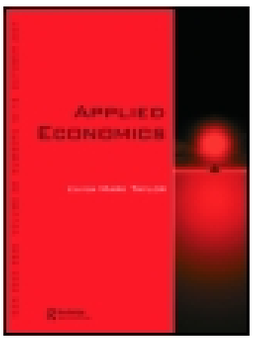

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Does clarity of central bank communication affect credibility? Evidences considering governor-specific effects

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ABSTRACT

Central banks have made great efforts to increase transparency and accountability to the public. Since then, studies seek empirical evidences about the effects of monetary policy communication over agent's expectations. The recent literature on central bank communication draws attention to the importance of clarity of central bank communication. However, researches on this theme are still scarce, and there are few empirical studies with conclusive findings. Our study seeks empirical evidences on the relation between clarity of central bank communication and credibility of monetary policy. Estimates through different methods aim to identify whether clarity of central bank communication improves credibility. The study is the first to provide empirical evidence that a clearer communication can improve credibility. We also consider the differences between the two governors who ruled the Central Bank of Brazil in the period under analysis. The results indicate that a clear communication can improve credibility, but it depends on the commitment of the central banker with the goal of inflation control. Furthermore, estimates based on quantile regression indicate that the benefit brought by the clarity to the credibility depends on the commitment of the monetary authority with the goal guiding inflation expectations.

KEYWORDS
Credibility; clarity; communication; central bank

JEL CLASSIFICATION
E44; E58; E37

I. Introduction

Central banks have made great efforts to increase transparency and accountability to the public (Eijffinger and Geraats 2006; Dincer and Eichengreen 2010). Since then, central bank communication represents an important tool to monetary policy effectiveness (Blinder et al. 2001, 2008). The literature on central bank communication continues to evolve and researches have been drawing attention to the importance of clarity of central bank communication (Jansen 2011a, 2011b; Bulíř, Čihák, and Jansen 2013a; Bulíř, Čihák, and Šmídková 2013b; Montes et al. 2016). This emerging literature stresses that the clarity of central bank communication is important to reduce uncertainties, and thus it may represent a key aspect for central banks to achieve their goals.

The literature on time consistency problem of monetary policy shows that credibility is important to manage expectations, to keep inflation low and to reduce the cost of disinflation (Blinder 2000; de Mendonça 2007; Montes and Bastos 2014). In a study regarding credibility, Blinder (2000) asks the following question: 'how can a central bank create or enhance credibility?'[1] Blinder (2000) lists possible determinants of the central bank credibility and includes transparency as an important tool to build credibility.[2] According to Bernanke et al. (1999), the credibility of the central bank depends as much on the objectivity and plausibility of its communications as on its record of hitting targets.

Under inflation targeting (IT), central banks attempt to establish credibility by conducting a transparent policy (Mishkin 2007).[3] According to Mishkin and Schmidt-Hebbel (2001), the adoption of IT is typically followed by major improvements in central bank communication in order to

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[1]Blinder (2000) mailed a questionnaire to the heads of 127 central banks – the entire membership of the Bank for International Settlements (BIS) – soliciting their opinions on a variety of issues related to central bank credibility.

[2]Blinder (2000) highlights that 'recent trends in central banking seem to be moving strongly in the direction of greater transparency, however, with such institutions at the Bank of England and the Reserve Bank of New Zealand in the vanguard. Both of these central banks explicitly adopted inflation targeting and a high degree of transparency as ways to create credibility from scratch. Brazil is embarking on that course now' (1429).

[3]Bernanke et al. (1999, 23) see the inflation targeting framework as serving two important functions: (1) improving communication between policymakers and the public, and, (2) providing discipline and accountability in the making of monetary policy.

enhance transparency. Bernanke et al. (1999, 36) argue that 'to maintain credibility in the eyes of the public, the central bank needs to provide timely information about the economy at large, the bank's monetary policy, and its policy intentions'. Empirical evidences show that central bank communication is important to reduce uncertainties about future monetary policy and anchor inflation expectations (e.g. Woodford 2005; Blinder et al. 2008; Montes et al. 2016).

In turn, studies on central bank communication argue that clarity represents a crucial dimension of central banks' communication, and thus it is important to transparency. Jansen (2011b) argues that even if a central bank communicates regularly, but does so opaquely, it can hardly be called transparent. Jansen (2011a) presents the rationale for the link between transparency and clarity arguing that 'readability is a fundamental precondition for transparency' (496). Thus, clarity – measured through the readability index proposed in Jansen (2011a, 2011b), Bulíř, Čihák, and Jansen (2013a) and Montes et al. (2016) – can be considered as an important tool to build credibility.

In the present article, we suggest the following relation: once clarity of central bank communication can reduce the information asymmetry between central bank and the public, it can provide gains in terms of monetary policy credibility if the central bank is committed with low inflation policy. Therefore, different from the existing studies regarding the effects of the clarity of central bank communication, this study aims to analyse whether the clarity of central bank communication affects monetary policy credibility in Brazil (an IT-developing country). Our study contributes to the literature on the effects of clarity of central bank communication once it is the first to address this relation, and also because it is the first to address this relation considering an IT-developing country. To our knowledge, no paper has empirically studied this relation so far.

Brazil has adopted the IT regime in 1999, and since then the Central Bank of Brazil (CBB) has improved transparency and experienced a high level of independence to control inflation. This study contributes to the literature since it provides empirical evidence about the influence of the clarity of CBB's communication on the credibility, considering an IT economy. In fact, the study is the first to provide evidence that a clearer communication can improve credibility. Furthermore, we also take into account governor-specific effects, that is, we repeat the analysis considering the commitment of the two governors (Henrique Meirelles and Alexandre Tombini) with the regime of IT for the period analysed.[4]

In terms of practical implications, the findings suggest an interesting insight: the benefit brought by the clarity to the credibility depends on the commitment of the monetary authority with the goal of keeping inflation low and stable. The results suggest that clearer communication can improve central bank credibility, but only if the central bank is committed with the inflation target. Hence, the central bank should improve the clarity of its announcements; but for this communication policy to be effective, the central bank must keep the commitment with the inflation target. In this sense, commitment with the inflation target is a necessary condition for the effectiveness of clarity. Thus, based on the clarity indexes we use (the *Flesh ease score* and the *Flesh-Kincaid grade level*) and on the arguments presented by Jansen (2011a, 2011b), the following interpretation may be established: if central bank communication becomes less clear, transparency is reduced and, therefore, the understanding of the public regarding the capacity of the central bank of keeping inflation low and stable is reduced, affecting the process of expectation formation and reducing central bank credibility. Moreover, if the central bank loses control over inflation, central bank communication (and, thus, clarity) also loses effectiveness in terms of guiding expectations.

The concept of credibility adopted in the study follows the idea of Agénor and Taylor (1992) that the credibility of the monetary policy is related to inflation expectations. In this sense, credibility is the confidence that the public has on the capacity of the central bank to address its targets, as pointed by Blinder (2000, 1423): 'A central bank is credible if

[4]Our intention was to analyse the specific effects of all CBB governors during the regime of inflation targeting but, due to data availability on expectations and due to the fact that prior to 2003 there was no standard for the period of time that the minutes of the Monetary Policy Committee (COPOM) meetings were published after each meeting, the analysis is for the period between May 2003 and March 2015.

people believe it will do what it says'. Hence, we follow de Mendonça (2007) to measure credibility.[5] According to several authors (e.g. Agénor and Taylor 1992; Svensson 2000; Cecchetti and Krause 2002; de Mendonça 2007; de Mendonça and de Guimarães E Souza 2009; Nahon and Meurer 2009; Montes and Bastos 2014), credibility is higher when inflation expectations are close to the target, which means agents believe central bank can achieve its goal. Besides, we make use of two clarity indexes presented in Jansen (2011a, 2011b) and also utilized by Bulíř, Čihák, and Jansen (2013a) and Montes et al. (2016). The indexes are the *Flesh ease score* (Flesch 1948) and the *Flesh-Kincaid grade level* (Kincaid et al. 1975). Both indexes measure the readability of the text based on text characteristics.

II. Literature on clarity of central bank communication

In the last two decades, the literature on central banking has shown relevant empirical evidences about the effects of monetary policy communication over agent's expectations. The findings in these studies suggest financial markets, equity markets and inflation expectations react to monetary policy announcements and signalling (see Blinder et al. 2008 for further information).

An important question arises with the advances in central bank communication studies. Does the clarity of central bank communication matter? The clarity of central bank communication refers to the quality of information provided and the capacity of comprehension the public has reading what central bank communicates. Furthermore, a clearer message is able to help central banks in the task of guiding the expectations of the public in an easier way than a more opaque message (Montes et al. 2016).

Few studies intended to answer this question and pointed some findings. Jansen (2011a, 2011b) uses the *Flesh ease score* (Flesch 1948) and the *Flesh-Kincaid grade level* (Kincaid et al. 1975) as proxy to clarity. Both studies measure the clarity of Humphrey–Hawkins testimonies. Jansen (2011a) analyses the effect of clarity over financial markets volatility. The author points out three important results: central bank clarity matters, it reduces volatility and its effect vary over time. Jansen (2011b) aims to analyse the differences between the clarity of Paul Volcker testimonies and the clarity of Greenspan testimonies. The work estimates two equations for both clarity indexes, one controlling to macroeconomic data and other only to a constant and linear trend. The results indicate there is no difference between the clarity of communications of the two Federal Reserve chairmen.

