

# More Effective Than We Thought

## Central Bank Independence and Inflation in Developing Countries\*

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### **Abstract**

*This study examines the effect of legal central bank independence on inflation in developing countries. In spite of the policy consensus suggesting that central bank independence is an effective tool to control inflation, the evidence is still limited, particularly for developing countries. Using a novel dataset, we analyze the effect of central bank independence on inflation for a sample of 118 developing countries between 1980 and 2013. We find that higher central bank independence is associated with lower inflation rates. This effect on inflation is stronger the more democratic a country is, but it is also present in non-democratic countries. Our results are robust to different specifications and methodologies. Furthermore, we find that all dimensions included in the measurement of central bank independence (objectives, personnel, policy, and financial independence) contribute to curb inflation. Our results shed light on which types of reforms may be more effective at fighting inflation in developing countries.*

**Keywords:** Central bank independence, inflation, measurement, democracy, developing countries.

**JEL Classification:** E31, E52, E58

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# 1 Introduction

Is central bank independence an effective tool to control inflation in developing countries? Price stability is the major monetary policy objective of most central banks. The motivation behind this objective is the widely studied notion that inflation, above a certain threshold, is detrimental to the real economy (Sidrauski, 1967; Tobin, 1965).<sup>1</sup> Developing countries are especially vulnerable to the negative effects of high inflation (Bick, 2010; Bittencourt, 2012; Burdekin et al., 2004; Ibarra and Trupkin, 2016; Kremer et al., 2013, among others). Therefore, much research has been devoted to find policies and institutions that promote price stability. Since the late 1980s, central bank independence – that is, allowing central banks to control monetary instruments without political interference – became the key institutional recipe to fight inflation, and inspired a wave of reforms in central banks around the world (Goodfriend, 2007). Although most countries granted more independence to their central banks, there is no conclusive evidence of a general negative relationship between central bank independence and inflation for developing countries (Alpanda and Honig, 2014; Cukierman, 1992; Neyapti, 2012).

The purpose of this study is to examine the effect of central bank independence (CBI) on inflation in developing countries. We use a novel dataset coded by Garriga (2016) on *legal* CBI, and find evidence that more independent central banks are associated with lower inflation rates in developing countries. This effect on inflation is stronger the more democratic a country is, but it is also present in non-democratic countries. Our empirical analysis differs from previous work because we explicitly account for both political and monetary institutional constraints, and because we use alternative estimation techniques. In particular, our results are robust when we use instrumental variables and the GMM systems estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) to take explicitly into account potential endogeneity concerns. Our results are also robust to different model specifications, methodologies, and subsamples.

We contribute to the literatures on central banking and on the economic effects of institutions. First, we empirically analyze the effect of CBI on inflation using a panel of 118 developing countries, with yearly data between 1980 and 2013. To our knowledge, this is the largest sample used in these types of studies. The coverage and frequency of our data give us

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<sup>1</sup> The view that high inflation is harmful for economies relies not only on theoretical arguments (for instance, Fischer and Modigliani, 1978; Orphanides and Solow, 1990), but also on numerous empirical studies (Barro, 1995; Bruno and Easterly, 1998; Fischer, 1993; Levine and Renelt, 1991; Li and Zou, 2002, among others).

confidence that the selection of cases or choices regarding periodization –such as using data in 5- or 10-year periods– are not affecting our results.

Second, we show that legal CBI has robust inflation-curbing effects in the majority of developing countries. Previous literature has found this effect in small subsets of developing countries (Acemoglu et al., 2008; Bodea and Hicks, 2015a; Jácome and Vázquez, 2008; Klomp and de Haan, 2010a; Landström, 2011), questioning the generalizability of the anti-inflationary effects attributed to CBI. In contrast, we find strong evidence that in most developing countries, enhancing the independence of the central bank can reduce the inflation rate between 1 and 6 percentage points, on average.<sup>2</sup> Interestingly, this effect is stronger in more democratic developing countries, but is also present in non-democracies.

Third, from a conceptual perspective, we show that all dimensions included in the definition of our legal CBI index matter. The analysis by components of the CBI index suggests that all dimensions weighed in our measure are significantly associated with lower inflation rates.<sup>3</sup> This is not a trivial result. The multidimensional feature of the aggregate CBI index captures a variety of effects, suggesting possible directions to reform central banks.

Finally, our results contribute to the growing literature studying the effects of political and monetary institutions in autocracies (Bodea et al., 2019; Boix and Svobik, 2013; Gandhi, 2008; Gandhi and Przeworski, 2007; Gehlbach and Keefer, 2012; Magaloni, 2008). Contrasting with previous work, which relied on small and less representative samples, we find robust evidence that CBI has a negative effect on inflation for a considerable set of non-democratic countries. In particular, our findings open new questions regarding the interactions between monetary institutions and exchange rate regimes as commitment mechanisms in non-democratic contexts (Bodea, 2010; Guisinger and Singer, 2010; Rodriguez, 2016; Steinberg and Malhotra, 2014).

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<sup>2</sup> These figures come from Table 2 and refer to the average change from a low to a high CBI for autocracies and full democracies, respectively.

<sup>3</sup> The construction of the dataset follows Cukierman et al. (1992) rules to weigh in a single index the following dimensions: personnel independence, central bank objectives, policy independence, and financial independence. Appendix 1 lists the variables included in each dimension.

## 2 The relationship between CBI and inflation

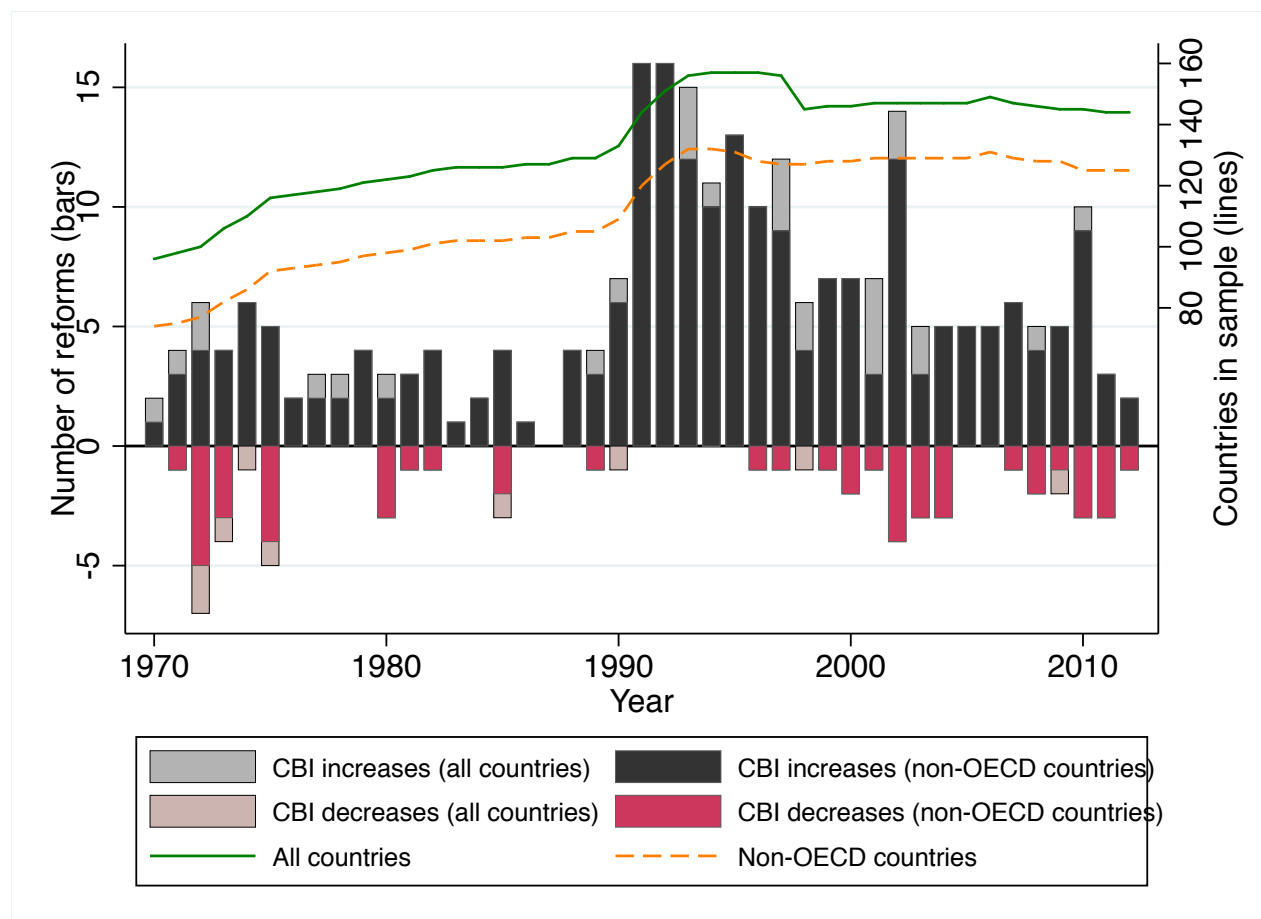
When governments have discretionary control over monetary instruments, they can prioritize other policy goals over price stability throughout their tenure. In particular, after nominal wages are set, politicians may be tempted to use monetary policy to produce short-term boosts in employment and output for electoral purposes, raising inflation. To overcome the time-inconsistency of commitments to price stability, and their inflationary bias (Kydland and Prescott, 1977), the literature stresses the benefits of enforced commitments (rules) over discretion (Barro and Gordon, 1983a, 1983b). In particular, Rogoff (1985) makes a case for delegating monetary policy to independent central banks. Once central bankers are insulated from political pressures, commitments to price stability can be credible, helping to maintain low inflation.

