IRANIAN ECONOMIC REVIEW
Print ISSN: 1026-6542
Online ISSN: 2588-6096
https://ier.ut.ac.ir/
University of Tehran

Central Bank Credibility in Inflation-Targeting Economies: Do Domestic Institutions Matter?

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Article Info

Article Type: Research Article

Article History:
Received: 20 December 2021
Received in revised form: 14 March 2022
Accepted: 04 April 2022
Published online: 03 December 2023

Keywords:
Central Bank Credibility, Inflation Targeting Framework, Institutional Determinants, Quantile Regression.

JEL Classification:
E50, E52, E58.

ABSTRACT

This paper examines the main institutional determinants of central bank credibility (CBC) from 1990 to 2014. As the CBC is highly concentrated in the right tail of the distribution, the mean-based approaches are an incomplete description of CBC reaction when the parameters are not uniform over the conditional distribution of the credibility. In departing from the problem, I use a Quantile Regression approach, providing superior information on the institutional determinants nexus across various parts of the credibility distribution. Covering 25 inflation targeting economies, I find institutional determinants are prominent and significant at the lower quantiles. This evidence could be attributed to the less sensitivity of the private sector's expectations to the institutional characteristics. Central bankers, aiming to stabilize the economy, credibility growth, or target inflation, could reduce public expectations by taking into account the non-linear impact of institutional factors on their credibility.

Cite this article: Kamal, E. (2023). Central Bank Credibility in Inflation-Targeting Economies: Do Domestic Institutions Matter? *Iranian Economic Review, 27*(4), 1495-1519.
DOI: 10.22059/IER.2022.87485

Publisher: University of Tehran Press.
DOI: 10.22059/IER.2022.87485

1. Introduction

In the monetary realm, failures to stick to quantitative limits on the growth of monetary aggregates favored the spread of inflation-targeting (IT) in the 1990s. According to Amato and Gerlach (2002), this evolution of monetary policy constitutes the most important change in the monetary policy framework since the collapse of the Bretton Woods system in 1971. Under IT, central banks are

mandated to achieve price stability and keep inflation expectations around the target by raising credibility.

The concept of credibility has been deeply considered in the very seminal papers of Cukierman and Meltzer (1986) and Blinder (1998; 2000). However, the debate over the central bank's credibility (CBC) has remained in two major questions: What measures the CBC? How does the institutional structure of a country affect the CBC? To address the first question, three main kinds of credibility measures have been extended in the literature. First, Bomfim and Rudebusch (2000) index. Second, a backward-looking measure of Neuenkirch and Tillmann (2014). This index focuses on how the private sector pays attention to the past performance of the central bank. The third is a forward-looking measure that refers to the gap between inflation expectation and the target (De Mendonça, 2007; Cecchetti and Krause, 2002; Levieuge et al., 2018). The well-known index of Levieuge et. al. (2018) belongs to this category. The advantages of this indicator refer to two main properties: first, it is not based on ad hoc upper and/or lower thresholds. Second, negative and positive deviations of expected inflation from the target are not considered equivalent in terms of (loss in) credibility (non-linearity). With these in mind, a credible central bank, on top of being attitude-inducing and willing as defined above, should have the ability. Beyond a strong rationale for internal factors and some beliefs in the central bank's ability to meet the announced target, some have argued that deeper external-specific factors determine whether a central bank can reach and enforce the announced target. These exogenous forces reflect in institutional factors. These political determinants ultimately affect the public belief, expectations, and attitude toward the central bank's ability. According to this argument and in the case of the latter question, the most powerful determinants of CBC are generally nested in its political economy aspects, such as the central bank independence (CBI), the nature of political institutions, and the quality of democracy in a society. Generally, the dominant view is that all political constraints at the core of policy-making effectively bind the public attitude.

Taking as my point of departure the CBC that is the public’s attitude about the central bank’s ability, the analysis below contributes to lines of scholarly inquiry. First, there is a limited studies regarding political economy of CBC (Kamal and Taghinejadomran, 2021). However, there is strong evidence in the literature about the political economy of the CBI, fiscal policies, and democratic policy-making (see e.g. Cukierman et al., 1992; Grilli et al., 1991; De Haan and Eijffinger, 2016; Burkovskaya, 2019; for CBI; Kopits and Symansky, 1998; Schuknecht, 2004;

Alesina and Passalacqua, 2016; Beetsma et al., 2019; Debrun and Jonung, 2019; for fiscal policies; Drazen, 2002 for CBI and democracy). Our sense of the vast empirical literature on this ground is that certain institutional features such as parliamentary versus majoritarian electoral rules, the presence of multiple constitutional checks and balances, partisan smokescreens, and the turnover rate of central bank governors are determinants of public debt. For instance, CBI, institutional constraints, and IT framework have contributed to improving policy outcomes (Alesina and Passalacqua, 2016; Debrun and Jonung, 2019). Specifically, the CBI in democracies along with a conservative fashion behavior, multiple veto players, and the presence of political opposition can limit government actions. This outcome is directly reflected in lower money supply growth. Besides being more disciplinarian, printing less money ensures a more robust money demand and reduces inflation expectations (Bodea and Hicks, 2015). Nevertheless, a variety of institutional arrangements raise questions about the impact of political institutions on the public's attitude about the central bank's ability. Second, to dig deeper into political determinants of central bank credibility, I use a forward-looking measure for three reasons: i- The CBC means people believe that the central bank has the ability to meet its previous announcements. ii- The central bank's ability is affected by some external institutional factors. iii- All these constraints at the core of policy-making impact on the public's expectations. Third, as the forward-looking measure of Levieuge et al. (2018) is highly concentrated in the right tail of the distribution, the mean-based approaches are an incomplete description of CBC reaction when the parameters are not uniform over the conditional distribution of the credibility. In departing from the problem, I use Quantile Regression (QR) to estimate the whole conditional distribution of credibility. Thus, to the best of my knowledge, this paper is the first study, seeking to fill these voids by providing evidence in the context of the institutional determinants of CBC in 25 IT economies from 1990 to 2014. Moreover, QR analysis offers a broad perspective on the asymmetric effect of institutional factors on the CBC. To realize these notions, this paper is organized as follows. Section Two provides an overview of the existing measures of central bank credibility. Section Three discusses institutional determinants of the CBC. Section Four provides data. Section Five analyses empirical results and Section Six discusses and concludes.

