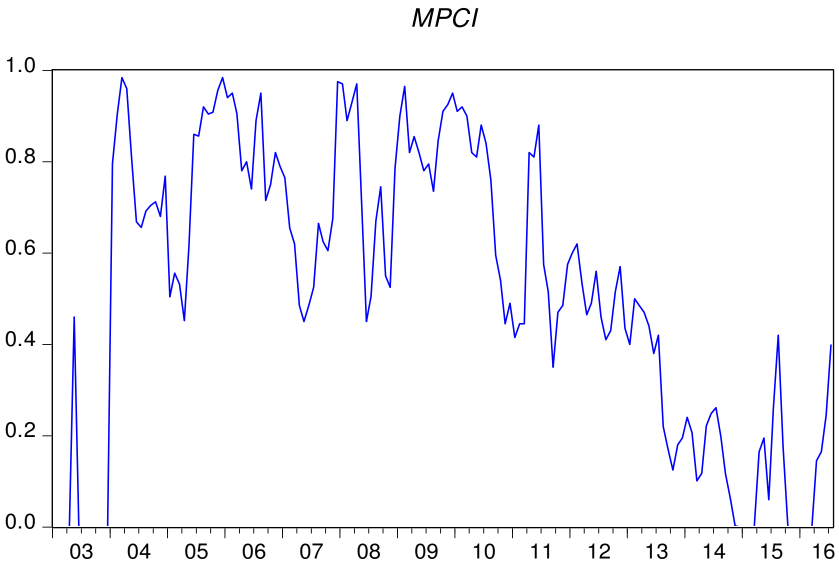
In order to provide robust results and to avoid the omitted-variable bias, we add in the analysis the effect of monetary policy credibility. In this sense, following the literature (e.g., Oliveira and Curi, 2016), we use the monetary policy credibility index (*MPCI*) proposed by de Mendonça (2007). The *MPCI* has a value equal to 1 when the annual expected inflation ($E[\pi]$) is equal to the target (π^T) and decreases in a linear way while inflationary expectation deviates from the announced target. Therefore, the credibility index shows a value between 0 and 1 strictly if the expected inflation is situated between the maximum and minimum limits (π^*) established for each year and assumes a value equal to 0 when the expected inflation exceeds one of these limits. The idea of the index is to capture the degree of anchorage in a normalized index (between 0 and 1). In this sense, when the expected inflation is above the inflation target (and at the same time it did not exceed the upper limit of the band), we use, in the denominator, the difference between the maximum limit (π^*_{tMAX}) and the inflation target (π^T). But, when the inflation expectation is below the inflation target (and at the same time it did not exceed the lower limit of the band), we use, in the denominator, the difference between the minimum limit (π^*_{tMIN}) and the inflation target (π^T). The index uses inflation expectations obtained from the CBB, as well as the inflation target and the tolerance bands defined by the monetary authority.

$$MPCI = \begin{cases} 1 & if\ E[\pi] = \pi^T_t \\ 1 - \frac{1}{\pi^*_t - \pi^T_t}\left[E[\pi] - \pi^T_t\right] & if\ \pi^*_{tMIN} < E[\pi] < \pi^*_{tMAX} \\ 0 & if\ E(\pi) \geq \pi^*_{tMAX}\ or\ E[\pi] \leq \pi^*_{tMIN} \end{cases} \quad (7)$$

Figure 3 presents the graph for the *MPCI*.

Figure 3

Monetary policy credibility index (MPCI) (2003M01to 2016M07)



We estimate equation (8) below for the different maturities. Due to possible endogeneity problems, we perform estimations using one-step generalized method of moments (GMM) with the Newey-West (HAC) matrix. It is important to note that since the main fiscal credibility index is FCI^1, we use this index in the regressions.

$$D_t\pi^m = \gamma_0 + \gamma_1 \pi_t + \gamma_2 vol(\pi_t) + \gamma_3\, gap_t + \gamma_4 d^s_t + \gamma_5 FCI^1_t + \gamma_6 MPCI_t + \zeta_t \quad (8)$$

where, m = 12, 24, 36, 48 months ahead, and "L" for the general level of the disagreement in expectations about inflation. The term ζ_t represents the error term (white noise).