Following these ideas, a considerable policy consensus grew around the potential of CBI to promote inflation stability (Bernhard et al., 2002; International Monetary Fund, 1999; Kern et al., 2019; World Bank, 1992). Numerous countries followed this policy advice. Between 1985 and 2012, and excluding the creation of regional central banks, there were 266 reforms to the statutory independence of central banks, 236 of which occurring in developing countries. Most of these reforms (77%) strengthened CBI (Garriga, 2016). See Figure 1. In spite of the broad impact of this policy advice, the empirical evidence backing it still is controversial, especially for developing countries.<sup>4</sup> Figure 1 shows the reforms in OECD and non-OECD countries in this period.

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<sup>4</sup> Although the figure shows several reforms affecting CBI before the mid-1980s (80 reforms), the 52 CBI increases in this period seem to respond to different motivations, such as transferring the governance of monetary policy to newly created central banks (31 cases).

Figure 1. Reforms to CBI in OECD and non-OECD countries, per year and effect of the reform on CBI scores.



*Notes:* Reforms that increase CBI are coded as positive numbers (bars above the zero line), and reforms that decrease CBI are coded as negative numbers (bars below the zero line). Darker colors indicate reforms in developing countries, and lighter colors indicate the reforms in OECD countries. Data from Garriga (2016). Regional central banks omitted.

Numerous studies find that CBI is associated with lower inflation in developed countries (e.g., Alesina and Summers, 1993; Arnone and Romelli, 2013; Cukierman, 1992; Klomp and De Haan, 2010; Persson and Tabellini, 1990). For developing countries, however, there is no evidence of a general negative relationship between legal CBI and inflation (Bagheri and Habibi, 1998; Crowe and Meade, 2007; Cukierman, 1992; Desai et al., 2003; Klomp and de Haan, 2010b). Some studies have found this correlation in Latin American countries (Jácome and Vázquez, 2008), in former communist countries (Loungani and Sheets, 1997; Neyapti, 2001), in developing democracies (Bodea and Hicks, 2015a), in countries with a medium level of political

constraints (Acemoglu et al., 2008), in countries with high inflation (Landström, 2011), and in small subsamples of countries (Klomp and de Haan, 2010a; Nurbayev, 2017).

In spite of these mixed results, CBI still is an important signal regarding price stability for markets and policymakers.<sup>5</sup> In fact, shielding the central bank from political pressures increases its credibility and helps mitigate the dynamic inconsistency problem often faced by developing countries (Bodea and Hicks, 2015b). In this context, we revisit the relationship between the independence of central banks and inflation.

### 3 Data and methods

#### 3.1 Our measurement of CBI

We measure the independence of central banks with data on legal CBI from Garriga (2016). Given the nature of the question we are addressing, a *de jure* index is an appropriate indicator of CBI for three reasons. First, since we want to study the effect of a policy on a key outcome variable like inflation, a legal measure of CBI is a good indicator of the extent to which countries followed such policy advice.<sup>6</sup> This is in line with important research using a variety of different measures of legal independence to compare central banks features across countries and time (Acemoglu et al., 2008; Alesina et al., 1989; Bodea and Hicks, 2015b; Cukierman, 1992; Eijffinger and Schaling, 1997; Grilli et al., 1991).<sup>7</sup> Second, *de jure* indices focus on specific claims contained in central bank statutes and, thus, are less biased by the presence of possible subjective judgments.

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<sup>5</sup> See for example the OECD discussion for greater CBI in Argentina (OECD, 2017).

<sup>6</sup> Furthermore, some scholars argue that the mere adoption of a legal statute guaranteeing CBI dampens inflationary expectations in the economy (Arnone and Romelli, 2013; Polillo and Guillén, 2005).

<sup>7</sup> Ideally, we would like to have a measure that reflects the effect of legal independence on the *actual* behavior of the central bank. This tends to be especially important in developing countries, where the distance between the law and the government's behavior may be wider than in developed ones. However, as Arnone and Romelli (2013) and Blancheton (2016) argue, such a measure is not easy to define. Background characteristics associated with the monetary system, its credibility, the degree of openness of the economy, and the development of the financial system play a determinant role.

Third, there is not an obviously better measure of CBI for the purposes of our study. On the one hand, other de jure measures are not free from criticism (de Haan and Kooi, 2000; Klomp and de Haan, 2010b). Furthermore, Acemoglu et al. (2008) argue that the Cukierman et al.'s (1992) index is the most commonly used de jure CBI index. Other studies that have updated or expanded Cukierman's et al.'s index have a much smaller geographic and temporal coverage (Bodea and Hicks, 2015b; Dincer and Eichengreen, 2014).<sup>8</sup> On the other hand, the alternative de facto index, the turnover rate of the central bank governor (TOR), associates the independence of this institution to the autonomy of its governor (Cukierman and Webb, 1995; de Haan and Siermann, 1996).<sup>9</sup> As Arnone and Romelli (2013) and Masciandro and Romelli (2013) argue, by not taking into consideration the independence of the other members of the board of directors, such an index might over or underestimate the degree of CBI. Still, for robustness checks, we also consider a measure of TOR (Dreher et al., 2010, 2008).

The legal CBI index from Garriga (2016) uses Cukierman, et al.'s (1992) criteria to code variables describing characteristics of the chief executive officer of the bank (appointment, dismissal, and term of office), the bank's policy formulation attributions (who formulates and has the final decision in monetary policy, and the role of the central bank in the budget process), objectives, and limitations on lending to the public sector. The scores are combined in a single index that ranges from 0 (lowest) to 1 (highest independence). Appendix 1 lists the variables included and their weights. Garriga's dataset covers 159 non-OECD countries, from 1970 to 2012, significantly expanding Cukierman et al.'s (1992) own data, and other efforts to extend them (Bodea and Hicks, 2015a; Crowe and Meade, 2007; Polillo and Guillén, 2005). Furthermore, the data's frequency permits analyzing yearly data, avoiding potential problems of using cross-sectional data, or data in 5- or 10-year periods (Acemoglu et al., 2008; Bagheri and Habibi, 1998; Neyapti, 2012; Nurbayev, 2017).

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<sup>8</sup> Bodea and Hicks (2015b) code 72 countries between 1972 and 2010. Dincer and Eichengreen (2014) code 86 countries between 1998 and 2010. We rely on Garriga's data set because it allows us to include all regions of the world, with more years in our sample, reducing the risks of selection bias. We thank an anonymous referee for encouraging this discussion.

<sup>9</sup> A behavioral measure of CBI is not compatible with this study given that we analyze the effect of an institutional reform (legal CBI) on a key policy variable (inflation).

## 3.2 Data

We test the relationship between CBI and inflation on a sample of 118 non-OECD countries between 1980 and 2013. We exclude observations pertaining to regional central banks, as in Bodea and Hicks (2015a).<sup>10</sup> Appendix 2 lists the countries included in the sample.

Our dependent variable is the log of the inflation rate, measured as the log of the average monthly change in the consumer price index (as in Aisen and Veiga, 2006). Given that some countries have extremely high inflation rates, using inflation instead of its log would make these high-inflation observations more influential (Klomp and de Haan, 2010b).<sup>11</sup> Furthermore, Klomp and de Haan's (2010b) meta-analysis confirms that the use of the logarithm of inflation instead of actual inflation as dependent variable has no effect on the significance of the CBI coefficient and at the same time mitigates problems of heteroscedasticity and outliers (as in Aisen and Veiga, 2006). Mathematically, the inflation rate in year  $t$  ( $\pi_t$ ) is the annual percent change in the monthly average consumer price index (CPI), that is

$$\pi_t = \left[ \left( \frac{\sum_{i=1}^{12} CPI_{i,t} / 12}{\sum_{i=1}^{12} CPI_{i,t-1} / 12} \right) - 1 \right] 100$$

where  $CPI_{i,t}$  and  $CPI_{i,t-1}$  capture the country's average consumer price index in month  $i$  of year  $t$  and  $t-1$ , respectively. For robustness checks, we also consider two alternative measures of inflation used in the literature. First, to take into account hyperinflation episodes, we define a *modified* inflation rate  $D$  as  $\pi/(1 + \pi)$  where  $\pi$  is the inflation rate.<sup>12</sup> This standardization leads to

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<sup>10</sup> Although our sample includes 118 countries, our specifications include fewer countries because of the non-overlapping coverage of one of our control variables: our data on democracies include 110 and 116 countries depending on whether we use Polity2 or Freedom House, respectively, – and these subsamples do not completely overlap. Therefore, when we use Polity2 we have a maximum of 110 countries while when we use Freedom House we have a maximum of 116 countries. Furthermore, the exclusion of observations with regional central banks, the inclusion of a lagged dependent variable, and missing data for other observations also reduce our sample size.

<sup>11</sup> In fact, correcting for outliers may affect the significance of the CBI indicator (Klomp and de Haan, 2010a).

<sup>12</sup> For price increases, this *modified* inflation rate  $D$  takes a value from 0 to 1, while with price decreases it ranges between -1 and 0.



a smoother dynamic of the inflation rate (Cukierman et al., 1992; Jácome and Vázquez, 2008; Vuletin and Zhu, 2011). Second, we also consider a transformation used by other scholars (Bodea and Hicks, 2015a; Busch and Joumlrgens, 2005; David, 2011; Pervez, 2015). This *modified* inflation rate II consists of using the logged inflation rate as the dependent variable while treating negative values similar to the log of the negative inflation rate.<sup>13</sup> The data come from the IMF's *International Financial Statistics*.