2. Central Bank Credibility Measures

Three main types of credibility measures have been extended in the literature. The first refers to the Bomfim and Rudebusch (2000) index, assessing the weight the private sector attaches to the inflation target when forming their inflation expectations. In this approach, long-run inflation expectations ($\pi^{e}_{\infty|t}$) equal to a weighted average of the current inflation target and the past inflation rates over α periods ($\overline{\pi}_{t-\alpha} = \pi_{t-1} + \cdots . + \pi_{t-\alpha})/\alpha$:

$$\pi^{e}_{\infty|t} = \lambda\hat{\pi}_t + (1-\lambda)\overline{\pi}_{t-\alpha}, \quad (1)$$

where the parameter λ measures the central bank credibility, meaning that the higher λ, the higher the weight attached by the economic agents to the target, and as a result, the higher the central bank credibility will be. If λ=1 the central bank is fully credible and the private sector's inflation expectations are equal to the announced target. In this case, the expected inflation is equal to the inflation target due to the absence of serial correlation in the shock process, the lack of any backward-looking element in the model equations, and the discretionary nature of monetary policy. On the contrary, If λ=0, there is no credibility at all. To sum up, two shortcomings driven by the following restrictions: first, when agents are heterogeneous, λ is considered as the fraction of the population believing that the target will be achieved. Second, λ is a time-invariant parameter.

The second type of credibility measure refers to the backward-looking version of Neuenkirch and Tillmann (2014). In this indicator, inflation expectations $\pi^{e}_{t|T}$ are a weighted sum of the inflation target $\hat{\pi}$ (the rational expectations component) and a non-rational term $(\overline{\pi}_{t-\alpha} - \hat{\pi})|\overline{\pi}_{t-\alpha} - \hat{\pi}|$:

$$\pi^{e}_{t|T} = \hat{\pi}_t + \delta(\overline{\pi}_{t-\alpha} - \hat{\pi})|\overline{\pi}_{t-\alpha} - \hat{\pi}|, \quad (2)$$

$CR_{NT} = (\overline{\pi}_{t-\alpha} - \hat{\pi})|\overline{\pi}_{t-\alpha} - \hat{\pi}|$ is a central bank credibility index $(-1 \leqslant CR_{NT} \leqslant 1)$. This term describs that how the average of past deviations or past performance of the central bank from the inflation target affects the current level of credibility.

The third type of measure points to the forward-looking measure. This indice refers to the gap between inflation expectations and the inflation target. The newest forward-looking indicator extended by Levieuge et. al. (2018) points out that any deviation of expectations from the target is a loss for credibility. Taking values from 0 (no credibility) to 1 (full credibility), it is defined such that:

$$CR_{LLR} = \frac{1}{\exp(\hat{\pi}^{e}) - \hat{\pi}^{e}}, \quad (3)$$

where $\hat{\pi}^e$denotes deviation between the expected inflation (π^e)and the target $\hat{\pi}$. Levieuge et al. (2018) argue that negative and positive deviations of the expected inflation from the target should not be considered equivalent in terms of (loss in) credibility. In this case, any deviation from the target is an asymmetric loss. Negative deviations do mean that credibility is compromised, but any positive deviation signals a higher loss in credibility than an equivalent negative one.

3. Institutional Determinants

In this section, we dig into the literature to discover the main institutional factors affectting the CBC. Basically, central bank preferences depend on the constitutional structure and political background (Masciandaro, 2021). From a theoretical perspective, Friedman (1962) believes that the constitutional rule in the monetary policy field set to tie central bankers' hands. While Keynes (1971) ensures that the government is the monetary policymaker. In this case, the central bank is only a technical body that retains discretion in implementing the day-to-day policy (Masciandaro, 2021; Rivot, 2013). In other words, the central bank acts as an institution that is the only executor of the government's administrative and bureaucratic agents. Therefore, the CBI, central bank's preferences, and the gain of credibility are likely to be meaningless concepts in that line of thought.

The narrative begins when the CBC emerges as a solution to unravel the general time-inconsistency problem raised by Kydland and Prescott (1977). Eijffinger and De Haan (2016) highlight that since institutions are the most important political architectures for determining the monetary regime, political institutions significantly influence the extent to which the independence of the central bank. In this context, several studies offer fundamental contributions in analysing the relationship between political institutions and the CBI (Cukierman, 2013; Cukierman and Webb, 1994; Grilli et al., 1991; Eijffinger and De Haan, 1996, 2016; Eijffinger and Hoeberichts, 1998; Keefer and Stasavage, 2002; Moser, 1999; Blinder et al., 2017; De Haan and Eijffinger, 2017; Beetsma et al., 2022; Burkovskaya, 2019; Masciandaro, 2021). Another strand of literature investigates the the relationship between the CBI and the implementation of conservative[1]

[1]. Central banker's conservatism is not only a proxy for the importance of monetary stability in policy makers' goal functions, but this feature can positively affect the private sector's view as the public are confident the central bank meets its inflation commitment. Although the conservatism and CBI both can boost the CBC, in the literature, they have different concepts: Independence is an institutional feature of the monetary regime, while conservatism is defined as a personal attitude of the central banker (see Hefeker and Zimmer, 2011; Darabi and Samimi, 2016; Masciandaro, 2021)

monetary policies (For example, Gali and Monacelli, 2005; Eijffinger and Hoeberichts, 2008; Hefeker and Zimmer, 2011; Darabi and Samimi, 2016). A recent strand of literature analyses that boosting credibility is conditional on the effectiveness of political factors (Berger et al., 2001; Fernández-Albertos, 2015; Farvaque, 2002; Pistoresi et al., 2011). Hallerberg (2002) claims that the central banks in federal countries with multi-party governments have the highest level of independence and credibility. This is often because that subnational governments prefer an independent central bank to restrain central political authorities' control over monetary policy.