Table 4 below presents the results. In general, the findings corroborate the results previously reported for the control variables.

Regarding the main variable of the study, all estimated coefficients for FCI^1 have negative signals and statistical significance. Thus, an increase in fiscal credibility reduces the disagreement in expectations about inflation for all maturities. Once again, the effect of fiscal credibility on the disagreement in expectations about inflation is stronger for longer maturities ($D_t\pi^{36}$ and $D_t\pi^{48}$).

In turn, although all estimated coefficients for the effect of monetary policy credibility present negative signals, statistical significance is found only in the estimates for the disagreement in expectations about inflation with shorter maturities ($D_t\pi^{12}$ and $D_t\pi^{24}$).

Table 4

GMM estimates of the effect of fiscal credibility (FCI^1) and monetary policy credibility ($MPCI$) on the disagreements in expectations about inflation ($D_t\pi^{12}$, $D_t\pi^{24}$, $D_t\pi^{36}$ e $D_t\pi^{48}$ e $D_t\pi^L$)

	GMM				
Variables	$D_t\pi^{12}$	$D_t\pi^{24}$	$D_t\pi^{36}$	$D_t\pi^{48}$	$D_t\pi^L$
C	**2.19** ***	**2.30** ***	**2.28** ***	**2.40** ***	**-0.45**
	(0.37)	(0.25)	(0.35)	(0.42)	(1.05)
	[5.83]	[9.06]	[6.40]	[5.67]	[-0.43]
π_t	**0.09** ***	**0.04** *	**0.07** **	**0.11** ***	**0.19** ***
	(0.03)	(0.02)	(0.03)	(0.04)	(0.07)
	[2.74]	[1.83]	[2.22]	[2.65]	[2.68]
$vol(\pi_t)$	**0.07**	**0.06**	**0.16** ***	**0.07** **	**0.001**
	(0.07)	(0.09)	(0.03)	(0.03)	(0.06)
	[0.89]	[0.66]	4.420907	[2.12]	[0.02]
gap_t	**-0.02** ***	**-0.02** ***	**0.003**	**-0.01**	**-0.04** **
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)
	[-4.24]	[-4.19]	[0.24]	[-1.04]	[-2.45]
d^s_t	**0.18** *	**-0.56** ***	**-0.86** ***	**-0.92** ***	**-0.91** **
	(0.11)	(0.14)	(0.18)	(0.24)	(0.44)
	[1.71]	[-3.85]	[-4.56]	[-3.74]	[-2.05]
FCI_t^1	**-0.85** ***	**-0.63** ***	**-0.88** ***	**-0.92** ***	**-1.49** **
	(0.24)	(0.21)	(0.32)	(0.26)	(0.74)
	[-3.49]	[-2.90]	[-2.74]	[-3.47]	[-1.99]
$MPCI_t$	**-0.87** ***	**-0.26** *	**-0.14**	**-0.34**	**-0.82**
	(0.23)	(0.15)	(0.23)	(0.27)	(0.74)
	[-3.66]	[-1.71]	[-0.59]	[-1.28]	[-1.11]
Adjust. R^2	0.36	0.24	0.43	0.44	0.52
J stat	17.43	23.31	21.52	17.32	16.2
J stat (Prob)	0.86	0.89	0.84	0.69	0.31
N° instr.	32	40	36	28	21

Notes: Marginal Significance Levels: *** denotes 0.01, ** denotes 0.05 and * denotes 0.1. Coefficients are in bold, standard errors in parentheses, and *t*-statistics in square brackets.

7. Conclusion

One of the tasks of the inflation targeting regime is to guide expectations towards the inflation target. But to succeed in this task, monetary and fiscal policies must be coordinated and the development of credibility cannot be ignored, since credibility is an important aspect for the process of inflation expectation formation. Some studies have addressed the effect of monetary policy credibility on the process of inflation expectation formation, and also on the disagreement in expectations about inflation. However, so far, there are no studies analyzing the effect of fiscal credibility on the disagreement in expectations about inflation. In this sense, our study contributes to the literature since it analyzes, in an unprecedented way, the effect of fiscal credibility on the disagreement in expectations about inflation.