Our models include a series of controls. The literature shows the conditioning effect of different measures of democracy or rule of law on CBI (Acemoglu et al., 2008; Bodea and Hicks, 2015a; Fazio et al., 2018). Thus, we include democracy both as a control and interacting with CBI. To proxy democracy, our baseline specification includes the *Polity2* score, that ranges from -10 (total autocracy) to 10 (total democracy) (Marshall and Keith Jagers, 2012). For robustness checks, we also use Freedom House's (2012) data – the average of a country's political rights and civil liberties score. Lower *Freedom House* scores indicate more democratic countries.

Both a country's exposure to capital movements, and its exchange rate regime affect the ability of monetary policy to affect inflation (Fleming, 1962; Mundell, 1961). To account for other policy choices that may affect the anti-inflationary effects of CBI, we include Chinn and Ito's (2008) measure of capital account openness. Although most empirical studies of the effect of CBI on inflation do not include this variable (Acemoglu et al., 2008; Bodea and Hicks, 2015a), developing countries have a wide variance in capital controls (Aizenman, 2018; Aizenman et al., 2010; Obstfeld et al., 2005; Rey, 2015). We also include *Peg*, a dichotomous variable indicating a fixed exchange rate, based on the *de facto* exchange rate regime classification by Reinhart & Rogoff (2009, 2004).<sup>14</sup>

Additionally, we control for *Real GDP per capita*, *Trade openness* –the sum of exports and imports as a share of GDP, following Daniels, et al. (2005) –, and *World Inflation* to capture the effect of price changes in the rest of the world (Bodea and Hicks, 2015a; Lin and Ye, 2012; Neely and Rapach, 2011). *World inflation* is the median yearly percentage change in the consumer

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<sup>13</sup> Additionally, we conducted a comparison of distributions for all three measures of inflation. Using a Kolmogorov-Smirnov test based on the kernel densities, we do not reject the hypothesis of equality of distribution functions. This provides evidence of the similarity of these measures. Results of these tests are not reported here but are available upon request.

<sup>14</sup> *Peg* equals 1 when there is no separate legal tender, when there is a pre-announced peg or currency board arrangement, when there is a pre-announced horizontal band  $\leq +/-2\%$ , or when there is a de facto peg.

price index of all World Bank reporting countries. These data are from the *World Development Indicators* (World Bank, 2018). Following Aisen and Veiga (2006) and Desai, et al. (2003), we control for *Political Instability* with Banks and Wilson's (2016) weighted yearly measure of the number of assassinations, strikes, guerrilla warfare, major crises, purges, riots, revolutions, and anti-government demonstrations.

To analyze the robustness of our main results, we perform a sensitivity analysis, controlling for additional effects. First, countries adopt inflation targeting as a way to increase their level of commitment and credibility to pursue a low inflation (Armand, 2017; Ftiti and Hichri, 2014; Lin and Ye, 2012, 2009; Mishkin, 2004; Ogrokhina and Rodriguez, 2018; Rose, 2007). Thus, we include *Inflation targeting*, a dummy variable that takes the value of 1 if the central bank has an inflation-targeting framework. Second, Acemoglu, et al. (2003) and Aizenman, et al. (2010) argue that countries with procyclical fiscal policy tend to experience more output volatility and higher inflation.<sup>15</sup> We include a measure of fiscal procyclicality (*Fiscal cyclicality*) based on Li, et al. (2011) methodology.<sup>16</sup> Third, following Aizenman, et al. (2010) and Bodea and Hicks (2015a), we include the interest rate differential between each country's interest rate and the US (*Interest rate diff*), as a measure of monetary policy autonomy. Finally, we also control for the degree of economic slack by including a measure of *Output gap*.<sup>17</sup> Following the IMF's WEO methodology from De Masi (1997), we use the Hodrick-Prescott filter (Hodrick and Prescott, 1997) to compute the *Output gap*, defined as the difference between observed real GDP and the trend of real GDP, as a percent of the trend of real GDP. Appendix 3 shows descriptive statistics.

Descriptive data suggest a general correlation between our measure of CBI and inflation. Figure 2 plots yearly averages of CBI and inflation in a sample of developing countries, from 1980 to 2012.<sup>18</sup> The quadrants are divided by the sample mean of inflation, and by the middle point of the CBI scale. All the higher-than-the-mean inflation observations are in the quadrant of

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<sup>15</sup> From a different perspective, Grainville and Mallick (2006) and Jawadi et al. (2016) also argue about the use of fiscal policy with monetary independence.

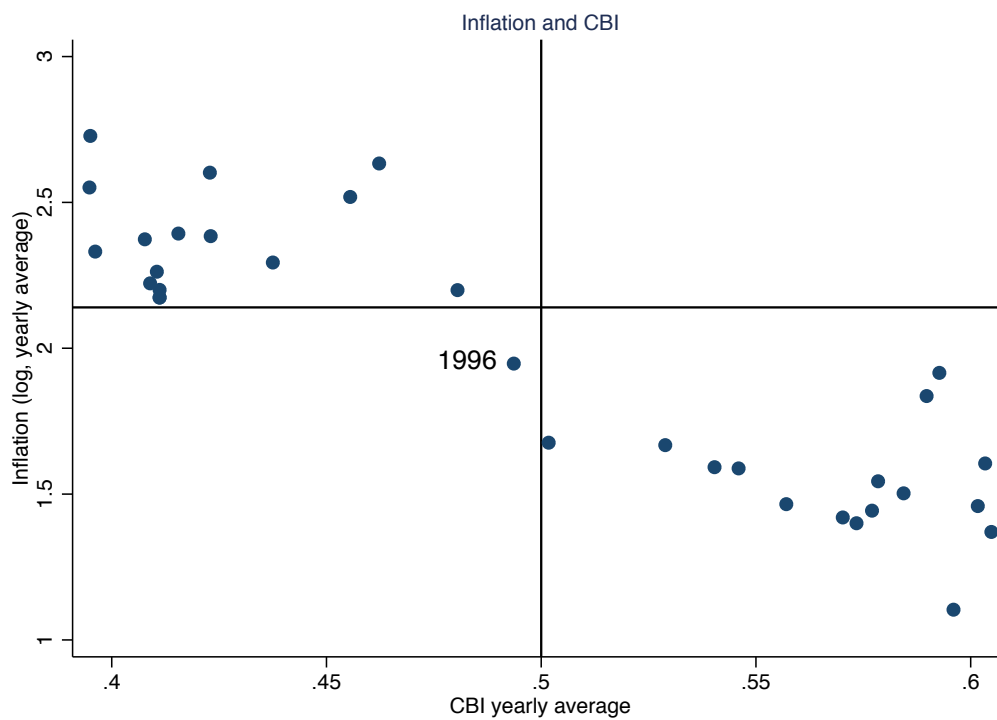
<sup>16</sup> *Fiscal cyclicality* comes from an averaged local linear estimator that uses a non-parametric time-varying coefficients panel data model between government consumption and output gap with fixed effects.

<sup>17</sup> We thank an anonymous reviewer for this suggestion.

<sup>18</sup> For this figure, we use the full sample (118 countries, 34 years) and remove eight extreme outliers before calculating the yearly average of inflation. The removed outliers are: Bolivia 1985, Congo, DR 1994, Kyrgyz Republic 2009, Mauritius 1986, Nicaragua 1988 and 1990, Ukraine 1993, and Zimbabwe 2007.

low CBI, whereas the years with lower inflation are in the high-CBI quadrant. One observation falls outside of the expected quadrants: 1996 (low CBI, below-the-mean inflation).

Figure 2. Correlation between yearly averages of CBI and inflation. Developing countries



*Note.* The horizontal line shows the sample mean for the log of inflation.

Figure 2 suggests a negative relationship between CBI and the inflation rate in developing countries. Although suggestive, these data do not control for confounding factors.

### 3.3 Estimation strategy

Given the panel structure of the data, where subscripts  $i$  and  $t$  represent country and time period respectively, our baseline specification is

$$\pi_{it} = \varphi\pi_{it-1} + \beta_1 CBI_{it} + \beta_2 Dem_{it} + \beta_3 CBI_{it} * Dem_{it} + \delta X_{it-1} + \xi_t + \eta_i + \varepsilon_{it} \quad (1)$$

where  $\pi_{it}$  and  $\pi_{i,t-1}$  are the measure of inflation rate for country  $i$  at time  $t$  and  $t-1$ , respectively;  $CBI_{it}$  is our measure of CBI;  $Dem_{it}$  is a measure of democracy;  $X_{it-1}$  represents a vector of time-varying control variables;  $\xi_t$  is a period-specific constant to account for common shocks;  $\eta_i$  is an unobserved country-specific effect that captures all time-invariant factors that affect the outcome; and  $\varepsilon_{it}$  is the error term. The inclusion of the interaction term enables the analysis of both the direct and indirect effects of CBI and democracy on inflation.

Our benchmark specification is a dynamic panel model with fixed effects. In this type of setup, the inclusion of a lagged dependent variable may introduce a bias (Nickell, 1981). As Wooldridge (2002) explains, when the number of time-series ( $T$ ) is small, this problem is nontrivial since shocks to fixed effects do not diminish over time. However, when  $T$  is at least 30 – it is 33 in our case – the bias is significantly reduced (Beck and Katz, 2011; Beck et al., 2014).<sup>19</sup> In fact, Beck and Katz (2011) conclude that in such case, regardless of the number of cross-sectional units, the Nickel bias is trivially small.