In a seminal paper, Cukierman (1992) suggests that the process of appointing monetary committee members is the primary mechanism that generates partisan implications in monetary institutions. According to Goodman (1991), the higher the party's political instability, the more independent the central bank will be. Since politicians in office anticipate that they will lose upcoming elections, they have a strong incentive to delegate authority to the central bank to restrict the range of policy actions and tie the hands of the future government (Eijffinger and De Haan, 1996). Nalepa and Xue (2018) report that the CBI enhances the CBC to the extent that there are multiple veto players in government. According to Keefer and Stasavage (2002), veto players such as individual politicians, political parties, institutions, and organizations have the power to block a proposed change in current policies, and their agreement is necessary before policies change. Furthermore, the CBI in democracies that have a deterrent effect on fiscal overspending may constrain fiscal policies (Bodea and Higashijima, 2017; Williamson, 2018; Debrun and Jonung, 2019; Strong and Yayi, 2021). Broadly, central banks in a democratic system not only have a delegated authority to achieve their legally mandated objective(s), but they also have the instrument independence to reach those objective(s). In such a society, delegating monetary policy to an independent central bank, promising to keep inflation low will be more credible (Eijffinger and De Haan, 2016; Bodea and Hicks, 2015). In a quotation of Bernanke (2010): "a central bank subject to short-term political influences would likely not be credible when it promised to meet the target inflation, as the public would recognize the risk that monetary policymakers could be pressured to pursue short-run expansionary policies that would be inconsistent with long-run price stability. When the central bank is not credible, the public will expect high inflation and, accordingly, demand more-rapid increases in nominal wages and prices. Thus, lack of independence of the central bank can lead to higher inflation and inflation

expectations in the longer run, with no offsetting benefits in terms of greater output or employment."

Unlike previously published research papers which focus on the relationship between the CBI, fiscal policies, and the political economy when the outcome is located at the mean, this paper pays attention to the relationship at the different points in the credibility distribution. As the response of the CBC to institutional determinants at the different locations on the distribution is expected to differ, understanding how the institutional factors affect the CBC when the credibility is low or high could be very useful to policymakers.

4. Data

Given mentioned characteristics of political economy settings, a set of key drivers are taken into account to capture the institutional determinants of CBC over the period 1990 to 2014[1]. According to this classification, the sample of IT economies is composed of Albania, Armenia, Australia, Brazil, Canada, Chile, Colombia, Czech Republic, Hungary, Indonesia, Israel, Mexico, New Zealand, Norway, Peru, Poland, Romania, South Africa, Sweden, Thailand, Turkey, United Kingdom, and Uruguay. Table 1 defines all variables. In this study, the endogenous variable is a CBC index, as suggested by Levieuge et al. (2018). Concerning private-sector inflation expectations, I use the forecast survey dataset provided by Consensus Economics, gathering forecasts of professional analysts for a large sample of macroeconomic variables.

The CBI is one of the radical institutional determinants of CBC. Bade and Parkin (1985), Grilli et al. (1991), Cukierman et al. (1992), and Alesina and Summers (1993) have developed a set of indices to gauge the degree of independence. Legal CBI and de facto CBI are the two main approaches to measuring CBI. Legal CBI refers to the level of independence abdicated by law (See Bade and Parkin, 1985; Grilli et al., 1991) whereas the de facto CBI refers to the level of autonomy that a central bank has in practice, i.e. the turnover rate (TOR) of central banks' governor (Cukierman et al., 1992). The turnover rate is counted by the number of central bank governor changes, based on the idea that removing a central banker prematurely (before the end of his/her first term) can be a sign of the executive branch's attempts to appoint an obedient central banker. In this paper, I focus on

[1]. Based on the data availability for expected inflation and CBI

de facto CBI (TOR)[1], known in the literature as an inverse proxy of CBI (i.e. a higher turnover rate indicates a lower level of independence). I also calculate the four-year the central bank governor's turnover rate (Strong and Yayi, 2020) using the data set provided by Dreher et al. (2008; 2010) and information on central bank websites.

To assess the effect of a democratic system, I draw data from International Institute for Democracy and Electoral Assistance (IDEA, 2020). To classify other political institution variables, I rely on the dataset from the Database of Political Institutions (DPI), Keefer and Stasavage (2003), and Beck et al. (2001). Following the literature, the existence of partisan veto players and the ideological polarization in the legislature is considered by two variables of polarization (Polariz[2]) and the government frac (Govfrac). Polariz is defined as the maximum difference between the value of the three largest government parties and the largest opposition party. Polariz will be zero if the chief executive's party has an absolute majority in the legislature. Government frac or fragmentation is the probability that two random picks will produce legislators from different parties. The higher fragmentation, the larger number of actors will be willing to act independently. The fraud dummy variable is on this question, is there electoral fraud? If candidate intimidation is serious enough to affect the outcome of elections, it takes value one otherwise, 0. Finally, The veto players in a political system are also a proxy of the institutional rigidity of checks and balances (Checks).

Additional to these institutional determinants, I consider two control variables. The variables refer to the economic structure and the macroeconomic performance, including pegged exchange rate regime and inflation rate. The International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions (1990-2019) presents exchange rate regimes. I classified countries according to those that adopt some form of a nominal pegged exchange rate (=1) and those that do not. I also use the inflation rate gathered from WDI as the higher the inflation rate, the lower the credibility will be.

[1]. I use TOR index of CBI (Eijffinger and De Haan, 2016; Masciandaro, 2021; Strong and Yayi, 2020) for two main reasons: first, the rule of law is less embedded in the political economy for emerging countries. Second, information on the real term in office is easily available for a large set of countries (Lucotte, 2009).