Besides the analysis for the effect of fiscal credibility on the disagreement in expectations about inflation, another contribution of the study was the development of a new fiscal credibility index using data of primary surplus expectations. Analyzing the behavior of the index over time, we observed that Brazil presented three phases of fiscal credibility between 2003 and 2016: a credibility building phase (between 2003 and 2008), another phase of higher credibility (even after a downturn due to the subprime crisis), and another one of severe deterioration of credibility (between 2014 and 2016 – period that coincides with the crisis of fiscal solvency of the country).

Regarding the results of the estimates, we observe that the increase of fiscal credibility reduces the disagreement in expectations about inflation. In addition, the results suggest fiscal credibility is an important aspect for inflation control, and also to guiding inflation expectations.

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Appendix A

The primary result required to bring debt to an optimal level

The extent to which governments raise primary balances in response to increases in public debt is a key parameter in public debt sustainability assessments. This can be seen, for example, by the equation that describes the government's budget constraint obtained from Celasun et al. (2007). The equation points that the stock of debt at the end of year *t*, denoted by D_t, equals debt outstanding at the end of the previous period (D_{t-1}), minus the overall government budget surplus in period *t* (PS_t – the primary surplus obtained in time t). The term $i_t.D_t$ corresponds to the nominal interest payments on debt, where i_t is the nominal interest rate paid on public debt in period t. Thus,

$$D_t = D_{t-1}\,(1+i_t) - PS_t \qquad (1.A)$$

In order to capture the effect of the output growth on the debt, the terms of equation (1.A) are expressed in relation to the GDP. Thus:

$$\frac{D_t}{Y_t} = \frac{Y_{t-1}}{Y_t}\frac{D_{t-1}(1+i_t)}{Y_{t-1}} - \frac{PS_t}{Y_t} \qquad (2.A)$$

Where, Y_t is the nominal GDP.

In turn, denoting y_t as the nominal GDP growth rate, ps_t and d_t are, respectively, the surplus and the debt in relation to the GDP, and once the term $\frac{Y_t}{Y_{t-1}}$ can be rewritten as $(1+y_t)$, we obtain,

$$d_t = \frac{d_{t-1}\,(1+i_t)}{(1+y_t)} - ps_t \qquad (3.A)$$

Deflating the nominal interest rate and the term related to the output growth by the inflation rate (π), we have $(1+y_t) = (1+g_t)(1+\pi_t)$, and $(1+i_t) = (1+r_t)(1+\pi_t)$, where g_t corresponds to the real output growth rate, and r_t corresponds to the real interest rate. Thus, equation (3.A) can be rewritten as,

$$d_t = d_{t-1}\frac{(1+r_t)(1+\pi_t)}{(1+g_t)(1+\pi_t)} - ps_t\text{, and , therefore,}$$

$$d_t = d_{t-1}\frac{(1+r_t)}{(1+g_t)} - ps_t \qquad (4.A)$$

Subtracting d_{t-1} on both sides of equation (4.A), we have:

$$\Delta d_t = d_{t-1}\frac{(r_t-g_t)}{(1+g_t)} - ps_t \qquad (5.A)$$

Some studies seek an equation that makes the debt stable (e.g., Ley, 2010). In this case, the debt of the current period should be equal to the debt of the previous period (t-1). In this sense, $\Delta d_t = d_t - d_{t-1} = 0$, and, as a consequence, the surplus that would stabilize the debt would be obtained by $ps_t = d_{t-1}\frac{(r_t-g_t)}{(1+g_t)}$.

However, a primary balance that just stabilizes the debt does not impose a strong constraint on governments able to issue debt. For this reason, equations (2) and (3) of section 3.2 have been derived taking into account a surplus that brings the debt to a sustainable level – and not only the result that stabilizes the debt. Wilcox (1989) points out that any pattern of deficit would be sustainable if it were possible for the government to finance itself indefinitely, which would increase its debt.