## 4 Results

Table 1 presents the results for our baseline specification. Column (1) shows the unconditional effect of CBI on inflation while column (2) presents our baseline model including the interaction between democracy and CBI. In column (1), CBI is negatively associated with inflation, suggesting an unconditional relation between CBI and inflation (as in Bodea and Hicks, 2015a; Loungani and Sheets, 1997). Regarding the control variables, the estimate associated with *Capital account openness* is negative and statistically significant, consistent with Aizenman et al. (2010), and Razin and Binyamini (2007). *Peg* also shows a negative and statistically significant effect, as expected (Aizenman et al., 2010; Bleaney and Fielding, 2002; Ghosh et al., 1997). The rest of the controls behave similarly in both models: the lagged dependent variable is positive, significant, and predicts about 50% of the variance of the inflation, giving evidence of inertia in the inflation rate. Neither *GDP per capita* nor *Trade openness* achieve statistical significance. *World*

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<sup>19</sup> In Beck et al. (2014) for  $T=40$  and  $N=200$  the bias in their point estimate is only -0.01.

*Inflation* is negative and statistically significant.<sup>20</sup> Finally, consistent with Aisen and Veiga (2006), we find that political instability has a positive relationship with the level of inflation for developing countries. These effects of the control variables are consistent across specifications.

In column (2), although the coefficient associated with CBI is not significant, the interaction term and the joint effect appear significant as indicated by the Wald test. The table reports the joint effect of CBI and the interaction term at different levels of democracy: Polity2=1, the lowest level of democracy for which the joint effect is significant; Polity2=6, the cut-point normally used to indicate a democratic regime, and Polity2=10, a full democracy.<sup>21</sup> Additionally, Figure 3 shows the interpretation of the joint effect, the marginal effect of CBI on the inflation rate by level of democracy.<sup>22</sup> CBI is significantly negatively associated with inflation when Polity2 is  $\geq 0$ , that is, even for most authoritarian regimes. This result differs from previous studies that find that CBI curbs inflation but only in democracies (Bodea and Hicks, 2015a) or only at some levels of institutional constraints (Acemoglu et al., 2008; Hielscher and Markwardt, 2012).<sup>23</sup> This does not mean that institutional constraints are irrelevant. We find that the negative effect of CBI on inflation is stronger in the presence of more democratic institutions.

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<sup>20</sup> To further understand what lies behind the negative coefficient associated with *World Inflation* measured in  $t-1$ , we pursued the following sensitivity analysis. We first considered *World Inflation* in period  $t$ , then in periods  $t$  and  $t-1$ , and finally in periods  $t$ ,  $t-1$ , and  $t-2$ . In all cases, our main results hold. Interestingly, we find evidence that suggests that the transmission of *World inflation* to domestic inflation has an overall positive relationship but shows cyclical oscillations. Following Arellano and Bond (1991) and Beck and Katz (2011), we decided to use one lag of *World Inflation* in our baseline specification to reduce the potential bias associated with endogeneity, and to be consistent with the lag structure of the rest of our control variables. To preserve space, we report these robustness checks in Appendix 4. We thank an anonymous referee for encouraging this discussion.

<sup>21</sup> The coefficients are the linear combination of CBI and the interaction term, at different levels of Polity2. The standard errors associated with these linear combinations are obtained using the delta method.

<sup>22</sup> Operationally, based on equation (1), this implies computing the change of inflation relative to CBI,  $\partial y_{it} / \partial CBI_{it} = \beta_1 + \beta_3 Dem_{it}$  for each value of democracy (Polity2).

<sup>23</sup> In our sample, more than 65% of the observations have Polity2 scores  $\geq 0$ .

**Table 1: Effect of CBI on inflation, 1980-2013.**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

	(1)	(2)
CBI	-0.823** (0.333)	-0.552 (0.357)
Democracy	-0.002 (0.007)	0.021 (0.014)
CBI*Democracy		-0.057* (0.033)
Capital account openness	-0.553*** (0.110)	-0.525*** (0.111)
Peg	-0.304*** (0.062)	-0.302*** (0.061)
Inflation <sub><i>t-1</i></sub>	0.501*** (0.062)	0.497*** (0.061)
GDP per capita <sub><i>t-1</i></sub>	0.128 (0.126)	0.111 (0.129)
Trade openness <sub><i>t-1</i></sub>	-0.001 (0.001)	-0.001 (0.001)
World inflation <sub><i>t-1</i></sub>	-0.046*** (0.015)	-0.045*** (0.015)
Political instability <sub><i>t-1</i></sub>	0.019*** (0.007)	0.018** (0.007)
Effect of CBI at Polity2=1		-0.609* (0.345)
at Polity2=6		-0.895** (0.335)
at Polity2=10		-1.123*** (0.383)
R <sup>2</sup>	0.404	0.405
N. observations	2241	2241
N. of countries	108	108

*Notes:* Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

Figure 3: Marginal effects of CBI on inflation by level of democracy.

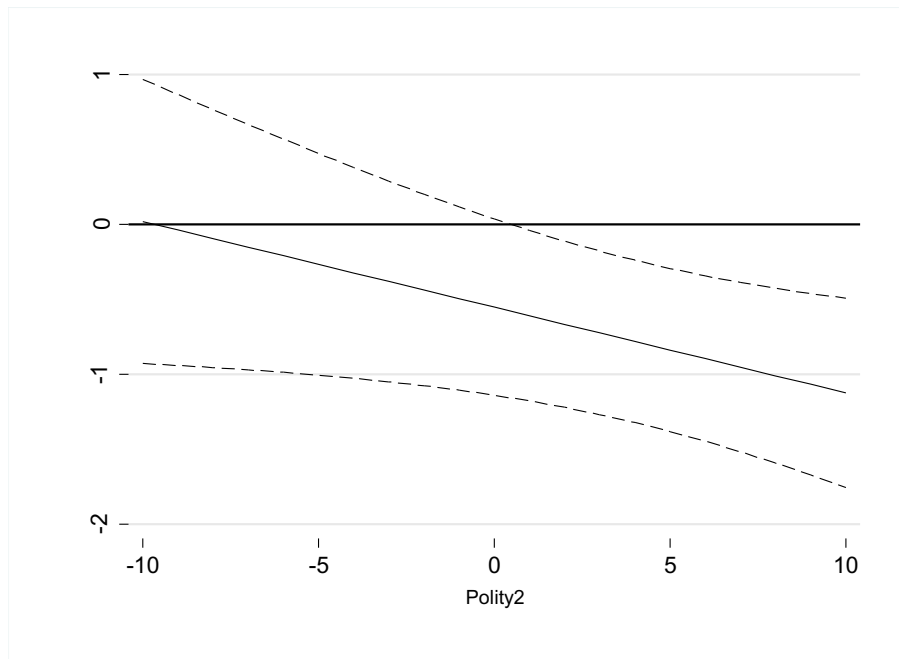


Table 2 shows the predicted inflation rates at different levels of CBI, for different levels of democracy and exchange rate regimes (fixed and flexible), while keeping all the other variables at their observational mean values.<sup>24</sup> All point estimates are significant at 95% confidence level. The predicted inflation rates for full democracies (Polity2=10) with low CBI ( $CBI=0.2$ ) are 10.9% and 14.8% for fixed and flexible exchange rate regimes, respectively. However, the predicted inflation rates for full democracies with high CBI ( $CBI=0.8$ ) are significantly smaller (almost half of those figures), 5.6% and 7.5% – for fixed and flexible exchange rate regimes, respectively. For instance, in 1995-1996, both Lithuania and Costa Rica were full democracies (according to Polity2) with fixed exchange rate regimes. Whereas the Lithuanian central bank had little independence ( $CBI=0.30$ ), Costa Rica had a highly independent central bank ( $CBI=0.73$ ). In that period, the inflation rate in Lithuania was about 32.14%, while it was 20.3% in Costa Rica. These figures are highly consistent with our model predictions.

<sup>24</sup> Predicted values from this table use specification from column (2) in Table 1.

**Table 2: Predicted values of inflation rate for democracies and autocracies, with fixed and flexible exchange rates, at different levels of CBI, 1980-2013.**

Flexible exchange rate		Polity2 index			
		Autocracy <i>Polity2 = -7</i>	Anocracy <i>Polity2 = 0</i>	Democracy <i>Polity2 = 6</i>	Full democracy <i>Polity2 = 10</i>
Fixed exchange rate					
Low central bank independence <i>CBI = 0.2</i>		9.36 \ 12.6	9.96 \ 13.4	10.56 \ 14.2	10.96 \ 14.8
<i>CBI = 0.3</i>		9.26 \ 12.4	9.46 \ 12.7	9.66 \ 13.0	9.86 \ 13.2
Average central bank independence <i>CBI = 0.5</i>		8.96 \ 12.0	8.56 \ 11.5	8.16 \ 11.0	7.96 \ 10.7
High central bank independence <i>CBI = 0.7</i>		8.66 \ 11.7	7.56 \ 10.2	6.76 \ 9.1	6.26 \ 8.4
<i>CBI = 0.8</i>		8.56 \ 11.5	7.16 \ 9.7	6.26 \ 8.3	5.66 \ 7.5

*Notes:* All point estimates are significant at 95% confidence level. Predicted values use specification from column (3) in Table 1. All variables are kept at their mean values with the exception of CBI, democracy, and Peg. In each cell, the first figure is for fixed exchange rates, and the second for flexible exchange rates.