The study of Bulíř, Čihák, and Jansen (2013a) also measures clarity with the indexes constructed by Flesch (1948) and Kincaid et al. (1975). The work analyses the determinants of central bank communication about inflation for six countries (Chile, Czech Republic, Poland, Sweden, Thailand and the UK) and the Euro area. The results indicate that the country-specific and the institution-specific factors are important, and the use of a single-clarity model to all countries is not appropriated.

Bulíř, Čihák, and Šmídková (2013b) present a different approach to measure the clarity of the monetary policy message, using content analysis of the European Central Bank (ECB) communication. They add clarity as a crucial dimension of central banks' communication and apply the measure to the ECB case. Moreover, they extend the analysis of ECB's communication to the more analytical Monthly Bulletin in addition to previously researched press releases. The findings suggest that the ECB presented a clear communication for the period between 1999 and 2007. The analysis identifies the ECB's written communication as clear in about 85–95% of instances, which is comparable with, or better than, similar results available for other central banks (Bulíř, Čihák, and Šmídková 2013b). They also find that the additional information on risk to inflation and especially projection risk assessment contained in the ECB's Monthly Bulletins helps to improve clarity compared to ECB's press releases. In contrast, the bulletin's

[5]Although different indexes of credibility have been proposed – as summarized in the works of de Mendonça and de Guimarães E Souza (2009) and Nahon and Meurer (2009) – and therefore there is a variety of indexes of credibility capable of being used in empirical analyses, this study does not seek to analyse the effect of clarity on each credibility index. The option for using the index proposed by de Mendonça (2007) is due to the following arguments: (i) the index is widely used in several applied studies and it is recognized by international literature; (ii) simplicity of understanding and preparation; (iii) the index captures the changes and fluctuations in credibility in a way compatible with the regime of inflation targeting adopted in Brazil, that is, the index uses predetermined tolerance bands, and not ad hoc tolerance bands as proposed by other indices; and (iv) the index has a better performance than other indices and it is rigorous enough and punishes appropriately deviations of inflation expectations in relation to the inflation target.

communication on monetary developments has a negative, albeit small, impact on clarity.

Regarding Brazil, Montes et al. (2016) measure the effects of transparency, central bank communication about monetary policy and clarity on the disagreement of inflation expectations in Brazil. In order to verify the effects of monetary policy signalling on disagreement about inflation expectations, they use the standard approach based on dummy variables as proposed by Rosa and Verga (2007). Furthermore, in order to estimate the influence of clarity of central bank communication on disagreement about inflation expectations, the authors follow the literature on the clarity of central bank communication (Jansen 2011a, 2011b; Bulíř, Čihák, and Jansen 2013a) and use a well-established statistic from the literature on readability, the Flesch (1948) statistic (or the Flesch reading ease score). Regarding the estimates, the authors analyse the joint effect of monetary policy signalling and clarity of central bank communication. The authors find that the act of signalling future monetary policy with clarity (a joint effect) is beneficial to reduce disagreement about inflation expectations. Besides, the authors also estimated joint effects involving clarity and the direction of the monetary policy signalling (whether hawkish or dovish). The findings suggest that clarity reduces disagreement when combined with the hawkish signalling and increases disagreement of inflation expectations when combined with dovish signalling.

Considering the existing literature on clarity of central bank communication, one can observe that many questions remain open regarding the effect of clarity of central bank communication on the economy, and therefore there are important gaps to be filled in the literature. For instance, since the main goal of central banks under IT is to keep inflation under control and to manage expectations, it is important to verify whether the clarity of central bank communication can be useful for central banks in the task of anchoring expectations and building credibility.

III. Empirical analysis

According to Blinder et al. (2008), there are two types of communication: (i) official announcements and (ii) communication through the specialized media. This study follows the literature regarding the effects of central bank communication and clarity of communication on financial market expectations for the Brazilian case (e.g. Montes 2012; Montes and Scarpari 2015; Montes and Nicolay 2015; Taborda 2015; Montes et al. 2016) and analyses the clarity of official announcements.[6] The Brazilian Central Bank releases two official announcements related to inflation and monetary policy, the inflation report and the minutes of the Brazilian Monetary Policy Committee (COPOM) meetings. The first is quarterly and provides information about the economic background and the inflation dynamics. The second follows the COPOM meetings and presents information about the economic outlook, monetary policy decisions and indicates the path of the monetary policy in the future. Once we are going to base our analysis in official announcements, we are concerned with the explanations of the central bank about monetary policy decisions, and in order to avoid the problem of insufficient data for a reliable empirical analysis, the minutes of the COPOM meetings are more pertinent to our purpose.[7]

The COPOM has periodic meetings to decide the basic interest rate (*IR*). After these meetings, the Committee publishes an official document (the minutes of the COPOM meetings) summarizing the analysis and the reasons for the decision. The meetings used to happen monthly before 2006, but after 2006, it starts happening every 45 days. Moreover, since May 2003 the minutes are published 8 days after the meeting.[8] This formal structure provides a good laboratory to analyse the relation between clarity of CBB's communication and credibility of the Brazilian IT regime. Besides, Brazil is a developing country, and according to Mishkin and

[6]The studies of Montes (2012), Montes and Scarpari (2015), Montes and Nicolay (2015), Taborda (2015) and Montes et al. (2016) find evidence that central bank communication (based on the minutes of the COPOM meetings) affects the expectations of financial markets participants in Brazil.

[7]According to Taborda (2015), 'The empirical literature on IT implementation and central bank transparency regards the release of the minutes as a step toward IT success. No matter its contents, a release itself demonstrates purpose and enhances transparency. However, the mere release of the minutes (whether or not they record the deliberation process verbatim, present voting records, or scrutinize a Board member's view) might not achieve two leading IT goals: establishing a clear communication with the public (Mishkin 2000); and attaining a coherent management of their expectations (Blinder et al. 2008). If the minutes (and their timely release) are a core element of procedural transparency, their clarity or the lack of it, their proper or improper wording, their verbose or succinct treatment of specific events, may have desirable or undesirable effects upon policy outcomes'.

[8]Prior to this date, there was no standard for the period of time that the minutes of the COPOM meetings were published after each meeting.

Savastano (2001), it has more uncertainty about inflation control. As a consequence, it is more difficult to build credibility.

The period of analysis runs from May 2003 to March 2015 (143 observations). The minutes of COPOM meetings are the main document of the CBB. This document aims to explain monetary policy decisions and signal the future intentions of the CBB in relation to monetary policy. Regarding the minutes of COPOM meetings, we follow Montes et al. (2016) and the database refers to the period of their regular publication, which always happens 8 days after the meeting that decides the basic *IR* (SELIC). To adequate the indexes to the monthly database, we repeated the value of the last observation when there was no meeting in the month (this procedure is adopted by Montes et al. 2016).

Data

The data are available on the CBB website, in which researchers and market practitioners can find information regarding macroeconomic and financial variables, as well as expectations about the future paths of some key variables.

The credibility index (CI) is based on the ideas of Cukierman and Meltzer (1986), Agénor and Taylor (1992) and Cecchetti and Krause (2002) that series of expected inflation could be applied to derive a CI. As Svensson (2000) proposed, the credibility can be measured by the difference between expected inflation and the target. In this sense, the CI is the index proposed by de Mendonça (2007). The CI 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 CI 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 zero when the expected inflation exceeds one of these limits. The index uses the series of inflation expectations of professional forecasters obtained from the CBB, the inflation target defined by the monetary authority and the tolerance bands. Hence,

$$ci = \begin{cases} 1 & \text{if } E[\pi] = \pi_t^T \\ 1 - \frac{1}{\pi_t^* - \pi_t^T}\left[E[\pi] - \pi_t^T\right] & \text{if } \pi_{tMIN}^* < E[\pi] < \pi_{tMAX}^* \\ 0 & \text{if } E(\pi) \geq \pi_{tMAX}^* \text{ or } E[\pi] \leq \pi_{tMIN}^* \end{cases} \quad (1)$$

Figure 1 shows the graph of the index.

According to Blinder (2000), the success in keeping inflation under control (i.e. the 'history of honesty') is an important aspect to build credibility. Thus, we check the effect of inflation deviation from the inflation target (*INFD*) on credibility. It is expected that a rise in *INFD* reduces credibility. This series is formed by the deviation of the inflation rate accumulated in a year (IPCA 'Consumer Price Index' – series 13522 obtained from the CBB) from the inflation target. Furthermore, due to the fact that

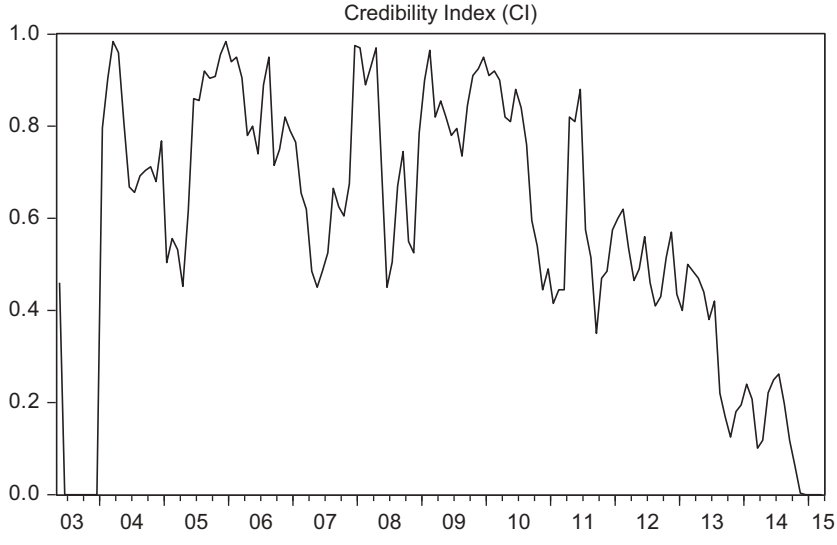

Figure 1. Credibility index. Source: Authors' elaboration.

a rise in the basic *IR* sends a signal to the market that the central bank fights to control inflation, we also check the effect of the basic *IR* on credibility. The expected impact of a rise in the *IR* is to increase monetary policy credibility. The *IR* is the nominal basic *IR* in Brazil (SELIC – series 4189 obtained from the CBB).