[2]. The maximum difference of orientation among government parties (0-2)

5. Empirical Results

5.1 Regression Analysis

The principal objective of this empirical analysis is to identify the main institutional determinants to boost the extent of the CBC in IT countries. Therefore, I evaluate the effect of institutional determinants given as follows:

$$CBC_{it} = \delta_0 + \delta_1{}' INST_{it} + \delta_2{}' X_{it} + \epsilon_{it}, \quad (4)$$

CBC_{it} is a credibility index and $INST_{it}$ is the vector of institutional variables. X_{it} denotes the vector of control variables, the subscripts i and t describe to the country and year, respectively. β_0 indicates the constant and ϵ_{it} refers to the error term.

As previously mentioned I use a four-year moving average to calculate the TOR (See Dreher and De Haan, 2008; Strong and Yayi, 2020).

The empirical evidence[1] presented in Table 3 relies primarily on data for the 1990–2014 period. Regressions are estimated via fixed effects. Regressions are estimated via fixed effects. Regression 4 tests the proposition about the effect of political institutions on the extent of CBC. As shown in Appendix Table 3, there exists a positive and significant relationship between the number of veto players (Checks) and the level of credibility. In line with Keefer and Stasavage (2002; 2003) and Lucotte (2009), in the presence of multiple veto players, it becomes harder to reverse a decision to delegate. In other words, political replacement of central bank governor is less likely in the presence of multiple political veto players. Such effectiveness increases with the polarizing of veto players. The analysis in Table 3 shows that the polarizing of preferences of veto players raise the CBC with a positive and significant coefficient. However, none of the rest of the main variables are statistically significant. On control variables, only the inflation rate significantly affects the CBC over the sample considered.

5.2 Quantile Regression

Figures 1 and 2 plot the histogram and kernel density of the outcome and highlight the considerable heterogeneity in the CBC distribution. These plots provide a visual summary of the distribution of credibility covering the 1990–2014 period. Although the credibility is distributed across the whole spectrum of index values, it is highly concentrated in the right tail of the distribution. The credibility distribution appears to narrow with the lower tail moving toward the mode of the distribution. Note that the considered regression in Table 3 does not make any

[1]. The panel unit root test is reported in Table A2 (See Appendix).

allowance for the fact that institutional effects may not be symmetric across the distribution of the outcome. They might differ between those central bankers who have high and those who have low credibility. To address this effect, I estimate a series of quantile regression to evaluate the influence of all determinants across various percentiles of the credibility distribution. The QR, introduced by Koenker and Bassett (1978), seeks to estimate how the conditional quantiles of credibility (outcome) are affected by institutional determinants (interest variables)(Koenker and Hallock, 2001; Siklos, 2008; Christelis et al., 2020). The QR has several desirable properties over the conventional OLS technique. First, QR estimators are more robust to outliers in the data than the OLS estimators, the same way, the median is more robust to outliers than the mean. Second, QR estimators are consistent even when the error terms are non-Gaussian. Third, due to the nonparametric nature of QR, researchers do not have to assume the distribution of the error term. Fourth, the QR is used to uncover the presence of asymmetry in the slope parameter (Chevapatrakul, 2015). Fifth, quantile regression is a proper tool for studying such heterogeneity in Figures 1 and 2 (Koenker and Hallock, 2001; Cameron and Trivedi, 2005).

To deliver these notions, following Siklos (2008), regression 4 is fitted for various quantiles such as (0.25, 0.50, 0.75, 0.95) as follows:

$$Q_{cbc}(q|INST) = \gamma_0 + \gamma_1^{'} INST_{it} + \gamma_2^{'} X_{it} + F_u^{-1}(q), \quad (5)$$

where F_u denotes the joint distribution function of the errors, q is the quantile, and all other terms have previously been defined.

Figure 3 illustrates the basic idea of a quantile analysis of the relationships between institutional factors and credibility. Superimposed on the plot are four estimated quantile regression scatters corresponding to the quantiles 0.25 (1), 0.5(2), 0.75(3), and 0.95(4). The median q=0.5 fit is indicated by the red plus, the lower quantile (25 percent) shown by (1) is plotted as the circle and the upper tail (0.75 and 0.95) of the CBC captured by times and triangular signs, respectively. The QR scatters reveal that the conditional distribution of the credibility index is skewed to the left. The narrower space of the upper quantiles denotes high density and a short upper tail. The wider space of the lower quantiles indicates a lower density with a longer lower tail. The conditional median and the other quantiles confirm that the least square fit is a relatively poor estimate of the conditional mean in the sample.

The estimates for a selection of quantiles are presented in Table 4 and Figure 4. I focus both on the median and the tails of the distribution of CBC. Figure 4 summarizes quantile regression results (Equation 5) for institutional determinants

of CBC. I plot 6 distinct quantile regression estimates (q) ranging from 0.25 to 0.95 by the solid curve with filled dots. Each plot has a horizontal quantile and a vertical scale of institutional factors. The dashed line marks the ordinary least squares estimation. The two dotted lines present conventional 90 percent confidence bands for the least-squares estimates. The shaded gray area also describes a 90 percent confidence interval for QR estimates. All plots reinforce the reason why least square regression may not fully convey the connection between political variables and CBC.

I start with the regression at the median credibility. On the contrary with the fixed effect results, the level of democracy (DEM) and government frac positively and fraud negatively affect the average CBC. Next, I turn to analysis at the lower quantile (viz., 0.25). Here, the effect of all institutional determinants on the level of credibility is significant with the expected signs. Finally, I turn to the upper tail of the CBC distribution and report regression results for the 0.75 and 0.95 quantiles. The result here is different. At the 0.75 and 0.95 quantiles, none of the institutional characteristics, except fraud at the location of 75 percent, are statistically significant. Concerning control variables, the inflation rate is statistically significant and negative in all quantiles, while pegged exchange rate regime negatively affects the credibility only at the upper tail of 95 percent.