Interestingly, Table 2 also suggests that in absence of an independent central bank, our specification predicts more inflation when countries are more democratic. Holding other things constant, for countries with low CBI ( $CBI=0.2$ ), a movement from autocracies ( $Polity2=-7$ ) to full democracies ( $Polity2=10$ ) is associated with an increase of 2.2 percentage points in the predicted inflation rate (from 12.6% to 14.8%) for flexible exchange rate regimes, and of 1.6 percentage points (from 9.3% to 10.9%) for fixed exchange rate regimes. However, when central banks enjoy higher levels of independence, more democracy is associated with reductions in the predicted inflation rate. For example, when  $CBI=0.8$ , the difference in predicted inflation rate between  $Polity2=-7$  and  $Polity2=10$  is 4.0 percentage points for flexible exchange rate regimes, and 2.9 percentage points for fixed exchange rate regimes. These findings are consistent with Cukierman et al.'s (2002) study of transition economies, and with a new literature showing that CBI has important effects in non-democratic countries (Baerg et al., 2017; Bodea et al., 2019; Johnson, 2016). These results also speak to the longstanding debate on the effects of democracy on inflation (Desai et al., 2003), with studies showing that democracy is associated with higher (Gasirowski, 2000) or lower (Doucouliagos and Ulubaşoğlu, 2008) inflation rates. Our findings suggest that the direction of this effect depends on how independent central banks are, and that accounting for CBI may help conciliating these results.



## 4.1 Sensitivity analysis

This section extends the main results and explores their robustness to alternative model specifications and estimation techniques. In all cases, we use our baseline specification.

Table 3 includes additional controls. Columns (1) and (2) include an indicator for the adoption of an *inflation-targeting* framework. Columns (3) and (4) include *Fiscal cyclicality*. Columns (5) and (6) control for the effect of the US monetary policy on the domestic interest rate (*Interest rates diff*) to capture monetary policy autonomy. Columns (7) and (8) include a measure of *Output gap* that capture the cyclicality of real GDP. Results from columns (1) to (8) are robust and consistent with Table 1. From the set of additional regressors, only *Inflation targeting* has a negative significant point estimate (columns (5) and (6)). This confirms previous research on the beneficial effects of adopting inflation targeting in developing countries (Lin and Ye, 2009). In columns (6) and (8), although the coefficient associated with CBI loses significance, the overall effect of CBI becomes significant once the level of democracy (Polity2) is  $\geq 0$ .

**Table 3: Effect of CBI on inflation, 1980-2013. Sensitivity analysis: Additional regressors**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CBI	-0.782** (0.330)	-0.574 (0.359)	-0.881** (0.341)	-0.763** (0.337)	-1.195*** (0.351)	-0.586* (0.352)	-0.857** (0.337)	-0.587 (0.360)
Democracy	0.000 (0.007)	0.018 (0.013)	0.002 (0.007)	0.012 (0.015)	-0.015 (0.011)	0.028 (0.020)	-0.003 (0.007)	0.020 (0.014)
CBI*Democracy		-0.044 (0.035)		-0.023 (0.032)		-0.101** (0.043)		-0.057* (0.035)
Cap. account Openness	-0.530*** (0.111)	-0.510*** (0.111)	-0.620*** (0.125)	-0.608*** (0.124)	-0.715*** (0.176)	-0.672*** (0.180)	-0.547*** (0.114)	-0.518*** (0.114)
Peg	-0.355*** (0.064)	-0.350*** (0.063)	-0.245*** (0.070)	-0.242*** (0.069)	-0.193** (0.091)	-0.191** (0.090)	-0.309*** (0.060)	-0.305*** (0.059)
Inflation <sub>t-1</sub>	0.487*** (0.061)	0.485*** (0.061)	0.450*** (0.068)	0.449*** (0.068)	0.183*** (0.068)	0.173** (0.068)	0.498*** (0.062)	0.494*** (0.062)
GDP per capita <sub>t-1</sub>	0.145 (0.129)	0.131 (0.131)	0.240* (0.133)	0.232* (0.131)	-0.123 (0.230)	-0.156 (0.229)	0.167 (0.139)	0.152 (0.140)
Trade openness <sub>t-1</sub>	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.002)	-0.002 (0.002)	-0.001 (0.001)	-0.001 (0.001)
World inflation <sub>t-1</sub>	-0.045*** (0.015)	-0.044*** (0.015)	-0.041** (0.019)	-0.041** (0.019)	-0.044* (0.023)	-0.040* (0.023)	-0.044*** (0.016)	-0.043*** (0.016)
Political instability <sub>t-1</sub>	0.017** (0.007)	0.016** (0.007)	0.015* (0.008)	0.015* (0.008)	0.014* (0.008)	0.012 (0.008)	0.020*** (0.007)	0.019*** (0.007)
Inflation targeting	-0.408*** (0.138)	-0.383*** (0.145)						
Fiscal cyclicality			5.339 (4.464)	5.355 (4.450)				
Interest rates differential					-0.042 (0.059)	-0.045 (0.059)		
Output gap							-0.360 (0.772)	-0.397 (0.759)
Effect of CBI at Polity2=1		-0.618* (0.346)		-0.786** (0.331)		-0.687** (0.335)		-0.647* (0.348)
at Polity2=6		-0.840*** (0.333)		-0.902*** (0.347)		-1.192*** (0.332)		-0.929*** (0.341)
at Polity2=10		-1.018*** (0.385)		-0.995*** (0.408)		-1.597*** (0.418)		1.158*** (0.394)
R <sup>2</sup>	0.408	0.409	0.382	0.382	0.194	0.199	0.405	0.407
N. observations	2241	2241	1744	1744	1286	1286	2204	2204
N. of countries	108	108	96	96	99	99	108	108

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

Table 4 uses two different measures for inflation, an alternative proxy for democracy, and the TOR as a common proxy for de facto CBI. Columns (1) and (2) show the estimates of using the *modified* inflation rate  $D$ . The coefficient associated with CBI loses significance but the effect of CBI at different levels of democracy remains significant, such that moving from an anocracy

(Polity2=1) to a full democracy (Polity2=10) strengthen the effect of CBI on inflation by 3 percentage points. Columns (3) and (4) show the results with the *modified* inflation rate II. In this case, results are stronger than in our baseline specification. The coefficient associated with CBI is now significant and the effect of CBI at different levels of democracy is slightly stronger than column (3) in Table 1. Shifting from an anocracy (Polity2=1) to a full democracy (Polity2=10) strengthen the effect of CBI on inflation by 14 percentage points.<sup>25</sup> In this regard, our baseline specification is a conservative estimation of the effect of CBI on inflation.

Columns (5) and (6) present the results using *Freedom House* scores as an alternative measure of democracy. Although different in their methodology and construction, the correlation between Polity2 and Freedom House is high, almost 0.85.<sup>26</sup> As expected, our main results hold when using this alternative measure of democracy.<sup>27</sup>

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<sup>25</sup> The 14 percentage point reduction is the difference between computing the effect of CBI at Polity2=1 (a reduction in inflation by a factor of 0.43, that is by 0.57), and the effect of CBI at Polity2=10 (a reduction in inflation by a factor of 0.29, that is by 0.71).

<sup>26</sup> The Freedom House index has a reversed scale relative to Polity2. In our regressions, we reverse the scale for comparison purposes. Additionally, relative to Polity2, the Freedom House index has a smaller variance and includes more countries.

<sup>27</sup> Figure A5.1 in appendix 5 shows that the general negative relationship between CBI and inflation is robust to the inclusion of additional controls, and to the use of different measures for inflation and democracy.

**Table 4: Effect of CBI on inflation, 1980-2013. Sensitivity analysis: Alternative measures for dependent and main independent variables**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

	<i>Modified</i> inflation rate <i>D</i>		<i>Modified</i> inflation rate II		Freedom House		TOR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CBI	-0.078** (0.037)	-0.063 (0.041)	-1.003*** (0.363)	-0.792** (0.392)	-0.755** (0.319)	-1.289** (0.559)	0.703*** (0.187)
Democracy	-0.000 (0.001)	0.001 (0.001)	-0.001 (0.007)	0.018 (0.015)	0.012 (0.027)	-0.057 (0.061)	-0.011* (0.006)
CBI*Democracy		-0.003 (0.004)		-0.047 (0.037)		0.161 (0.137)	
Cap. account	-0.051*** (0.013)	-0.049*** (0.013)	-0.719*** (0.128)	-0.694*** (0.128)	-0.537*** (0.108)	-0.523*** (0.109)	-0.506*** (0.120)
Openness							
Peg	-0.032*** (0.007)	-0.032*** (0.007)	-0.294*** (0.069)	-0.292*** (0.069)	-0.273*** (0.064)	-0.271*** (0.063)	-0.243*** (0.069)
Inflation <sub><i>t-1</i></sub>	0.653*** (0.046)	0.652*** (0.046)	0.421*** (0.056)	0.419*** (0.055)	0.490*** (0.060)	0.487*** (0.059)	0.387*** (0.085)
GDP per capita <sub><i>t-1</i></sub>	0.040** (0.015)	0.039** (0.016)	0.188 (0.162)	0.172 (0.164)	0.152 (0.126)	0.158 (0.130)	0.131 (0.137)
Trade openness <sub><i>t-1</i></sub>	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	-0.002 (0.001)
World inflation <sub><i>t-1</i></sub>	-0.004*** (0.001)	-0.004*** (0.001)	-0.036** (0.015)	-0.035** (0.015)	-0.047*** (0.016)	-0.047*** (0.016)	-0.017 (0.015)
Political instability <sub><i>t-1</i></sub>	0.002** (0.001)	0.002** (0.001)	0.012* (0.007)	0.011 (0.007)	0.020*** (0.007)	0.019*** (0.007)	0.018** (0.008)
Effect of CBI							
at Polity2=1/FH=4		-0.066* (0.039)		-0.838** (0.379)		-0.645** (0.329)	
at Polity2=6/FH=2		-0.084*** (0.036)		-1.071*** (0.366)		-0.967*** (0.367)	
at Polity2=10/FH=1		-0.097*** (0.040)		-1.257*** (0.421)		-1.128*** (0.452)	
R <sup>2</sup>	0.567	0.567	0.325	0.325	0.381	0.382	0.320
N. observations	2392	2392	2384	2384	2349	2349	2274
N. of countries	108	108	108	108	116	116	101

*Notes:* Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

Our results contrast with previous studies that failed to find a statistically significant association between legal CBI and inflation in developing countries. To reduce concerns regarding our results being an artifact of the sample and/or model specification used in this study, column (7) in Table 4 replaces our measure of legal CBI with a de facto measure, the TOR (data from Dreher et al., 2008). The TOR is also used as a proxy for CBI in developing countries, and is generally correlated with inflation (Cukierman, 1992; de Haan and Kooi, 2000;

Ftiti et al., 2017; Klomp and de Haan, 2010b; Posso and Tawadros, 2013).<sup>28</sup> The positive coefficient indicates that higher turnover rates (less independence) are associated with higher inflation. This suggests that our sample and model specification provide results consistent with this previous literature. Furthermore, these results suggest that legal CBI conditioned by democracy might be a reasonable proxy for *actual* CBI.