Due to the pass-through effect from exchange rate (ER) to inflation, inflation expectations are affected by ER variations (de Mendonça and Tostes 2015), and as a consequence, credibility is also affected. Hence, we also check the influence of the ER – this series is the nominal ER (purchase, 'end of period').

Regarding clarity indexes, the quality of information is related to the capacity of comprehension that the public has about any information reported. Hence, in the context of the information provided by the central bank, the readability of a text is important to the public in order to understand the information that the central bank reports. Jansen (2011a) suggests that difficulties to read a text can lead to missed or misunderstood information. In some cases, the individual even abandons the read. Furthermore, Jansen (2011a) indicates two indices to measure clarity of central bank communication through readability aspects: *Flesch reading easy score* (Flesch 1948) and *Flesch-Kincaid grade level* (Kincaid et al.).

The Flesch (1948) statistics (FI) indicates easiness to read the text. The index utilizes textual aspects as the number of word per sentences and the number of syllables per word. The index is calculated as follows:

$$\begin{aligned} \mathrm{FI} = {} & 206.835 - 1.015 \times (\#\mathrm{word}/\#\mathrm{sentences}) \\ & - 84.6 \times (\#\mathrm{syllables}/\#\mathrm{words}) \end{aligned} \tag{2}$$

The index proposed by Kincaid et al. (1975) (FKI) represents the years of study needed to fully understand the text. This interpretation makes easier to compare different values. The index is calculated as follows:

$$\begin{aligned} \mathrm{FKI} = {} & 0.39 \times (\#\mathrm{word}/\#\mathrm{sentences}) + 11.8 \\ & \times (\#\mathrm{syllables}/\#\mathrm{words}) - 15.59 \end{aligned} \tag{3}$$

It is important to highlight that we use the indexes in the first difference (*d_FI* and *d_FKI*). We made this option because what can help the central bank to build credibility is not the level of clarity in the announcements, but its variation, that is, if the communication becomes clearer or more opaque. Thus, the first difference of the indexes is more adequate to explain movements in the credibility of monetary policy than the level of the indexes.

Due to the *Lula effect* – name given for the distrust of economic agents and markets in relation to the President-elect Luiz Inácio 'Lula' da Silva – the Brazilian economy experienced a period of high inflation and low credibility. In this sense, a dummy variable (DUMMY) was created to represent the period of distrust of economic agents right after the election, that is, when credibility was being built. In the early years of IT in Brazil, the CBB was building credibility and confidence; therefore, this dummy receives value 1 to all observations before December 2003 and 0 otherwise. Figure 1 shows the graph of the CI and illustrates this period that comprises the *Lula effect*.

The primary surplus as a percentage of GDP (PS) and the gross public debt as a percentage of GDP (DEBT) (both series obtained from the National Treasury) enter the estimates as instrumental variables.

Preliminary findings

Before proceeding with the analysis, we made the following unit root tests: ADF, Phillips–Perron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS). Moreover, due to the fact that structural change is pervasive in economic time-series relationships, it is important to test for possible structural breaks. Hence, we apply Perron (1997) unit root test with structural break, which proposes determining the break point 'endogenously' from the data. Table 1 presents the results (all series are stationary, except the ER). Since the CI is a variable with values between 0 and 1, unit root tests are not necessary, that is, the variable is stationary.

In order to provide preliminary evidences on the relation between clarity and credibility, we perform the Granger causality test. Moreover, a dynamic analysis based on VAR model is performed. The VAR estimations, through impulse-response function, provide a dynamic analysis and permits us to evaluate the response of the variables to shocks (or innovations) provoked by residual variables over time (Sims 1980). We estimate the impulse-response

Table 1. Unit root tests.

Variables	ADF				PP				KPSS				Perron-structural break				Perron-structural break				Perron-structural break			
	Lag	I/T	Test	Prob.	Band	I/T	Test	Prob.	Band	I/T	Test	1%	Lag	I	Test	10%	Lag	T	Test	10%	Lag	I/T	Test	10%
INFD	1	I	−4.275	0.001	7	I	−4.403	0.000	9	I	0.212	0.739	5	I	−7.194	−4.92	5	T	−4.856	−4.48	5	I/T	−7.182	−5.29
ER	0		0.063	0.701	5		−0.048	0.665	9	I/T	0.338	0.216	0	I	−0.54	−4.92	0	T	−2.176	−4.48	0	I/T	−1.914	−5.29
d_ER	0	I/T	−10.518	0.000	2	I/T	−10.595	0.000	3	I/T	0.068	0.216	0	I	−11.189	−4.92	0	T	−10.992	−4.48	0	I/T	−11.304	−5.29
IR	1	I/T	−4.396	0.003	8	I	−3.439	0.011	10	I/T	0.207	0.216	4	I	−2.965	−4.92	4	T	−3.541	−4.48	4	I/T	−4.046	−5.29
d_FI	2		−8.736	0.000	26		−23.393	0.000	45	I	0.132	0.739	0	I	−14.882	−4.92	0	T	−14.783	−4.48	0	I/T	−15.158	−5.29
d_FKI	2		−9.651	0.000	25		−26.075	0.000	39	I	0.112	0.739	0	I	−16.748	−4.92	0	T	−16.609	−4.48	0	I/T	−16.739	−5.29

Source: Authors' elaboration.
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 constant; *I/T* denotes constant and trend.

Table 2. Granger causality test.

Null hypothesis:	Obs.	*F*-Statistic	Prob.
d_FI does not Granger cause CI	125	3.38	0.07
CI does not Granger cause D_FI		0.01	0.93
d_FKI does not Granger cause CI	125	3.97	0.05
CI does not Granger cause *d_FI*		0.02	0.88

Source: Authors' elaboration.

functions through generalized impulses, following the methodology of Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998). This methodology eliminates the problem of ordering the variables, which is important once we intend to observe the relation of both variables as dependent variables to corroborate the results founded in the Granger causality test. The choice of the VAR lag order was determined using the Schwarz information criterion (SC) and the Hannan–Quinn information criterion (HQ). The results indicate that the VAR lag order is 1 (see Table A1 in the Appendix). Moreover, we check the stability of the VAR (see Figure A1 in the Appendix).

Table 2 presents the results of the Granger causality test. One can observe that the assumption that clarity does not cause credibility is rejected and, on the other hand, one can observe that credibility does not cause clarity. This first finding indicates that the relation observed is an influence of clarity on credibility and not the opposite.

Figure 2 shows the graphs for the generalized impulse–response functions between credibility and *d_FKI* and between credibility and *d_FI*. The findings indicate that a positive shock or innovation in *d_FKI*, which means more years of study to comprehend the text (and thus less clarity), reduces credibility over time. Besides, the innovation in *d_FI*, related to an improvement in the clarity, once Flesch Index represents the easiness to ready the text, has a positive impact on credibility over time. These results suggest that clarity of central bank communication can help to improve monetary policy credibility. In turn, the opposite relations do not present statistical significant, as we found in the Granger causality test. Thus, credibility has no influence on clarity.

Estimation and results

In order to obtain robust evidences on the effect of clarity of central bank communication over

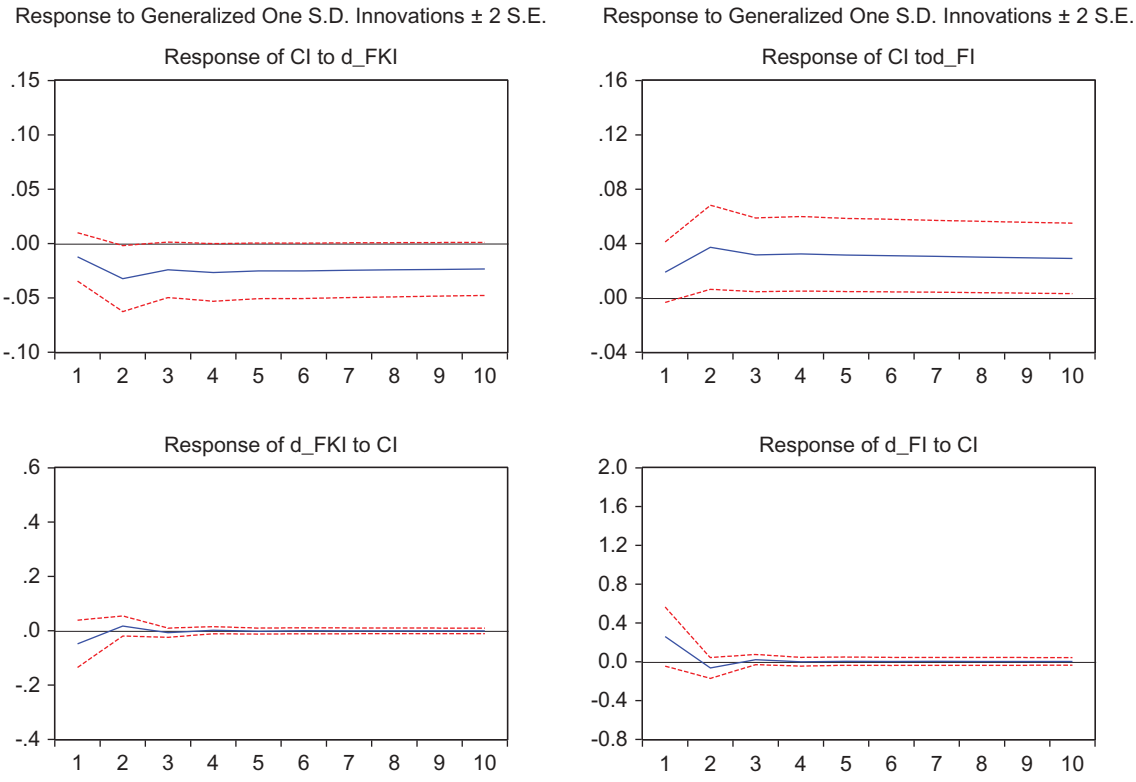

Figure 2. VAR analysis (impulse-response). Source: Authors' elaboration.