6. Conclusion

This paper identifies the major institutional determinants of the CBC in 25 IT economies by contributing to the literature in two ways. First, surprisingly, empirical evidence on this concept is only limited to the political economy of CBI in the literature, while CBI is one of determinants of the CBC. Thus, this paper seeks to fill this void by providing evidence in the context of the institutional determinants of CBC. Second, as the credibility is highly concentrated in the right tail of the distribution, the mean-based approaches are incapable of unearthing the fact that the effect of political factors may be asymmetric across the distribution. In departing from the literature, I use the QR approach following Koenker and Bassett (1978) and Siklos (2008), providing superior information on the political determinants nexus across various parts of the CBC distribution. The asymmetric response is state-dependent and conditional on the location of the CBC on the distribution. Therefore, I empirically tested my data using a QR panel model from 1990 to 2014. The main results of institutional determinants of the CBC can be summarized as follows.

Although the effect of all institutional determinants on the credibility is significant at the 25th quantile, the level DEM and Govfrac is more important at the median, while the impact of electoral fraud on the CBC is crucial at the upper levels of credibility (50^{th} and 75^{th} quantiles). To clarify these institutional specifications, I start with the inverse proxy of CBI (TOR index). The sensitivity of the credibility to the turnover rate of the central bank's governor is statistically significant only when CBC is low and under 25 percent. This outcome could be attributed to the higher expected inflation during periods of lower CBI where credibility is more elastic to the increase of TOR. Furthermore, the response of CBC to the presence of multiple veto players and the polarization at the lower quantile shows that when the central bank is not credible enough, the rise of the number of checks and balances and their polarizing could be as a flip of good news. Such positive action reduces the expected inflation. The response of CBC to the democratic environment is statistically significant and strong at 25^{th} and median quantiles. This result is in line with Burkovskaya (2019). On another institutional determinant, ideological polarizing in the legislature by Govfrac positively affects the level of credibility only when CBC is relatively dropping. Specifically, the higher fragmentation, the larger number of independent parties. These independent parties influence affirmative on the agents' expectations and increase the CBC even when policy changes. Finally, the higher elasticity of credibility to the electoral fraud at the upper quantiles might be explained by influencing the public's attitude toward the level of democracy. Once electoral fraud happens, the public doubt the central bank's independence and the existence of democracy. These would negatively affect the private sector's view and reduce CBC back to a lower level. The quantile regression results suggest that out of political determinants, CBC is mostly found to respond to the institutional factors at the lower tails of the CBC distribution. The evidence could be attributed to the less sensitivity of the private sector's expectations to the institutional characteristics of a central bank.

An understanding of the asymmetries in the relationship between CBC and political factors could be a matter to policymakers. Central bankers, aiming to stabilize the economy, credibility growth, or target inflation, could reduce public expectations by taking into account the non-linear impact of institutional factors on their credibility.

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Appendix

Table A1. Definition and Sources of Variables

Variables	Definition	Sources
Level of Democracy (DEM)	This index has been constructed by the average level of three types of democracy attributes, representative government fundamental rights, and checks on Government. The representative government attribute emphasizes contested and inclusive popular elections for legislative, and executive offices by four sub-attributes including clean elections, free political parties, inclusive suffrage, and elected government. Fundamental rights in the form of liberal and social rights support both fair representation and the vertical mechanism of accountability by composing three sub-attributes: access to justice, civil liberties, and social rights and equality. Finally, the three sub-attributes (Effective parliament, Judicial independence, Media integrity) are aggregated into the Checks on Government. If the legislature and the judiciary or a critical and pluralistic press check executive power, they are not prone to be abused for private gain and to biased political decision-making and implementation.	The Global State of Democracy (2020), International Institute for Democracy and Electoral Assistance (International IDEA), Author's calculations
CBI index (TOR)	Central Bank Independence Index is defined as a 4-year moving average of the Turnover rate.	Dreher et al. (2008; 2010), WDI, World Economic Outlook database and

		author's calculation
Checks and Balances	The number of decision-makers whose agreement is necessary before policies can be changed. or the number of veto players in government parties	Database of Political Institutions (DPI),WDI, Beck et al. (2000), Keefer and Stasavage (2003)
Govfrac (Government fractionalization)	Probability that two random picks will produce legislators from different parties	Database of Political Institutions (DPI),WDI, Beck et al(2000),Keefer and Stasavage (2003)
Polarize	The maximum difference of orientation among government parties (0-2)	Database of Political Institutions (DPI),WDI, Beck et al. (2000), Keefer and Stasavage (2003)
Fraud	Is there electoral fraud? Value 1 if vote fraud or candidate intimidation were serious enough to affect the outcome of elections, otherwise 0.	Database of Political Institutions (DPI), WDI, Beck et al. (2000)
Inflation	Measured by the annual percentage change of consumer prices.	WDI
Inflation Expectations	The rate at which the private sector expects prices to rise in the future.	The forecast survey dataset provided by Consensus Economics
Pegged	A currency peg is a policy in which a national government sets a specific fixed exchange rate for its currency with a foreign currency or a basket of currencies.	Annual Report on Exchange Arrangements and Exchange Restrictions, IMF(1990-2019)

Table A2. Fisher-Type Unit Root Test

Variables	Inverse chi-squared(40) P /p-value	Inverse normal z /p-value	Inverse logit t(104) L* /p-value	Modified inv. chi-squared Pm /p-value
CBC	270.293/ 0.000	-10.2430/ 0.000	-15.1338/ 0.000	23.3842/ 0.000
Democracy (DEM)	164.015/ 0.000	-6.764/ 0.000	-8.788/ 0.000	12.303/ 0.000
TOR	266.360 / 0.000	-12.649/ 0.000	-15.971/ 0.000	22.974/ 0.000
Govfrac	97.996/ 0.004	-5.926/ 0.01	-6.074/ 0.03	7.306/ 0.000
Polariz	54.963/ 0.005	-4.437/ 0.006	-4.363/ 0.02	4.969/ 0.000
Checks	77.418/ 0.01	-5.346/ 0.009	-5.296/ 0.01	6.121/ 0.05
Inflation	246.40/ 0.000	-10.601/ 0.000	-13.859/ 0.000	20.893/ 0.000

Source: Research finding.