Our results are also robust to alternative estimation methodologies. Given the panel structure of our data, we first remove the lagged dependent variable and estimate equation (1) using fixed effects as suggested by Klomp and de Haan (2010b). The methodological drawback is that point estimates are less precise since the variance tends to be higher – due to a specification error – when omitting the lag (Mizon, 1995). Second, given that the inclusion of lagged independent variables may not eliminate all potential endogeneity and reverse causation concerns associated with CBI, we perform an instrumental variable (IV) approach where CBI is an endogenous variable. Bodea and Hicks (2015b) find that CBI is mostly driven by regional diffusion. Thus, we use the regional average of CBI as instrument, because it influences a country’s individual CBI, but it is unlikely to affect a country’s inflation rate.<sup>29</sup> Since our baseline specification has an interaction term, we also use the interaction between the regional average of CBI and the level of democracy (as suggested by Wooldridge, 2002) as an additional instrument. Third, an alternative way to avoid Nickell bias is to use GMM dynamic panel data estimators (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). This approach addresses the issues of joint endogeneity of all explanatory variables in a dynamic formulation, and reduces potential biases induced by fixed effects. However, Roodman (2009) warns that the instrument count can easily grow large relative to the sample size. This can potentially overfit endogenous variables, failing to purge their endogenous components and biasing estimates. Finally, to filter out business cycle fluctuations from our annual data and focus on the long run effects, we follow Barro (1991) and Barro and Sala-i-Martin (1991) and measure our variables as 5-year averages.<sup>30</sup>

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<sup>28</sup> Notice that Dreher et al. (2010, 2008) find that central bankers who fail to control inflation tend to be replaced more often, and argue that the TOR is endogenous to inflation.

<sup>29</sup> Operationally, this implies computing a regional average of CBI for each country  $i$  (excluding country  $i$ ). The correlation between the regional average CBI and a country’s individual CBI is 0.56.

<sup>30</sup> This approach, frequently used in the growth literature, enables us to focus on changes that require more time to process. We thank an anonymous referee for this suggestion.

Table 5 presents the results for alternative methodologies. In all cases, our results are qualitatively similar to those found in Table 1. The negative coefficient associated with CBI, and the effect of CBI at different levels of democracy, are significant across methodologies. For columns (3) and (4), the joint F-statistics of the first stage of the IV regressions show that the instruments are relevant and greater than Staiger and Stock's (1997) rule of thumb of 10. For columns (5) and (6), we use the Hansen  $J$  test of overidentifying restrictions and a test of second order serial correlation of the residuals. Both tests are rejected. Thus, the validity of the instruments cannot be rejected. Finally, in columns (7) and (8), when using five-year averages of our variables, our sample is significantly smaller (approximately 20% of the observations we have in our baseline specification). Interestingly, our results remain intact, with similar point estimates, and the same level of significance.

**Table 5: Effect of CBI on inflation, 1980-2013. Alternative methodologies**

Dependent variable: Inflation rate (log)

Estimation	FE without <i>lagged DV</i>		Instrumental Variables		Dynamic GMM		5-year Averages	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CBI	-1.363** (0.564)	-0.918* (0.538)	-2.315*** (0.550)	-1.800** (0.900)	-1.647*** (0.606)	-1.436** (0.642)	-1.108** (0.516)	-0.833 (0.553)
Democracy	0.002 (0.010)	0.041* (0.021)	0.005 (0.006)	0.029 (0.027)	0.006 (0.007)	0.039 (0.050)	0.005 (0.015)	0.030 (0.022)
CBI*Democracy		-0.096* (0.052)		-0.061 (0.072)		-0.076 (0.109)		-0.063 (0.055)
Cap. account	-1.071*** (0.233)	-1.016*** (0.225)	-0.555*** (0.094)	-0.525*** (0.104)	-0.149 (0.194)	-0.103 (0.227)	-0.926*** (0.241)	-0.882*** (0.236)
Openness								
Peg	-0.435*** (0.102)	-0.431*** (0.100)	-0.306*** (0.050)	-0.303*** (0.050)	-0.318*** (0.084)	-0.325*** (0.088)	-0.436*** (0.145)	-0.435*** (0.145)
Inflation <sub><i>t-1</i></sub>			0.481*** (0.042)	0.479*** (0.041)	0.620*** (0.071)	0.606*** (0.075)	0.250*** (0.042)	0.246*** (0.043)
GDP per capita <sub><i>t-1</i></sub>	0.013 (0.187)	-0.018 (0.188)	0.166 (0.117)	0.139 (0.121)	0.191** (0.088)	0.203** (0.092)	0.375 (0.281)	0.345 (0.288)
Trade openness <sub><i>t-1</i></sub>	0.001 (0.002)	0.001 (0.002)	0.001 (0.001)	0.000 (0.001)	-0.004*** (0.001)	-0.004*** (0.002)	0.000 (0.003)	0.000 (0.003)
World inflation <sub><i>t-1</i></sub>	-0.000 (0.017)	0.001 (0.017)	-0.047*** (0.013)	-0.046*** (0.013)	-0.057*** (0.014)	-0.057*** (0.014)	-0.183*** (0.027)	-0.183*** (0.027)
Political instability <sub><i>t-1</i></sub>	0.031*** (0.009)	0.028*** (0.008)	0.025*** (0.008)	0.023*** (0.008)	-0.014 (0.025)	-0.015 (0.025)	0.080*** (0.019)	0.076*** (0.019)
Effect of CBI at Polity2=1		-1.014* (0.531)		-1.860** (0.843)		-1.512** (0.619)		-0.896* (0.533)
at Polity2=6		-1.492*** (0.575)		-2.163*** (0.609)		-1.892*** (0.774)		-1.208** (0.521)
at Polity2=10		-1.875*** (0.683)		-2.405*** (0.533)		-2.196** (1.096)		-1.459*** (0.606)
R <sup>2</sup>	0.216	0.221					0.425	0.427
N. observations	2326	2326	2144	2144	2241	2241	484	484
N. of countries	108	108	106	106	108	108	106	106
<i>First-stage reg.</i>								
CBI regional			1.036*** (0.071)	4.519*** (0.656)				
CBI regional *Democracy				0.702*** (0.058)				
<i>F-Statistic</i>			212.32	74.33				
<i>Specification tests (p-values)</i>								
Hansen test					0.563	0.579		
Second order serial correlation					0.165	0.181		

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ . Columns (5) and (6) use the two-step system GMM estimator with Windmeijer (2005) small sample robust correction.

### 4.1.1 Other robustness tests

Tables 1 to 5 provide strong support for the existence of a negative relationship between CBI and inflation. These findings are not sensitive to different model specifications, measurement choices, or estimation techniques. To analyze further the robustness of our main findings, we conducted additional tests altering the sample for the analyses and found that our results are indeed robust. Below, we summarize the results and present in Tables A5.1 to A5.6 (Appendix 5) the details of the tests.

*Influence of outliers:* Although the transformations of the inflation rate presented in the previous subsection reduces the impact of outliers on our results, we conduct additional tests to minimize concerns about outliers. First, we use a jackknife estimation of our main specification. That is, the analysis is performed in subsamples omitting one country at a time, and then aggregating the estimates. Second, we exclude countries that experienced hyperinflations during the period covered in our sample.<sup>31</sup> Finally, we include a dummy variable identifying high inflation observations (Alpanda and Honig, 2014). In all cases, our main results remain stable and significant.

*Regional influences:* We analyze if our results change by systematically omitting subgroups of countries. Other studies find similar effects for subregional samples (Cukierman, 1992; Jácome and Vázquez, 2008). Our results are robust in subsamples that omit one continent or subcontinent at a time.

*Level of democracy:* We analyze our results in different regime types. For this, we use the Polity2 score to create four groups: (i) autocracies (Polity2 between -10 and -6), (ii) closed anocracies (Polity2 between -5 and 0), (iii) open anocracies (Polity2 between 1 and 5), and (iv) democracies (Polity2 between 6 to 10).<sup>32</sup> Our results hold in the last three subgroups. This is consistent with our main results, and confirms that CBI does not have significant anti-inflationary effects in very autocratic countries.

*Income groups:* We analyze our results by income group. Our main results remain stable and significant for lower-middle and upper-middle income countries (67 out of the 101 countries from our sample). However, they become insignificant for low and high-income countries. This

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<sup>31</sup> These countries are Angola, Argentina, Belarus, Bolivia, Brazil, Congo (DR), Nicaragua, and Zimbabwe.

<sup>32</sup> These are regimes that combine characteristics of autocracies and of democracies, such as some level of political competition (Schmidt, 2016; Vreeland, 2008)(Schmidt, 2016; Vreeland, 2008).



is not surprising since these two subgroups only include 22 and 12 countries, respectively, affecting the standard errors of our regressions.