Let X_{t+1} be the public debt target (as a percentage of GDP) for a given period $t+1$. Then, in order to know the required fiscal adjustment to bring the debt (d_t) to X_{t+1}, based on equation (5.A), we have,

$$\Delta d_{t+1} = X_{t+1} - d_t = d_t \frac{(r_{t+1} - g_{t+1})}{(1+g_{t+1})} - ps_{t+1} \tag{6.A}$$

Thus, the required fiscal surplus to bring debt to X_{t+1} is:

$$ps_{t+1} = d_t \frac{(r_{t+1} - g_{t+1})}{(1+g_{t+1})} - (X_{t+1} - d_t) \tag{7.A}$$

Once the target is set for the future (usually 12 months ahead), then, for investors to calculate, today, what is the required surplus in a year to reach the optimal debt, it is necessary to take into account the expected values that the variables that determine the debt path will have within one year (i.e., the expected real interest rate and the expected output growth). Therefore, the expected fiscal adjustment to stabilize the debt at a given level is:

$$E_t ps_{t+1} = (d_t - X_{t+1}) + d_t \frac{E_t(r_{t+1}) - E_t(g_{t+1})}{1+E_t(g_{t+1})} \tag{8.A}$$

where, $E_t ps_{t+1}$ is the surplus estimated in t for the debt to reach X% of GDP in one year ($t+1$); $E_t(g_{t+1})$ is the expected output growth rate formed in t for ($t+1$), and; $E_t(r_{t+1})$ is the expected real interest rate formed in t for ($t+1$);[15]

For the purposes of this paper, and in accordance with equations (2) and (3) of section 3.2, for the gross debt in one year to reach 50% of GDP (or 70%), it will be expected a primary surplus of:

$$E_t(ps_{t+1}) = (d_t - 50\%) + d_t \left[\frac{Et(rt+1) - Et(gt+1)}{1+Et(gt+1)} \right]$$

and

$$E_t(ps_{t+1}) = (d_t - 70\%) + d_t \left[\frac{Et(rt+1) - Et(gt+1)}{1+Et(gt+1)} \right]$$

[15] The expected real interest rate has been derived from the expected nominal interest rate (Selic), deflated by the inflation expectation (IPCA).

Appendix B

Table B.1 Principal Component analysis

Eigenvalues: (Sum = 4, Average = 1)					
Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	3.719	3.520	0.930	3.719	0.930
2	0.199	0.143	0.050	3.917	0.979
3	0.055	0.028	0.014	3.973	0.993
4	0.027	---	0.007	4.000	1.000

Table B.2 Unit root tests

Series	ADF				Philips-Perron				KPSS			
	Lag	I/T	Test	prob.	Band	I/T	Test	prob.	Band	I/T	LM-Test	1%
$D_t\pi^{12}$	0	I/T	-9.830	0.000	2	I	-9.478	0.000	9	I	0.411	0.739
$D_t\pi^{24}$	0	I	-5.507	0.000	6	I	-5.638	0.000	9	I	0.411	0.739
$D_t\pi^{36}$	0	I	-5.181	0.000	8	I	-5.343	0.000	10	I	0.469	0.739
$D_t\pi^{48}$	0	I	-3.747	0.004	5	I	-3.754	0.004	10	I	0.549	0.739
$D_t\pi^{NG}$	0		-6.233	0.000	4		-6.114	0.000	9	I	0.492	0.739
π_t	12		0.030	0.691	7	I	-2.776	0.064	10	I	0.274	0.74
	11	I/T	-7.640	0.000								
$vol(\pi_t)$	6		-3.560	0.000	4	I/T	-8.612	0.000	7	I	0.639	0.74
gap_t	12		-3.435	0.001	2		-8.178	0.000	5	I	0.030	0.739
$e_t^{\pi 12}$	2	I/T	-6.265	0.00	5	I/T	-4.669	0.00	10	I	0.299	0.74
$exch$	0		-7.871	0.00	5		-7.992	0.00	6	I	0.221	0.74

Note: ADF - the final choice of lag was made based on Schwarz information criterion. PP and KPSS tests - Band is the bandwidth truncation chosen for the Bartlett kernel. “I” denotes intercept; “I/T” denotes intercept and trend.