monetary policy credibility, we provide estimates through different methods: OLS,[9] one-step GMM with Newey–West covariance matrix, and two-step generalized method of moments (GMM 2-STEP) with Windmeijer covariance matrix. GMM is used to deal with endogeneity and identification problems (Wooldridge 2001). Besides, GMM presents robust estimators even in the presence of serial autocorrelation and heteroscedasticity of unknown form, or non-linearity, which is typical in macroeconomic time-series models (Hansen 1982). We follow the methodology of Johnston (1984) to select the instruments on GMM estimation, that is, the instruments were dated to the period t–1 or earlier to assure the exogeneity.[10] 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, that is, 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 SEs.

Besides the effect of clarity of central bank communication over credibility, we also choose – based on the literature on credibility – control variables able to explain the behaviour of credibility. Following Blinder (2000), the success in keeping inflation under control (i.e. the history of honesty) and the reputation of fight against inflation are important to build credibility. The history of honesty is measured through the deviation of inflation from the target. Furthermore, we represent the idea of fight against inflation through the effect of the basic *IR* on inflation expectations, and thus on credibility. The idea is that when the central bank makes a tight monetary policy, by raising the *IR*, it shows effort to control inflation in the near future and thus enhances credibility. In turn, since there

[9]Regarding OLS estimates, we estimate OLS with the Newey–West covariance matrix. Furthermore, Ramsey's RESET test is presented for all OLS estimates. RESET is a general test for the following types of specification errors: omitted variables; incorrect functional form; and correlation between regressors and the error term, which may be caused, among other things, by measurement error in regressors or simultaneity (endogeneity) (see Ramsey 1969 and Wooldridge 2009). As one can see, the outcomes of the Ramsey's RESET test in all OLS estimates indicate that the estimates do not present problems of model specification (such as simultaneity).

[10]Regarding all GMM estimations, we present the Durbin–Wu–Hausman test of the endogeneity of regressors (Durbin 1954; Wu 1973; Hausman 1978).

are studies that find evidence on the pass-through effect from the ER to inflation in Brazil (e.g. Minella et al. 2003; de Mendonça and Tostes 2015), we also consider the effect of ER variations on the CI.

In order to verify whether the clarity of central bank communication affects the monetary policy credibility, Equations (4) and (5) are estimated.

$$CI_t = \alpha_1 + \alpha_2 INFD_t + \alpha_3 IR_{t-1} + \alpha_4 d\_ER + \alpha_5 d\_FKI_{t-1} + \alpha_6 DUMMY + \varepsilon_t \quad (4)$$

$$CI_t = \beta_1 + \beta_2 INFD_t + \beta_3 IR_{t-1} + \beta_4 d\_ER + \beta_5 d\_FI_{t-1} + \beta_6 DUMMY + \vartheta_t \quad (5)$$

where ε and ϑ are random error terms.

Table 3 presents the results. Regarding OLS estimates, the *F*-statistic of all equations indicates that the regressions are significant. Furthermore, the outcomes of the Ramsey Regression Specification Error Test (RESET) test indicate that the estimations do not present problems of model specification. In terms of GMM estimations, the *J*-statistic and the Durbin–Wu–Hausman test indicate that we cannot reject the hypothesis that the model is correctly specified.[11] Furthermore, all estimated coefficients present the expected signals.

The findings for '*INFD*' reveal that when the deviation of inflation from the target increases, it reduces credibility. This result is consistent with what is proposed in the literature (e.g. Blinder 2000). Regarding the estimates for the influence of the *IR*, the findings indicate, with statistical significance, a positive effect on credibility, that is, when the central bank raises the *IR* to control inflation, the

Table 3. OLS and GMM estimates (dependent variable: credibility index (C)I).

	OLS		GMM		GMM 2-STEP	
	Equation (4)	Equation (5)	Equation (4)	Equation (5)	Equation (4)	Equation (5)
CONSTANT	**0.291****	**0.293****	**0.415*****	**0.391*****	**0.366*****	**0.408*****
	(0.117)	*(0.117)*	*(0.095)*	*(0.096)*	*(0.125)*	*(0.114)*
	[2.489]	[2.499]	[4.358]	[4.029]	[2.924]	[3.571]
INFD	**−0.095*****	**−0.095*****	**−0.056****	**−0.048***	**−0.065***	**−0.064***
	(0.028)	*(0.028)*	*(0.025)*	*(0.026)*	*(0.035)*	*(0.036)*
	[−3.374]	[−3.381]	[−2.207]	[−1.846]	[−1.849]	[−1.785]
IR (−1)	**0.034*****	**0.034*****	**0.026*****	**0.027*****	**0.030*****	**0.027*****
	(0.008)	*(0.008)*	*(0.006)*	*(0.006)*	*(0.007)*	*(0.007)*
	[4.281]	[4.250]	[3.922]	[4.120]	[3.850]	[3.491]
d_ER	**−0.355**	**−0.367***	**−0.863****	**−1.100***	**−0.586***	**−0.686***
	(0.218)	*(0.218)*	*(0.427)*	*(0.558)*	*(0.351)*	*(0.384)*
	[−1.630]	[−1.688]	[−2.020]	[−1.972]	[−1.668]	[−1.785]
d_FKI (−1)	**−0.032**		**−0.065***		**−0.091***	
	(0.023)		*(0.036)*		*(0.051)*	
	[−1.402]		[−1.799]		[−1.749]	
d_FI (−1)		**0.012***		**0.042*****		**0.043****
		(0.007)		*(0.014)*		*(0.017)*
		[1.694]		[2.914]		[2.545]
DUMMY	**−0.593*****	**−0.587*****	**−1.073*****	**−0.856*****	**−1.035*****	**−0.943****
	(0.134)	*(0.133)*	*(0.295)*	*(0.181)*	*(0.372)*	(0.377)
	[−4.433]	[−4.415]	[−3.628]	[−4.732]	[−2.777]	[−2.499]
Adjusted R^2	0.474	0.475	0.247	0.205	0.249	0.187
F-Statistic	26.208	26.380				
p-Value	0.000	0.000				
Ramsey RESET	1.284	1.329				
p-Value	0.259	0.251				
Rank			22	21	32	31
Durbin–Wu–Hausman test (prob.)			0.794	0.695	0.924	0.725
p-Value (*J*-statistic)			0.436	0.422	0.888	0.903

Source: Authors' estimates.
Marginal significance levels: *** 0.01, ** 0.05, * 0.1.
Coefficients in bold, SEs in parentheses and *t*-statistics in square brackets. Regarding OLS estimates, due to the problems of autocorrelation and heteroscedasticity (Table A2 in the Appendix shows the residual diagnostic tests), the reported *t*-statistics in the OLS estimates are based on the estimator of Newey and West (1987).

[11] Instrumental variables GMM:
Equation (3): CI(−1 to −5), *INFD*(−1), *IR*(−2 to −6) *d_ER*(−1 to −4), *d_FKI*(−2 to −3), *d_PS*(−1 to −4).
Equation (4): CI(−1 to −5), *INFD*(−1), *IR*(−2 to −5), *d_ER*(−1 to −4) *d_FI*(−2 to −3) *d_PS*(−1 to −4).
Instrumental variables GMM 2-STEP:
Equation (3): CI(−1 to −5), *INFD*(−1), *IR*(−2 to −7), *d_ER*(−1 to −3), *d_FKI*(−2 to −6) *d_PS*(−1 to −6), DEBT(−1 to −5).
Equation (4): CI(−1 to −5), *INFD*(−1), *IR*(−2 to −7), *d_ER*(−1 to −3), *d_FI*(−2 to −5) *d_PS*(−1 to −4) DEBT(0 to −6).

public perceives this action as an effort of the central bank to fight against inflation, which causes a positive influence on credibility. The estimated coefficients for *d_ER* have negative signal, thus the public considers the pass-through effect of the ER to inflation when forming inflation expectations. The dummy variable presents negative coefficients and statistical significance, which captures the distrust of economic agents on the new president-elect right after the election.

Regarding the influence of the clarity of the CBB's communication on credibility, the estimated coefficients of *d_FKI* and *d_FI* present the expected signals and statistical significance was found in almost all coefficients (except for *d_FKI* in the estimate through OLS). Since *d_FKI* represents the variation in the years of study necessary to comprehend the text, thus, when the central bank communication becomes easier to understand, less years of study are necessary to comprehend the text and, as a consequence, credibility is improved. The negative coefficient of *d_FKI* indicates that a higher clarity of central bank communication can improve monetary policy credibility. In turn, when *d_FI* increases, it represents the easiness to read the text. Therefore, a positive variation in the index represents more clarity and it improves monetary policy credibility. Furthermore, another important aspect may be considered, when the central bank is struggling to control inflation, a greater number of explanations should be given in the reports, which may result in loss of clarity in communication and thus loss of credibility.