Table A3. Baseline Results (Fixed Effects Estimation)

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Democracy (DEM)	-0.109					
	(0.794)					
TOR		0.011				
		(0.032)				
Govfrac			0.104			
			(0.080)			
Polariz				0.041 **		
				(0.018)		
Fraud					0.142	
					(0.089)	
Checks						0.029 *
						(0.017)
Pegex	0.014	0.0119	-0.016	-0.036	0.012	-0.011
	(0.108)	(0.107)	(0.109)	(0.104)	(0.106)	(0.108)
Inflation	-4.387 ***	-4.387 ***	-4.255 ***	-4.835 ***	-4.443 ***	-4.541 ***
	(0.578)	(0.574)	(0.580)	(0.635)	(0.572)	(0.580)
Const.	1.030	0.942 ***	0.909 ***	0.921 ***	0.938 ***	0.835 ***
	(0.633)	(0.024)	(0.035)	(0.031)	(0.024)	(0.069)
Observations	288	288	274	287	285	288
Hausman			21.63			
			(0.03)			

Source: Research finding.

Note: Std. errors are in parentheses. *, **, and *** denote significance at the 10, 5 and 1 percent levels, respectively. Hausman test rejects the random effect in favor of fixed effect at the level of 5 percent.

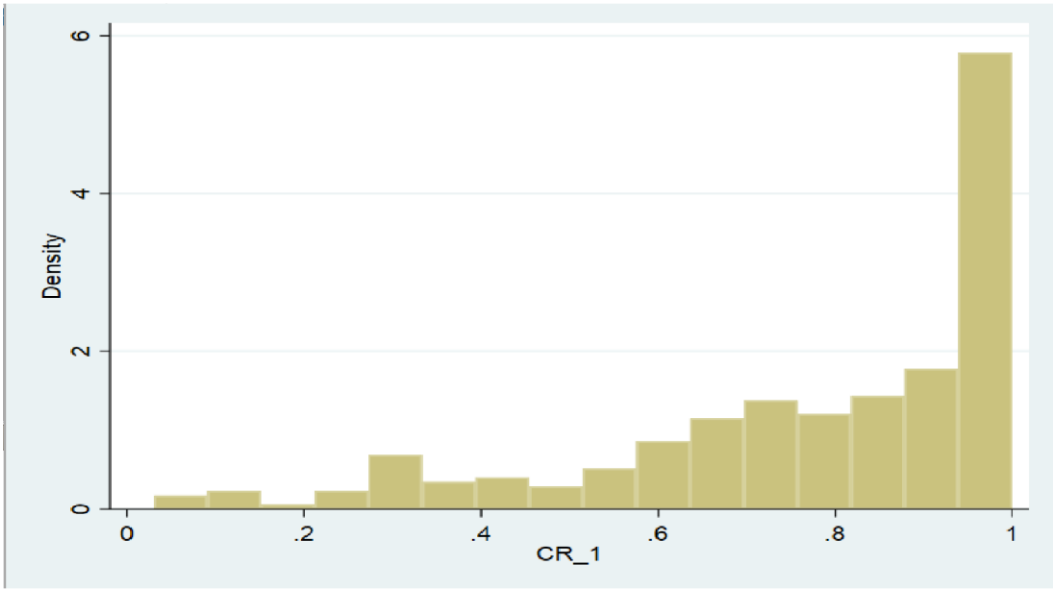

Figure A1. Histogram of the CBC
Source: Research finding.

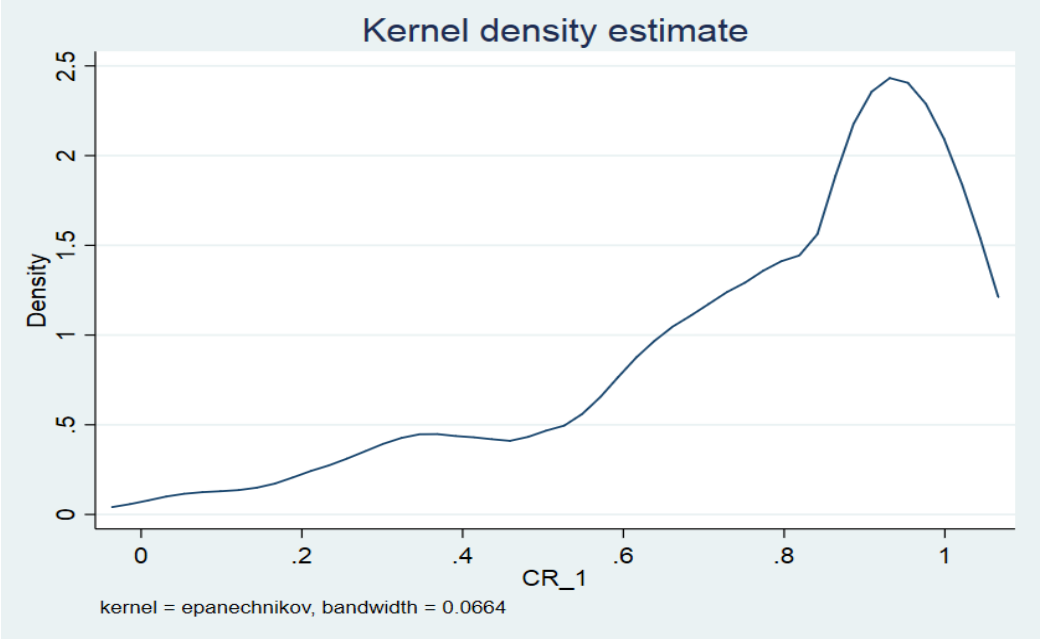

Figure A2. Kernel Density Plot
Source: Research finding.