*Different time windows:* Following Dreher et al. (2010), we considered shorter periods for our analysis. Results hold when we exclude the 1980s (1990-2013) and the years after the global financial crisis (1980-2006).

*Exclusion of crises:* There is compelling evidence of the difficulties monetary authorities have to control inflation in the face of shocks (Granville and Mallick, 2010; Holtemöller and Mallick, 2016; Mallick and Sousa, 2011). In this case, we analyze the consistency of our results removing the episodes of banking, currency, and debt crises. Additionally, we construct a measure of occurrence of any of these crises. Our results hold in all cases.

## 4.2 Analysis by components

CBI is frequently measured using composite indices (Alesina et al., 1989; Cukierman, 1992; Grilli et al., 1991). When weighted indices measure variables of interest, three main concerns regarding the validity of the scores produced arise: conceptualization, measurement, and aggregation (Munck and Verkuilen, 2002; Treier and Jackman, 2008). In this section, we examine whether the use of the weighted index conflates dimensions of CBI that are related with inflation, with others that are not – the aggregation concern. In other words, we analyze whether some of the index's components are driving our results.

In particular, we examine whether all four dimensions of CBI, measured following Cukierman et al.'s (1992) rules, are associated with lower inflation rates, or if the aggregate index performs better than its components.<sup>33</sup> In doing so, this analysis has implications for the conceptualization of CBI, and for policies designed to implement it. On the one hand, it is important to assess the relevance of the components included in the definition – and consequently, the measurement – of CBI. On the other hand, the analysis by components sheds

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<sup>33</sup> We are aware that authors like Banaian, et al.(1998) and Bagheri and Habibi (1998, p. 193) have challenged the relevance of the variables included in the Cukierman et al. (1992) index. However, this criticism relies on the empirical properties of those components for statistical analyses, but not on their theoretical foundations.

light on what dimensions of CBI may be more effective at fighting inflation in developing countries.

Thus, we disaggregate our CBI index in its four main components (dimensions): stability of the chief executive officer of the bank (personnel independence), central bank objectives, independence in policy formulation, and limitations on lending to the public sector (financial independence). Each component ranges from 0 to 1 and has a fixed weight in the aggregate CBI index.<sup>34</sup> The correlation between the aggregate (*weighted*) CBI index and its four components in our sample is 0.60 (personnel), 0.59 (objectives), 0.74 (policy), and 0.90 (financial). The components are not highly correlated among them – the only exception is the 0.49 correlation between policy and financial independence. We replicate our baseline specification substituting the CBI index by each of these components. Table 6 shows the results.

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<sup>34</sup> Appendix 1 lists the variables included in each component, and their weights.

**Table 6: Effect of CBI on inflation, 1980-2013. Components of CBI**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

	Personnel independence (20%)†		CB objectives (15%)†		Policy independence (15%)†		Financial independence (50%)†	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CBI	-0.595*	-0.489	-0.688***	-0.593**	-0.256	-0.088	-0.415*	-0.215*
	(0.345)	(0.347)	(0.244)	(0.237)	(0.177)	(0.162)	(0.224)	(0.254)
Democracy	-0.005	0.017	-0.004	0.009	-0.005	0.010	-0.001	0.014
	(0.007)	(0.016)	(0.006)	(0.011)	(0.007)	(0.009)	(0.007)	(0.010)
CBI*Democracy		-0.044		-0.030		-0.042**		-0.041
		(0.035)		(0.020)		(0.017)		(0.024)
Cap. account openness	-0.585***	-0.592***	-0.525***	-0.520***	-0.543***	-0.529***	-0.569***	-0.536***
	(0.122)	(0.123)	(0.109)	(0.109)	(0.116)	(0.115)	(0.112)	(0.113)
Peg	-0.307***	-0.304***	-0.316***	-0.319***	-0.300***	-0.295***	-0.313***	-0.312***
	(0.062)	(0.062)	(0.061)	(0.062)	(0.063)	(0.062)	(0.063)	(0.062)
Inflation <sub>t-1</sub>	0.504***	0.500***	0.501***	0.497***	0.508***	0.503***	0.495***	0.493***
	(0.064)	(0.064)	(0.061)	(0.061)	(0.062)	(0.061)	(0.062)	(0.061)
GDP per capita <sub>t-1</sub>	0.088	0.090	0.080	0.076	0.113	0.115	0.002	-0.030
	(0.127)	(0.125)	(0.125)	(0.125)	(0.128)	(0.122)	(0.133)	(0.132)
Trade openness <sub>t-1</sub>	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
World inflation <sub>t-1</sub>	-0.044***	-0.043***	-0.043***	-0.042***	-0.046***	-0.045***	-0.044***	-0.043***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Political instability <sub>t-1</sub>	0.018***	0.017**	0.016**	0.015**	0.019***	0.018**	0.020***	0.019***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Effect of CBI at Polity2=1		-0.533		-0.623***		-0.129		-0.255
		(0.338)		(0.238)		(0.164)		(0.244)
at Polity2=4		-0.666**		-0.713***		-0.255		-0.377*
		(0.333)		(0.250)		(0.178)		(0.228)
at Polity2=6		-0.753**		-0.774***		-0.338*		-0.458**
		(0.347)		(0.265)		(0.194)		(0.230)
at Polity2=10		-0.930**		-0.894***		-0.506**		-0.619**
		(0.413)		(0.311)		(0.239)		(0.262)
R <sup>2</sup>	0.401	0.401	0.407	0.408	0.400	0.402	0.395	0.396
N. observations	2241	2241	2226	2226	2241	2241	2232	2232
N. of countries	108	108	107	107	108	108	108	108

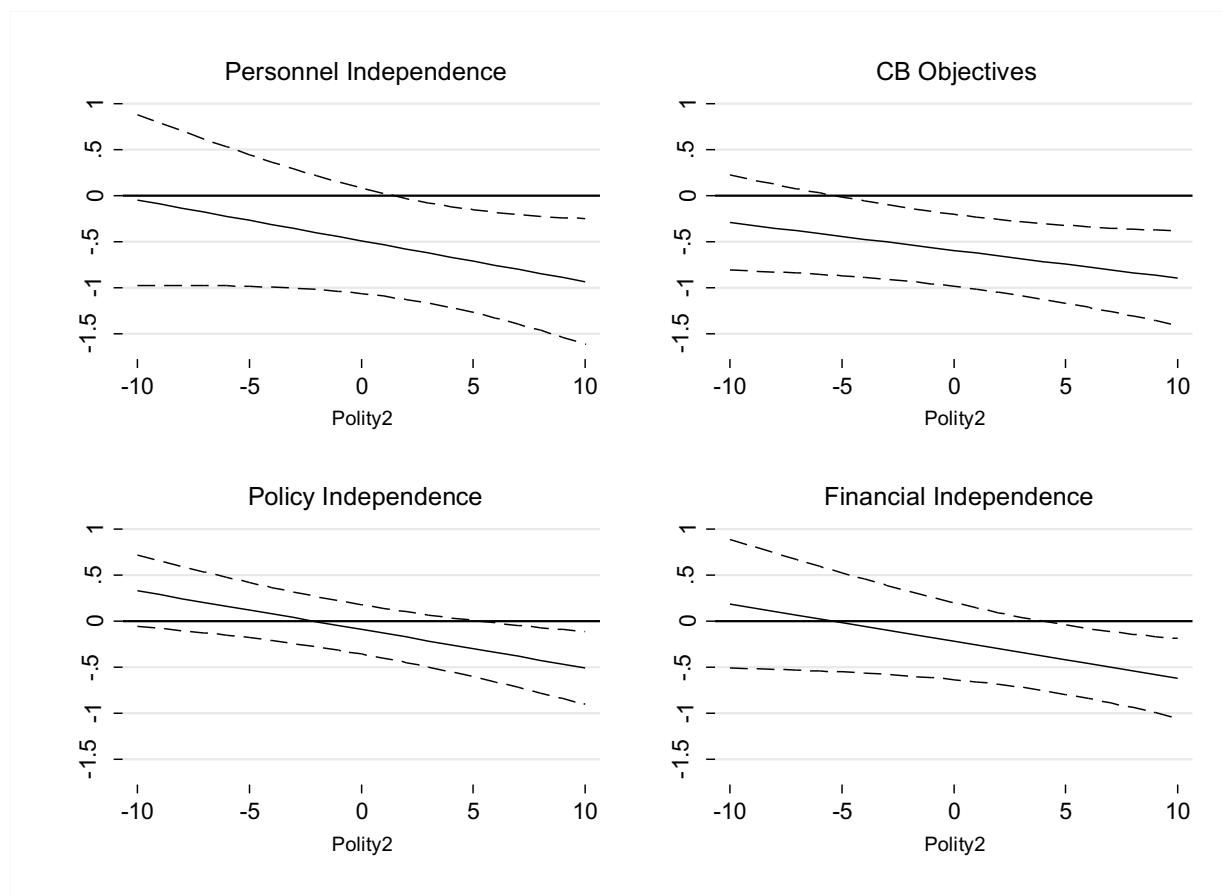
Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

† This percentage indicates the weight of this component in the aggregate (weighted) CBI index.

The coefficients associated with all the CBI components are negative, but not all of them are significant. In column (3), the coefficient for central bank objectives is strongly significant, while in columns (1) and (7) those of personnel and financial independence are marginally significant. However, when the effect of democracy is accounted for – in columns (2), (4), (6), and (8) – a clearer picture emerges. Figure 4 shows these marginal effects. Policy and financial independence are significantly associated with lower inflation rates in democracies (CBI is

negative and significant at 95% confidence level when Polity2=8 and Polity2=6, respectively), while personnel independence and central bank objectives are significant even in anocracies (Polity2=4 and Polity2=-3, respectively).