The results observed in the Granger causality test, VAR, OLS and GMM estimations show the same relation between clarity of central bank communication and monetary policy credibility. The findings indicate that communicating clearly can enhance credibility.

Governor-specific effects

During the period under study, the CBB was ruled by two governors: Henrique Meirelles (from January 2003 to December 2010) and Alexandre Tombini (from January 2011 to now). Hence, we analyse if there exists difference in the effect of the clarity of the CBB's communication on the credibility considering the mandate of these two governors. In this sense, we seek to answer the following question: What was the effect of clarity of central bank communication over credibility during Meirelles' mandate and during Tombini's mandate?

First, we observe how the credibility behaves during the mandate of each governor (Figure 3 presents the graphs). One can see that during Meirelles' mandate, the credibility is higher, on average, than during Tombini's mandate (the red line in the group of graphs called 'Average' shows the average). Moreover, it is possible to observe that, although the occurrence of fluctuations in the CI during Meirelles' mandate, the trend is increasing at the beginning and then it is stationary, while during Tombini's mandate one can observe that credibility deteriorates (the red line in the group of graphs called 'Trend' shows the trend).

Indeed, there is a considerable difference in the behaviour of the CI in the two mandates. The mean value of the CI during Meirelles' mandate is 0.699, with an SD of 0.255, while, during Tombini's mandate, the mean value of the CI was 0.365, and the SD 0.220. With this in mind, we analyse if there exists governor-specific effects with regard to the influence of the clarity of central bank communication on monetary policy credibility.

In order to answer the question raised above, we create two dummy variables representing the mandate of each governor. The dummy variable called 'MEIRELLES' receives value 1 between May 2003 and December 2010 and value 0 otherwise, and the dummy variable called 'TOMBINI' receives value 1 between January 2011 and March 2015 and value 0 otherwise.

Thus, we construct a multiplicative variable to measure the effect of the clarity of central bank communication over monetary policy credibility for each governor, that is, we create four new variables ('*d_FKI**MEIRELLES', '*d_FKI**TOMBINI', '*d_FI**MEIRELLES' and '*d_FI**TOMBINI').

The models are estimated with the new variables and the same control variables used in Equations (4) and (5). Therefore, we estimate Equations (6)–(11). Table 4 presents the results for Equations (6)–(8), and Table 5 presents the results for Equations (9)–(11).

$$CI_t = \varphi_1 + \varphi_2 INFD_t + \varphi_3 IR_{t-1} + \varphi_4 d_{ER} + \varphi_5 MEIRELLES * d\_FKI_{t-1} + \varphi_6 DUMMY + \varsigma_t \quad (6)$$

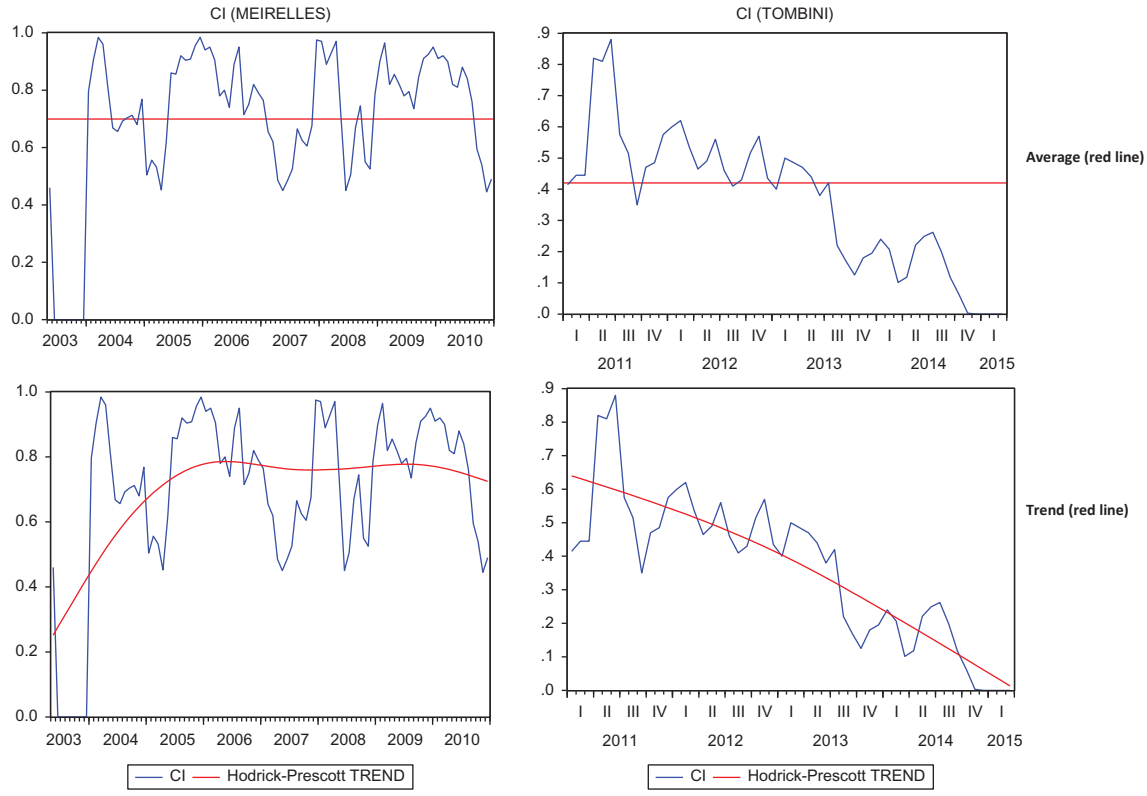

Figure 3. Credibility during the mandate of each governor. Source: Authors' elaboration.

$$CI_t = \rho_1 + \rho_2 INFD_t + \rho_3 IR_{t-1} + \rho_4 d_{ER} + \rho_5 TOMBINI * d\_FKI_{t-1} + \rho_6 DUMMY + \theta_t \quad (7)$$

$$CI_t = \gamma_1 + \gamma_2 INFD_t + \gamma_3 IR_{t-1} + \gamma_4 d_{ER} + \gamma_5 MEIRELLES * d\_FKI_{t-1} + \gamma_6 TOMBINI * d\_FKI_{t-1} + \gamma_7 DUMMY + \Phi_t \quad (8)$$

$$CI_t = \delta_1 + \delta_2 INFD_t + \delta_3 IR_{t-1} + \delta_4 d_{ER} + \delta_5 MEIRELLES * d\_FI_{t-1} + \delta_6 DUMMY + \Psi_t \quad (9)$$

$$CI_t = \eta_1 + \eta_2 INFD_t + \eta_3 IR_{t-1} + \eta_4 d_{ER} + \eta_5 TOMBINI * d\_FI_{t-1} + \eta_6 DUMMY + \Omega_t \quad (10)$$

$$CI_t = \omega_1 + \omega_2 INFD_t + \omega_3 IR_{t-1} + \omega_4 d_{ER} + \omega_5 MEIRELLES * d\_FI_{t-1} + \omega_6 TOMBINI * d\_FI_{t-1} + \omega_7 DUMMY + X_t \quad (11)$$

where $\varsigma, \theta, \Phi, \psi, \Omega$ and X are random error terms.

The results corroborate the signals previously found for all control variables (*INFD*, *IR*, *d_ER* and DUMMY). One can see that *INFD*, *IR* and DUMMY present statistical significance in all estimations, while *d_ER* presents robust signal but statistical significance only in some estimates.

The estimates for the multiplicative variables, utilized to measure the effects of the clarity of CBB's communication considering each governor, indicate differences for the effect of the clarity of central bank communication between the two governors. The variables MEIRELLES**d_FKI* and MEIRELLES**d_FI* present the effects in the same direction of the clarity indexes (*d_FKI* and *d_FI*). Table 4 shows that all estimated coefficients for MEIRELLES**d_FKI* have a negative signal and statistical significance was found for all GMM estimates. In turn, the estimated coefficients for the variable TOMBINI**d_FKI* did not present statistical significance in all estimations. The results presented in Table 5 show that the estimated coefficients for the variable MEIRELLES**d_FI* have a positive signal, and statistical significance was found for all GMM estimates, but the estimated coefficients for the variable TOMBINI**d_FI* did not present statistical significance in all estimations.

Table 4. OLS and GMM estimates (dependent variable: credibility index).