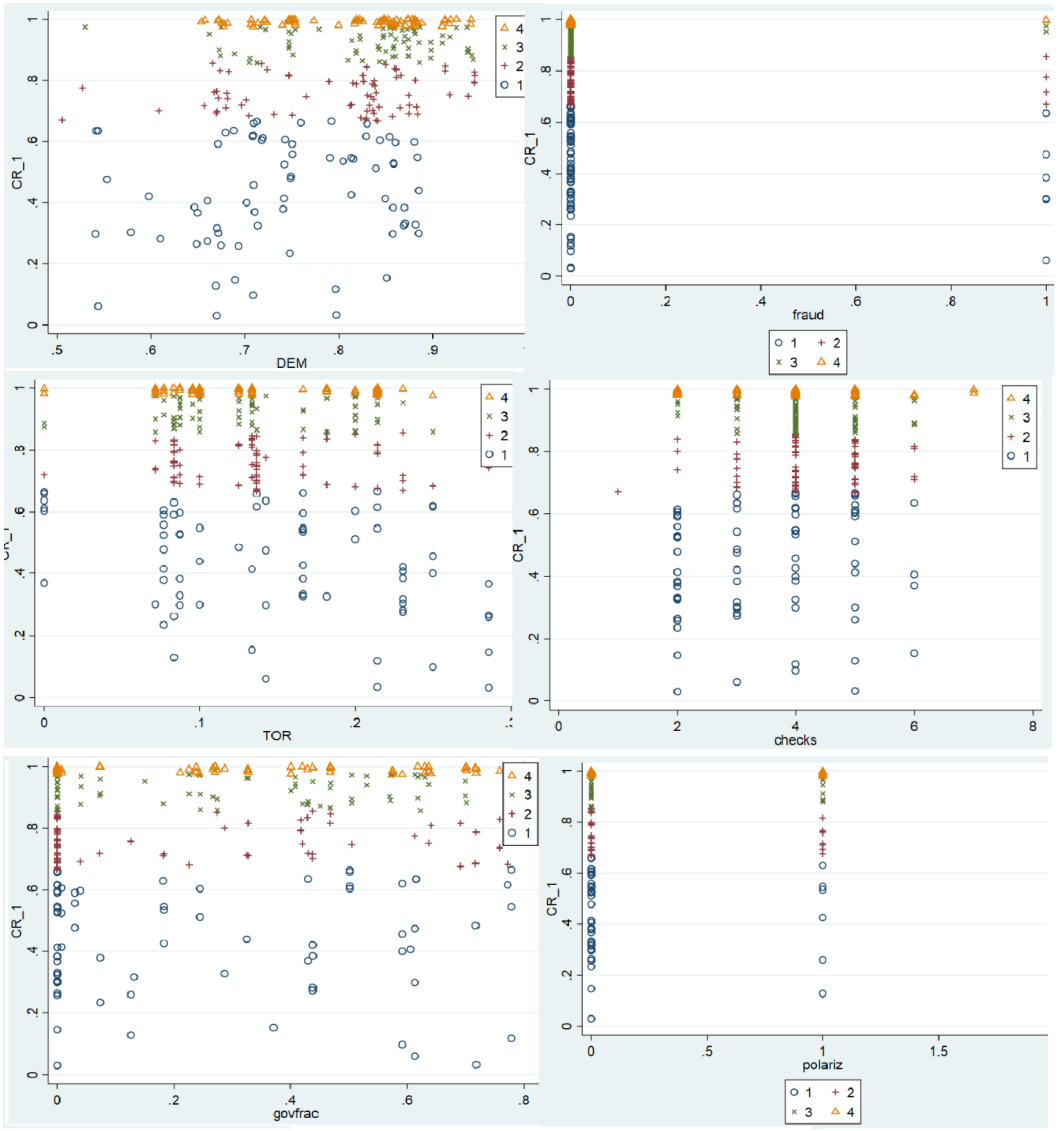

Figure A3. Quantile Regression Estimates for CBC

Source: Research finding.

Table A4. Quantile Regression Estimates

Variables	(0.25)	(0.5)	(0.75)	(0.95)	(0.25)	(0.5)	(0.75)	(0.95)	(0.25)	(0.5)	(0.75)	(0.95)
Democracy (DEM)	0.470 *	0.457 **	0.086	0.008								
	(0.259)	(0.186)	(0.141)	(0.007)								
TOR					-0.70 *	0.102	0.006	-0.011				
					(0.311)	(0.315)	(0.162)	(0.011)				
Checks									0.031 *	-0.005	0.0002	-0.0003
									(0.015)	(0.017)	(0.008)	(0.0007)
Pegged	0.051	-0.105	-0.030	-0.066 ***	0.082	-0.108	-0.0316	-0.06 ***	0.158	-0.100	-0.033	-0.066 ***
	(0.177)	(0.127)	(0.096)	(0.005)	(0.147)	(0.149)	(0.077)	(0.005)	(0.134)	(0.150)	(0.076)	(0.006)
Inflation	-5.791 ***	-4.293 ***	-1.14 ***	-0.062 *	-6.312 ***	-4.840 ***	-1.21 ***	-0.09 ***	-5.95 ***	-4.976 ***	-1.167 ***	-0.0753 ***
	(0.938)	(0.675)	(0.511)	(0.027)	(0.743)	(0.752)	(0.388)	(0.027)	(0.669)	(0.751)	(0.382)	(0.030)
Constant	0.490 *	0.604 ***	0.931 ***	0.994 ***	0.977 ***	0.9813 ***	1.007 ***	1.00 ***	0.751 ***	1.016 ***	1.00 ***	1.002 ***
	(0.222)	(0.160)	(0.121)	(0.006)	(0.050)	(0.051)	(0.026)	(0.001)	(0.070)	(0.079)	(0.040)	(0.003)
Observations	288	288	288	288	288	288	288	288	286	286	286	286
Jarque–Bera test						38.37						
						(0.000)						

Source: Research finding.