	OLS			GMM			GMM 2-STEP		
	Equation (6)	Equation (7)	Equation (8)	Equation (6)	Equation (7)	Equation (8)	Equation (6)	Equation (7)	Equation (8)
CONSTANT	**0.292****	**0.289****	**0.291****	**0.413*****	**0.423*****	**0.419*****	**0.371*****	**0.363*****	**0.386*****
	(0.117)	*(0.118)*	*(0.118)*	*(0.093)*	*(0.098)*	*(0.096)*	*(0.117)*	*(0.138)*	*(0.116)*
	[2.497]	[2.458]	[2.467]	[4.451]	[4.316]	[4.380]	[3.155]	[2.623]	[3.320]
INFD	**−0.094*****	**−0.094*****	**−0.095*****	**−0.058****	**−0.049****	**−0.056****	**−0.068***	**−0.060***	**−0.071****
	(0.028)	*(0.028)*	*(0.028)*	*(0.025)*	*(0.022)*	*(0.024)*	*(0.035)*	*(0.031)*	*(0.033)*
	[−3.378]	[−3.328]	[−3.353]	[−2.266]	[−2.189]	[−2.281]	[−1.966]	[−1.937]	[−2.157]
IR (−1)	**0.034*****	**0.034*****	**0.034*****	**0.026*****	**0.025*****	**0.026*****	**0.030*****	**0.029*****	**0.029*****
	(0.008)	*(0.008)*	*(0.008)*	*(0.006)*	*(0.007)*	*(0.007)*	*(0.007)*	*(0.009)*	*(0.008)*
	[4.273]	[4.285]	[4.234]	[4.119]	[3.598]	[3.900]	[4.104]	[3.208]	[3.883]
d_ER	**−0.356**	**−0.358**	**−0.355**	**−0.857****	**−0.587**	**−0.715**	**−0.590***	**−0.528**	**−0.625***
	(0.217)	*(0.216)*	*(0.219)*	*(0.409)*	*(0.488)*	*(0.483)*	*(0.346)*	*(0.393)*	*(0.363)*
	[−1.645]	[−1.655]	[−1.623]	[−2.096]	[−1.202]	[−1.480]	[−1.704]	[−1.342]	[−1.724]
*d_FKI**MEIRELLES (−1)	**−0.034**		**−0.034**	**−0.077***		**−0.081****	**−0.111***		**−0.117***
	(0.025)		*(0.025)*	*(0.039)*		*(0.041)*	*(0.058)*		(0.061)
	[−1.341]		[−1.337]	[−1.967]		[−2.01]	[−1.888]		[−1.929]
*d_FKI**TOMBINI (−1)		**−0.025**	**−0.026**		**0.238**	**0.278**		**0.188**	**0.157**
		(0.066)	*(0.066)*		*(0.214)*	*(0.221)*		(0.201)	*(0.205)*
		[−0.388]	[−0.390]		[1.113]	[1.261]		[0.938]	[0.763]
DUMMY	**−0.593*****	**−0.603*****	**−0.593*****	**−1.041*****	**−1.077*****	**−0.980*****	**−0.989*****	**−1.160****	**−0.971*****
	(0.133)	*(0.133)*	*(0.134)*	*(0.277)*	*(0.272)*	*(0.231)*	*(0.330)*	*(0.479)*	(0.322)
	[−4.455]	[−4.530]	[−4.421]	[−3.765]	[−3.958]	[−4.240]	[−2.997]	[−2.422]	[−3.017]
Adjusted R^2	0.473	0.471	0.470	0.258	0.296	0.266	0.249	0.277	0.229
F-Statistic	26.174	25.904	21.680						
p-Value	0.000	0.000	0.000						
Ramsey RESET	1.300	1.254	1.294						
p-Value	0.256	0.265	0.257						
Rank				22	22	22	32	32	32
Durbin–Wu–Hausman test (prob.)				0.833	0.743	0.841	0.902	0.976	0.936
p-Value (*J*-statistic)				0.443	0.378	0.384	0.909	0.839	0.894

Source: Authors' estimates.
Marginal significance levels: ***0.01, **0.05, *0.1.
Coefficients in bold, SEs in parentheses and *t*-statistics in square brackets. Regarding OLS estimates, due to the problems of autocorrelation and heteroscedasticity (Table A2 in the Appendix shows the residual diagnostic tests), the reported *t*-statistics in the OLS estimates are based on the estimator of Newey and West (1987).

The results suggest that clarity of the CBB's communication played an important role to build credibility during Meirelles' mandate; however, during Tombini's mandate so far, the effect of clarity of the CBB's communication on monetary policy credibility is not observable. These findings suggest the following practical implication: a clear communication can improve credibility, but it depends on the results obtained by the central bank in terms of inflation control.

IV. Robustness analysis: TOBIT estimation and quantile regression

In order to verify the robustness of the results and provide further evidences on the effects of the clarity of central bank communication over monetary policy credibility, we run TOBIT estimations (Tobin 1958). The TOBIT model is an adequate method because the CI is a continuous variable that assumes different values between 0 and 1. It is worth noting that the values of the dependent variable (CI) are not concentrated in censored values. In fact, as one can see through Figure 1, these values represent less than 10% of the sample. The TOBIT model uses all of the information, including information about the censoring, and provides consistent estimates of the parameters (Long 1997).[12] The specifications for the analysis through TOBIT model are

$$CI_t = \alpha_1 + \alpha_2 INFD_t + \alpha_3 IR_{t-1} + \alpha_4 d\_ER + \alpha_5 d\_FKI_{t-1} + \varepsilon_t \quad (12)$$

$$CI_t = \beta_1 + \beta_2 INFD_t + \beta_3 IR_{t-1} + \beta_4 d\_ER + \beta_5 d\_FI_{t-1} + \vartheta_t \quad (13)$$

[12]We run TOBIT model with robust Huber–White covariance approach.

Table 5. OLS and GMM estimates (dependent variable: credibility index).

	OLS			GMM			GMM 2-STEP		
	Equation (9)	Equation (10)	Equation (11)	Equation (9)	Equation (10)	Equation (11)	Equation (9)	Equation (10)	Equation (11)
CONSTANT	**0.293****	**0.288****	**0.292****	**0.390*****	**0.365*****	**0.388*****	**0.385*****	**0.373****	**0.389*****
	(0.117)	*(0.118)*	*(0.119)*	*(0.094)*	*(0.101)*	*(0.069)*	*(0.112)*	*(0.168)*	*(0.124)*
	[2.500]	[2.448]	[2.460]	[4.132]	[3.620]	[5.619]	[3.435]	[2.222]	[3.123]
INFD	**−0.094*****	**−0.094*****	**−0.095*****	**−0.049***	**−0.038***	**−0.063*****	**−0.068***	**−0.050**	**−0.065***
	(0.028)	*(0.028)*	*(0.028)*	*(0.025)*	*(0.022)*	*(0.021)*	*(0.035)*	*(0.044)*	*(0.036)*
	[−3.376]	[−3.346]	[−3.369]	[−1.985]	[−1.721]	[−3.041]	[−1.954]	[−1.138]	[−1.817]
IR (−1)	**0.034*****	**0.0345*****	**0.034*****	**0.027*****	**0.028*****	**0.028*****	**0.028*****	**0.028*****	**0.028*****
	(0.008)	*(0.008)*	*(0.008)*	*(0.006)*	*(0.007)*	*(0.005)*	*(0.008)*	*(0.009)*	*(0.008)*
	[4.237]	[4.294]	[4.208]	[4.326]	[3.931]	[5.856]	[3.726]	[2.995]	[3.433]
d_ER	**−0.365***	**−0.361***	**−0.367***	**−0.845***	**−0.655**	**−0.677****	**−0.600***	**−0.665**	**−0.602**
	(0.217)	*(0.215)*	*(0.218)*	*(0.465)*	*(0.634)*	*(0.266)*	*(0.348)*	*(0.908)*	*(0.429)*
	[−1.680]	[−1.680]	[−1.682]	[−1.816]	[−1.033]	[−2.535]	[−1.725]	[−0.733]	[−1.405]
*d_FI**MEIRELLES (−1)	**0.010**		**0.010**	**0.039*****		**0.032*****	**0.041****		**0.041****
	(0.006)		*(0.007)*	*(0.013)*		*(0.011)*	*(0.016)*		(0.018)
	[1.466]		[1.461]	[3.038]		[2.887]	[2.508]		[2.299]
*d_FI**TOMBINI (−1)		**0.016**	**0.016**		**0.032**	**0.021**		**0.019**	**0.016**
		(0.016)	*(0.016)*		*(0.049)*	*(0.034)*		(0.087)	*(0.062)*
		[1.011]	[1.011]		[0.640]	[0.601]		[0.217]	[0.255]
DUMMY	**−0.589*****	**−0.603*****	**−0.588*****	**−0.847*****	**−1.026*****	**−0.998*****	**−0.865*****	**−1.322***	**−0.890*****
	(0.133)	*(0.133)*	*(0.133)*	*(0.166)*	*(0.242)*	*(0.281)*	*(0.273)*	*(0.786)*	(0.329)
	[−4.447]	[−4.529]	[−4.413]	[−5.090]	[−4.239]	[−3.549]	[−3.171]	[−1.683]	[−2.710]
Adjusted R^2	0.473	0.473	0.472	0.292	0.330	0.234	0.237	0.236	0.226
F-Statistic	26.179	26.091	21.842						
p-Value	0.000	0.000	0.000						
Ramsey RESET	1.226	1.374	1.337						
p-Value	0.270	0.243	0.250						
Rank				21	21	30	30	27	30
Durbin–Wu–Hausman test (prob.)				0.772	0.789	0.924	0.814	0.823	0.920
p-Value (*J*-statistic)				0.434	0.233	0.848	0.899	0.625	0.857

Source: Authors' estimates.
Marginal significance levels: ***0.01, **0.05, *0.1.
Coefficients in bold, SEs in parentheses and *t*-statistics in square brackets. Regarding OLS estimates, due to the problems of autocorrelation and heteroscedasticity (Table A2 in the Appendix shows the residual diagnostic tests), the reported *t*-statistics in the OLS estimates are based on the estimator of Newey and West (1987).

$$CI_t = \varphi_1 + \varphi_2 INFD_t + \varphi_3 IR_{t-1} + \varphi_4 d_{ER} + \varphi_5 MEIRELLES * d\_FKI_{t-1} + \varsigma_t \quad (14)$$

$$CI_t = \rho_1 + \rho_2 INFD_t + \rho_3 IR_{t-1} + \rho_4 d_{ER} + \rho_5 TOMBINI * d\_FKI_{t-1} + \theta_t \quad (15)$$

$$CI_t = \gamma_1 + \gamma_2 INFD_t + \gamma_3 IR_{t-1} + \gamma_4 d_{ER} + \gamma_5 MEIRELLES * d\_FKI_{t-1} + \gamma_6 TOMBINI * d\_FKI_{t-1} + \Phi_t \quad (16)$$

$$CI_t = \delta_1 + \delta_2 INFD_t + \delta_3 IR_{t-1} + \delta_4 d_{ER} + \delta_5 MEIRELLES * d\_FI_{t-1} + \Psi_t \quad (17)$$

$$CI_t = \eta_1 + \eta_2 INFD_t + \eta_3 IR_{t-1} + \eta_4 d_{ER} + \eta_5 TOMBINI * d\_FI_{t-1} + \Omega_t \quad (18)$$

$$CI_t = \omega_1 + \omega_2 INFD_t + \omega_3 IR_{t-1} + \omega_4 d_{ER} + \omega_5 MEIRELLES * d\_FI_{t-1} + \omega_6 TOMBINI * d\_FI_{t-1} + \mathrm{X}_t \quad (19)$$

where $\varepsilon, \vartheta, \varsigma, \theta, \Phi, \psi, \Omega$ and X are random error terms.

Furthermore, we perform quantile regression estimations to observe the effect clarity has on different levels of credibility. Introduced by Koenker and Bassett (1978), quantile regression divides the distribution in a way that a given proportion of observations is located below the quantile. In this sense, it is possible to observe the estimated coefficient to different parts of the credibility distribution. We estimate the quantile regression with moving blocks bootstrap (MBB), which provides robust SEs to heteroscedasticity and autocorrelation of unknown form (Fitzenberger 1998). The quantile regression method allows one to observe the effects of clarity for different levels of credibility, that is, the method allows checking the hypothesis that clarity becomes relevant if the monetary policy is committed with the inflation target.

Table 6 presents TOBIT estimates. The findings corroborate previous results. Thus, all estimates provided by the different methods – in order to check robustness – indicate the same results.

Table 6. TOBIT estimates (dependent variable: credibility index).

	Equation (12)	Equation (13)	Equation (14)	Equation (15)	Equation (16)	Equation (17)	Equation (18)	Equation (19)
CONSTANT	**0.473*****	**0.473*****	**0.475*****	**0.474*****	**0.474*****	**0.475*****	**0.473*****	**0.473*****
	(0.072)	*(0.072)*	*(0.072)*	*(0.073)*	*(0.072)*	*(0.072)*	*(0.073)*	*(0.072)*
	[6.578]	[6.586]	[6.599]	[6.508]	[6.566]	[6.602]	[6.496]	[6.557]
INFD	**−0.138*****	**−0.138*****	**−0.138*****	**−0.138*****	**−0.138*****	**−0.138*****	**−0.138*****	**−0.138*****
	(0.017)	*(0.017)*	*(0.017)*	*(0.017)*	*(0.017)*	*(0.017)*	*(0.017)*	*(0.017)*
	[−7.999]	[−8.047]	[−7.974]	[−7.879]	[−7.973]	[−8.009]	[−7.906]	[−8.036]
IR (−1)	**0.021*****	**0.021*****	**0.021*****	**0.021*****	**0.021*****	**0.021*****	**0.021*****	**0.021*****
	(0.006)	*(0.006)*	*(0.006)*	*(0.006)*	*(0.006)*	*(0.006)*	*(0.006)*	*(0.006)*
	[3.469]	[3.487]	[3.446]	[3.407]	[3.450]	[3.448]	[3.424]	[3.469]
d_ER	**−0.374***	**−0.396***	**−0.377***	**−0.382***	**−0.375***	**−0.394***	**−0.385***	**−0.396***
	(0.221)	*[0.222]*	*(0.221)*	*(0.218)*	*(0.221)*	*(0.221)*	*(0.218)*	*(0.222)*
	[−1.694]	[−1.784]	[−1.708]	[−1.755]	[−1.698]	[−1.780]	[−1.769]	[−1.784]
d_FKI (−1)	**−0.055***							
	(0.032)							
	[−1.71]							
d_FI (−1)		**0.021***						
		(0.011)						
		[1.859]						
*d_FKI**MEIRELLES (−1)			**−0.060***		**−0.060***			
			(0.035)		*(0.035)*			
			[−1.747]		[−1.747]			
*d_FKI**TOMBINI (−1)				**−0.030**	**−0.030**			
				(0.099)	*(0.098)*			
				[−0.306]	[−0.308]			
*d_FI**MEIRELLES (−1)						**0.021***		**0.021***
						(0.013)		*(0.013)*
						[1.690]		[1.690]
*d_FI**TOMBINI (−1)							**0.018**	**0.018**
							(0.024)	*(0.024)*
							[0.765]	[0.766]
Left censored obs.	10	10	10	10	10	10	10	10
Right censored obs.	0	0	0	0	0	0	0	0
Uncensored obs.	131	131	131	131	131	131	131	131

Source: Authors' estimates.
Marginal significance levels: ***0.01, **0.05, *0.1.

Regarding quantile regression, we choose to use simpler specifications. These specifications capture the central idea of the previous analysis: the relation between clarity and credibility. The lagged CI is included as a regressor in order to capture the effect of all other variables as well as the idea of persistence. The specifications are

$$CI_t = \gamma_1 + \gamma_2 CI_{t-1} + \gamma_3 d\_FKI_{t-1} + \varepsilon_t \quad (20)$$

$$CI_t = \rho_1 + \rho_2 CI_{t-1} + \rho_3 d\_FI_{t-1} + \zeta_t \quad (21)$$

Table 7 presents the estimates. The findings reveal that for higher levels of credibility, the effect of clarity on the credibility is higher and statistically significant; while for low levels of credibility, the effect of clarity on the credibility is smaller and, in most cases, the estimated coefficients do not show statistical significance. The estimated coefficients for *d_FKI* are increasing, in absolute values, alongside the quantiles, and the coefficients for *d_FI* present similar results.

The findings corroborate the hypothesis that clarity is important for credibility, but it depends on the level of credibility and thus on the commitment of the central banker with the goal of inflation control. The results reinforce the reasons why clarity was more effective during Meirelles' mandate than during Tombini's mandate.

Figure 4 presents the graphs for the dynamics of the coefficients per quantile. The graphs illustrate the results reported in Table 6. It is possible to observe that the coefficients, which represent the effect of the clarity of central bank communication on credibility, increase, in absolute values, for higher values of credibility.

V. Discussion

Despite the years of 2003 and 2004, when the inflation rate exceeded the upper tolerance limits of the inflation target due to the *Lula effect*, the mandate of Meirelles is marked by the maintenance of inflation within the tolerance limits. On the other hand, the mandate of Tombini is marked by an increase in the inflation rate, which in 2015 exceeded the upper limit (see Table 8). If we compare the mean value of inflation deviations from the inflation target for the whole mandate of Meirelles with the mean value of such deviations for

Table 7. OLS and quantile regression estimates (dependent variable: credibility index).

		Quantiles								
	OLS	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
CONSTANT	**0.051***	**−0.025**	**−0.036***	**−0.006**	**−0.005**	**0.005**	**0.013**	**0.032***	**0.076*****	**0.154*****
	(0.031)	(0.030)	(0.021)	(0.018)	(0.010)	(0.011)	(0.014)	(0.019)	(0.020)	(0.052)
	[1.660]	[−0.840]	[−1.713]	[0.315]	[0.050]	[0.438]	[0.932]	[1.661]	[3.867]	[2.949]
CI (−1)	**0.912*****	**0.820*****	**0.933*****	**0.941*****	**0.961*****	**0.982*****	**1.011*****	**1.008*****	**0.979*****	**0.923*****
	(0.042)	[0.053]	[0.039]	[0.028]	[0.016]	[0.018]	[0.022]	[0.028]	[0.028]	[0.073]
	[21.773]	[15.323]	[23.688]	[33.131]	[58.535]	[54.515]	[45.190]	[36.071]	[34.664]	[12.638]
d_FKI (−1)	**−0.039****	**−0.028***	**−0.023**	**−0.011**	**−0.006**	**−0.018**	**−0.022**	**−0.040***	**−0.069****	**−0.103*****
	(0.020)	(0.016)	(0.016)	(0.023)	(0.020)	(0.020)	(0.018)	(0.019)	(0.027)	(0.038)
	[−1.977]	[−1.710]	[−1.427]	[−0.486]	[−0.277]	[−0.888]	[−1.220]	[−2.084]	[−2.578]	[−2.734]
CONSTANT	**0.052***	**−0.020**	**−0.031**	**−0.009**	**0.000**	**0.001**	**0.013**	**0.035***	**0.095*****	**0.161*****
	(0.031)	(0.030)	(0.023)	(0.018)	(0.009)	(0.010)	(0.015)	(0.020)	(0.022)	(0.049)
	[1.666]	[−0.689]	[−1.361]	[−0.509]	[0.000]	[0.050]	[0.905]	[1.780]	[4.280]	[3.243]
CI (−1)	**0.911*****	**0.814*****	**0.922*****	**0.940*****	**0.959*****	**0.988*****	**1.010*****	**1.000**	**0.950*****	**0.915*****
	(0.043)	(0.052)	(0.040)	(0.029)	(0.015)	(0.018)	(0.024)	(0.028)	(0.030)	(0.071)
	[21.229]	[15.621]	[22.928]	[32.483]	[65.441]	[55.107]	[42.125]	[36.107]	[31.608]	[12.844]
d_FI (−1)	**0.010****	**0.009**	**0.008**	**0.004**	**0.002**	**0.002**	**0.004**	**0.007**	**0.016*****	**0.030*****
	(0.005)	(0.006)	(0.005)	(0.006)	(0.004)	(0.005)	(0.004)	(0.005)	(0.006)	(0.010)
	[2.188]	[1.627]	[1.551]	[0.766]	[0.411]	[0.391]	[1.056]	[1.613]	[2.784]	[3.124]

Source: Authors' estimates.
Marginal significance levels: ***0.01, **0.05, *0.1.
Coefficients in bold, SEs in parentheses and *t*-statistics in square brackets. Regarding OLS estimates, due to the problems of autocorrelation and heteroscedasticity, the reported *t*-statistics in the OLS estimates are based on the estimator of Newey and West (1987). In the quantile regression, we follow Fitzenberger (1998) and we use moving blocks bootstrap (MBB) as an estimator for standard errors in quantile regression that is robust to heteroscedasticity and autocorrelation of unknown forms.