Note: Std. errors are in parentheses. *, **, and *** denote significance at the 10, 5 and 1 percent levels, respectively. The null hypothesis in Jarque–Bera test reports normality in data distribution. The result shows that the normality in data distribution is rejected in favor of the asymmetric distribution of credibility in sample economies.

Table A5. Quantile Regression Estimates

Variables	(0.25)	(0.5)	(0.75)	(0.95)	(0.25)	(0.5)	(0.75)	(0.95)	(0.25)	(0.5)	(0.75)	(0.95)
Govfrac	0.16 ***	0.131 *	0.022	-0.0007								
	(0.062)	(0.069)	(0.038)	(0.002)								
Polariz					0.06 ***	0.032	0.011	0.0005				
					(0.022)	(0.011)	(0.0117)	(0.0007)				
Fraud									-0.22 *	-0.187 *	-0.1257 *	-0.002
									(0.088)	(0.077)	(0.051)	(0.003)
Pegged	0.069	-0.091	-0.024	-0.066 ***	0.059	-0.1004	-0.036	-0.067 ***	0.038	-0.111	-0.033	-0.066 ***
	(0.132)	(0.147)	(0.081)	(0.005)	(0.145)	(0.145)	(0.072)	(0.004)	(0.151)	(0.132)	(0.087)	(0.006)
Inflation	-6.29 ***	-4.36 ***	-1.3 ***	-0.082 ***	-5.89 ***	-3.85 ***	-1.2 ***	-0.065 *	-6.52 ***	-4.65 ***	-1.187 ***	-0.083 ***
	(0.655)	(0.730)	(0.404)	(0.029)	(0.817)	(0.818)	(0.408)	(0.027)	(0.750)	(0.655)	(0.435)	(0.033)
Constant	0.84 ***	0.94 ***	1.0 ***	1.00 ***	0.80 ***	0.94 ***	0.99 ***	0.999 ***	0.91 ***	0.994 ***	1.00 ***	1.00 ***
	(0.034)	(0.038)	(0.021)	(0.001)	(0.046)	(0.046)	(0.023)	(0.001)	(0.034)	(0.030)	(0.020)	(0.001)
Observations	287	287	287	287	240	240	240	240	288	288	288	288

Source: Research finding.

Note: Std. errors are in parentheses. *, **, and *** denote significance at the 10, 5 and 1 percent levels, respectively.

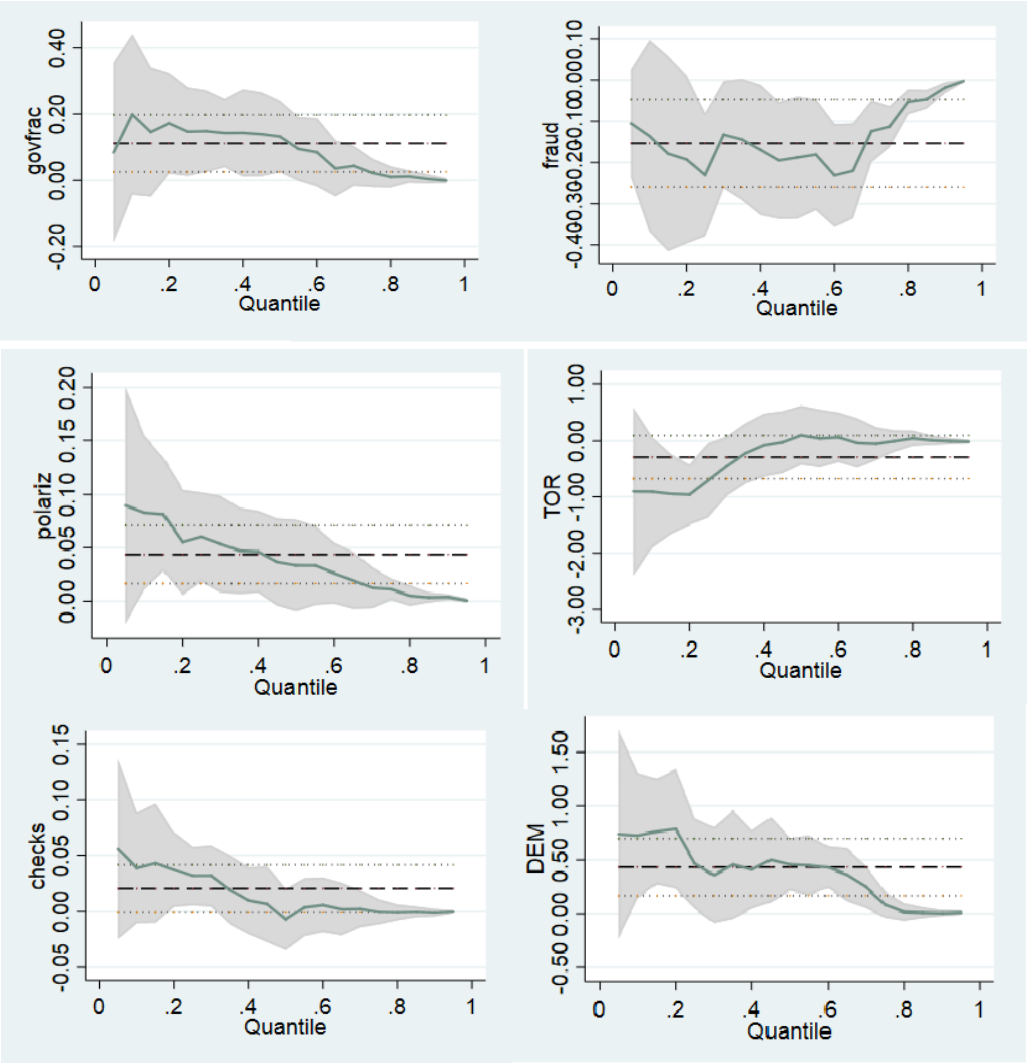

Figure A4. Ordinary Least Squares and Quantile Regression Estimates for CBC
Source: Research finding.