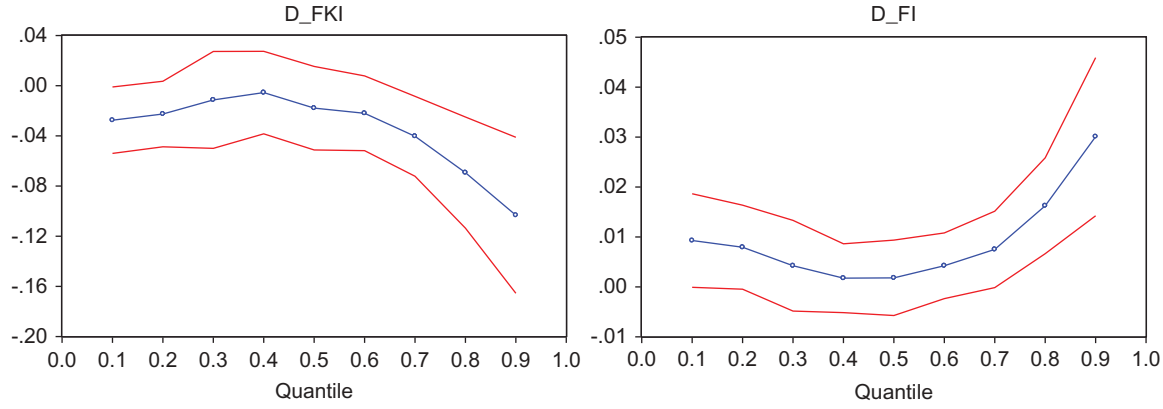

Figure 4. Coefficient per quantile (dependent variable: credibility index (CI). Source: Authors' elaboration.

Table 8. Inflation rates (Consumer Price Index – IPCA) and inflation targets.

Period	Observed inflation	Lower limit	Upper limit	Inflation target	CBB governors
2003	9.3	1.5	6.5	8.5	
2004	7.6	3.0	8.0	5.5	
2005	5.7	2.0	7.0	4.5	
2006	3.1	2.5	6.5	4.5	Meirelles
2007	4.5	2.5	6.5	4.5	
2008	5.9	2.5	6.5	4.5	
2009	4.3	2.5	6.5	4.5	
2010	5.9	2.5	6.5	4.5	
2011	6.5	2.5	6.5	4.5	Tombini
2012	5.8	2.5	6.5	4.5	
2013	5.9	2.5	6.5	4.5	
2014	6.4	2.5	6.5	4.5	
2015	10.6	2.5	6.5	4.5	

Source: Data obtained from the website of the Central Bank of Brazil.
The observed inflation for 2015 refers to the inflation rate accumulated in 12 months observed in March.

the so far mandate of Tombini, it is possible to observe (based on monthly data that we use in our analysis) that Meirelles had a mean value of 1.07 while Tombini has a mean value of 1.73.

In terms of the clarity of the CBB's communication, based on the indexes we use – *Flesch reading easy score* (FI) and *Flesch-Kincaid grade level* (FKI) – one can see that both indexes indicate a little more clarity during Tombini's mandate (see Table 9). Nevertheless, the findings suggest that the clarity of the CBB's communication did not present significance during Tombini's mandate, though considering the whole period analysed as well as Meirelles' mandate the findings indicate the effect of clarity on credibility.

Table 9. Clarity indexes (mean values).

	Clarity indexes (mean values)	
CBB governors	FI	FKI
Tombini	25.12	17.83
Meirelles	22.54	18.32

Source: Authors' elaboration.

In this sense, based on the findings of the empirical analysis and on data presented above, some interesting insights arise: the benefit brought by the clarity to the credibility depends on the commitment of the monetary authority with the goal of keeping inflation under control, as well as with the ability to guide expectations. If the central bank is committed with the goal of keeping inflation under control, clarity is an element of central bank communication which helps to build credibility. However, if the monetary authority deviates from its main goal, clarity does not present the expected effect on credibility; and the reason for this is quite simple: the public stops paying attention to what the central bank is talking, no matter how.

VI. Conclusion

This paper analysed the influence of the clarity of the CBB's communication on the credibility of monetary policy. Based on the literature about the clarity of central bank communication, we use two clarity indexes: the *Flesh ease score* and the *Flesh-Kincaid grade level*. Both indexes measure the readability of the text. In turn, in order to measure credibility, we use the CI proposed by de Mendonça (2007). Based on different econometric techniques, the findings suggest that when the CBB increases the clarity of its reports, credibility is enhanced.

Moreover, we tried to answer whether the effect of the clarity of the CBB's communication on credibility depends on the governor in charge. This is particularly important due to the fact that the two governors of the CBB differ in terms of success regarding inflation control. Meirelles achieved high values of credibility and kept the inflation rate closer to the target, while Tombini achieved higher inflation rates and lower levels of credibility. Our findings suggest that the lack of commitment in Tombini's mandate reduced the benefit from the clarity of central bank communication. Therefore, the beneficial effect of clearer communication over the credibility of monetary policy depends on the commitment of the central banker with the goal of inflation control.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Table A1. VAR lag order.

VAR lag order: CI and *d_FI*					VAR lag order: CI and *d_FKI*				
Model	With constant		Without constant		Model	With constant		Without constant	
Lag	SC	HQ	SC	HQ	Lag	SC	HQ	SC	HQ
0	3.681	3.653			0	1.307	1.279		
1	2.363*	2.279*	2.325*	2.269*	1	−0.089*	−0.173*	−0.127*	−0.183*
2	2.454	2.315	2.435	2.323	2	−0.027	−0.166	−0.046	−0.158
3	2.557	2.362	2.547	2.380	3	0.054	−0.141	0.043	−0.124
4	2.582	2.331	2.548	2.325	4	0.099	−0.153	0.063	−0.160
5	2.722	2.415	2.684	2.405	5	0.211	−0.096	0.167	−0.112
6	2.809	2.446	2.774	2.440	6	0.327	−0.036	0.285	−0.049
7	2.942	2.524	2.897	2.507	7	0.421	0.003	0.370	−0.020
8	3.007	2.533	2.955	2.509	8	0.541	0.067	0.482	0.036

* indicates lag order selected by the criterion.
SC: Schwarz information criterion; HQ: Hannan–Quinn information criterion.

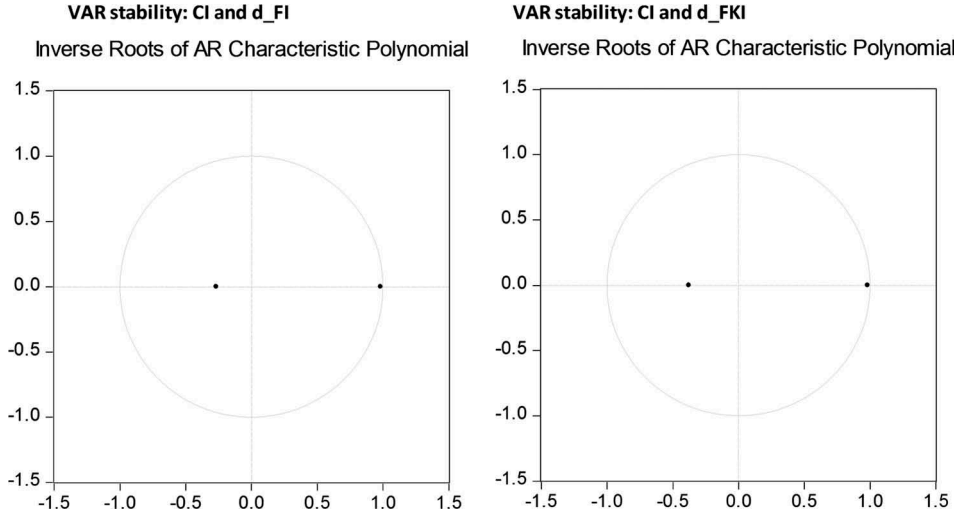

Figure A1. Inverse roots of AR characteristic polynomial. Source: Authors' elaboration.

Table A2. Residual diagnostic tests (OLS estimates).

	Equation (3)	Equation (4)	Equation (5)	Equation (6)	Equation (7)	Equation (8)	Equation (9)	Equation (10)
LM (1)	382.476	380.020	380.505	377.854	379.792	384.311	374.724	380.393
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LM (2)	190.002	188.673	188.997	188.054	188.647	190.951	186.198	188.826
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breuch–Pagan	2.234	2.214	2.171	2.461	2.010	2.132	2.412	1.930
p-Value	0.054	0.056	0.061	0.036	0.069	0.065	0.040	0.080
Jarque–Bera	3.438	3.248	3.424	3.380	3.340	3.253	3.384	3.260
p-Value	0.179	0.197	0.180	0.184	0.179	0.197	0.184	0.196

Source: Authors' elaboration.