Figure 4: Marginal effects of CBI on inflation. Analysis by components.



Furthermore, the effects are sizeable. From column (3) in Table 1, for a fully democratic developing country (Polity2=10), a shift from a dependent central bank to an independent bank is associated with a 67.5% decrease in the inflation rate.<sup>35</sup> For the median annual inflation rate in our sample (8.56%), this would represent a 6.0 percentage point reduction.<sup>36</sup> From columns (2),

<sup>35</sup> Cape Verde (2002-2012), Chile (2006-2009), Costa Rica (1978-2012), Cyprus (2002-2007), Israel (1999-2009), Jamaica (1978-1992), Mauritius (2004-2012), Mongolia (1996-2012), Trinidad and Tobago (1997-2012), and Uruguay (1989-2012) are examples of developing countries scoring 10 in Polity2 in our sample.

<sup>36</sup> We get very similar effects if we use the sample mean instead of the median.

(4), (6), and (8) in Table 6, the impacts on the inflation rate of a shift from a dependent central bank to an independent one, for each of the components are as follow: Personnel independence is associated with a 60.5% decrease (5.1 percentage points); central bank objectives, policy independence, and financial independence with 59.1% (5.0 percentage points), 39.7% (3.4 percentage points) and 46.2% (3.9 percentage points) decreases, respectively.

For the purposes of our sensitivity analysis, these results suggest that a single dimension of the index does not drive the effect of CBI on inflation in developing countries, and none of them seem completely unrelated to inflation. In fact, each dimension may have different effects depending on the institutional context in which the central bank operates. For example, in non-democratic contexts, setting price stability as the main objective of the central bank, and provisions regarding appointment and tenure of the central bankers are associated with lower inflation in authoritarian regimes (this effect is significant when  $\text{Polity2} \geq -3$  and  $\text{Polity2} \geq 4$ , respectively). Interestingly, legal limits to the ability of the government to borrow from the central bank, and to intervene in monetary policy (financial and policy independence, respectively), only seem to be associated with lower inflation in democratic countries.<sup>37</sup>

## 5 Concluding remarks

One of the main motivations to grant independence to central banks is the need to avoid political pressures to pursue expansionary policies that cause inflation. Although the negative relationship between CBI and inflation is widely documented for developed countries, the evidence for developing countries is scarce and partial. Yet, recent studies suggest that evidence obtained in smaller and non-representative samples could be affected by selection bias (Garriga, 2016). Our study builds on this empirical literature to examine the effectiveness of legal CBI as an anti-inflationary tool on a broad panel of developing countries. The span of our sample – 118 developing countries between 1980 and 2013 – gives us confidence that selection of cases or choices regarding periodization are not affecting our results.

We provide robust evidence of the inflation curbing effects of legal CBI under different institutional contexts. Although democratic constraints enhance the anti-inflationary effects of

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<sup>37</sup> These results open other questions for further research. Here, we interpret the results within the framework of our concerns about the sensitivity of our main results.

CBI, these effects are also robust and sizeable also in non-democratic countries. This opens avenues for further research of the mechanisms that make independent central banks effective even in countries with weak political constraints. As research suggests, it is possible that de jure protections to central bankers are effective in non-democratic regimes because they reflect other kinds of power-sharing agreements among authoritarian elites (Baerg et al., 2017), because authoritarian regimes have (weaker but effective) political constraints (Bodea et al., 2019), because of autocrats' preferences regarding international markets confidence (Maxfield, 1997), or the country's future political direction (Boylan, 1998), or because of the diffusion of norms that make CBI effective even in non-democracies (Johnson, 2016, 2006).<sup>38</sup>

Our analysis reinforces the importance of the independence of the central bank as an effective mechanism to reduce the inflation, but not as the only one. Capital account openness, fixed exchange rate, and the adoption of inflation targeting are associated with lower inflation as well. Yet, our results suggest that the effect of CBI on price stability subsists after controlling for these other policies, and it is stronger in the presence of floating exchange rates regimes.

Finally, our analysis shows that a single dimension of our index of CBI does not drive its effect on inflation. This has important conceptual implications when studying the channels through which CBI affects price stability and other key outcomes. However, further research is still required to understand fully how different aspects of CBI affect the relationships between central banks and governments, and how other market actors may be affected.

The main results and implications from this study contribute to the discussion on the effects of granting independence to central banks. Overall, using a very broad sample of developing countries, we provide strong evidence that legal protection to central banks for the conduction of monetary policy is associated with lower inflation in developing countries. Furthermore, this result is conditional on the strength of other political constraints associated with the level of democracy in place.

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<sup>38</sup> Determining the mechanisms that make CBI effective in autocracies exceeds the purposes of this study.

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## Appendix 1. Summary of Cukierman, Webb and Neyapti (1992) coding and weighing rules

Dimension	Components (weight in the index)	Variables (weight in the component)	Categories
Personnel independence	CEO (0.20)	1. <i>Term of office of CEO (0.25)</i>	5
		2. <i>Who appoints the CEO (0.25)</i>	5
		3. <i>Provisions for dismissal of CEO (0.25)</i>	7
		4. <i>CEO allowed to hold another office in government (0.25)</i>	2
Central bank objectives	Objectives (0.15)	5. <i>Central Bank objectives (1)</i>	6
Policy independence	Policy formulation (0.15)	6. <i>Who formulates monetary policy (0.25)</i>	4
		7. <i>Government directives and resolution of conflicts (0.50)</i>	6
		8. <i>Central Bank given active role in formulation of government's budget (0.25)</i>	2
Financial independence	Limitation on lending to the government (0.50)	9. <i>Limitations on advances (0.30)</i>	4
		10. <i>Limitations on securitized lending (0.20)</i>	4
		11. <i>Who decides control of terms of lending to government (0.20)</i>	4
		12. <i>Beneficiaries of Central Bank lending (0.10)</i>	4
		13. <i>Type of limits when they exist (0.05)</i>	4
		14. <i>Maturity of loans (0.05)</i>	4
		15. <i>Restrictions on interest rates (0.05)</i>	5
16. <i>Prohibition on Central Bank lending in primary market to Government (0.05)</i>	2		

## Appendix 2. Countries included in the analyses

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Albania	Ecuador	Lesotho	Qatar
Algeria	Egypt, Arab Rep.	Liberia	Russian Federation
Angola	El Salvador	Libya	Rwanda
Argentina	Estonia	Lithuania	Samoa
Armenia	Ethiopia	Macedonia, FYR	Saudi Arabia
Azerbaijan	Fiji	Madagascar	Seychelles
Bahamas, The	Gambia, The	Malawi	Sierra Leone
Bahrain	Georgia	Malaysia	Slovak Republic
Bangladesh	Ghana	Maldives	Slovenia
Barbados	Guatemala	Malta	Solomon Islands
Belarus	Guinea	Mauritania	South Africa
Belize	Guyana	Mauritius	Sri Lanka
Bhutan	Haiti	Mexico	Sudan
Bolivia	Honduras	Moldova	Suriname
Botswana	Hungary	Mongolia	Tajikistan
Brazil	India	Montenegro	Tanzania
Bulgaria	Indonesia	Morocco	Thailand
Burundi	Iran, Islamic Rep.	Mozambique	Tonga
Cape Verde	Iraq	Myanmar	Trinidad and Tobago
Cambodia	Israel	Namibia	Tunisia
Chile	Jamaica	Nepal	Uganda
China	Jordan	Nicaragua	Ukraine
Colombia	Kazakhstan	Nigeria	Uruguay
Comoros	Kenya	Oman	Venezuela, RB
Congo, Dem. Rep.	Korea, Rep.	Pakistan	Vietnam
Costa Rica	Kuwait	Panama	Yemen, Rep.
Croatia	Kyrgyz Republic	Paraguay	Zambia
Cyprus	Lao PDR	Peru	Zimbabwe
Djibouti	Latvia	Philippines	
Dominican Republic	Lebanon	Poland	

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### Appendix 3. Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Inflation rate (log)	2,494	2.143	1.338	-6.932	11.101
CBI	2,580	0.492	0.190	0.135	0.904
CBI component: Personnel	2,580	0.513	0.193	0.000	1.000
CBI component: Objectives	2,563	0.507	0.248	0.000	1.000
CBI component: Policy	2,580	0.453	0.319	0.000	1.000
CBI component: Financial	2,564	0.490	0.244	0.013	1.000
Democracy (Polity2)	2,433	2.563	6.405	-10	10
Democracy (Freedom House)	2,538	3.772	1.680	1	7
Peg	2,580	0.622	0.485	0.000	1.000
Capital account openness	2,539	0.414	0.343	0.000	1.000
GDP per capita (log)	2,579	7.893	1.155	5.390	11.194
Trade openness	2,576	75.839	38.754	0.167	311.356
World inflation	2,540	5.780	2.494	2.784	12.738
Political instability (log)	2,580	3.493	3.589	0.000	11.358
Fiscal cyclicality	1,974	0.0003	0.006	-0.141	0.163
Interest rate differential	1,494	-3.018	1.262	-9.484	7.018
Inflation targeting	2,580	0.060	0.238	0.000	1.000
Output gap	2,540	-0.001	0.029	-0.500	0.271
<i>Modified</i> inflation rate D	2,580	0.117	0.159	-0.594	0.998
<i>Modified</i> inflation rate II	2,576	2.074	1.387	-6.932	11.101
Regional CBI (IV analysis)	2,469	0.511	0.110	0.0264	0.753

#### Appendix 4. Changes in the lag structure of *World Inflation*

**Table A4.1: Effect of CBI on inflation, 1980-2013. World inflation analysis.**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

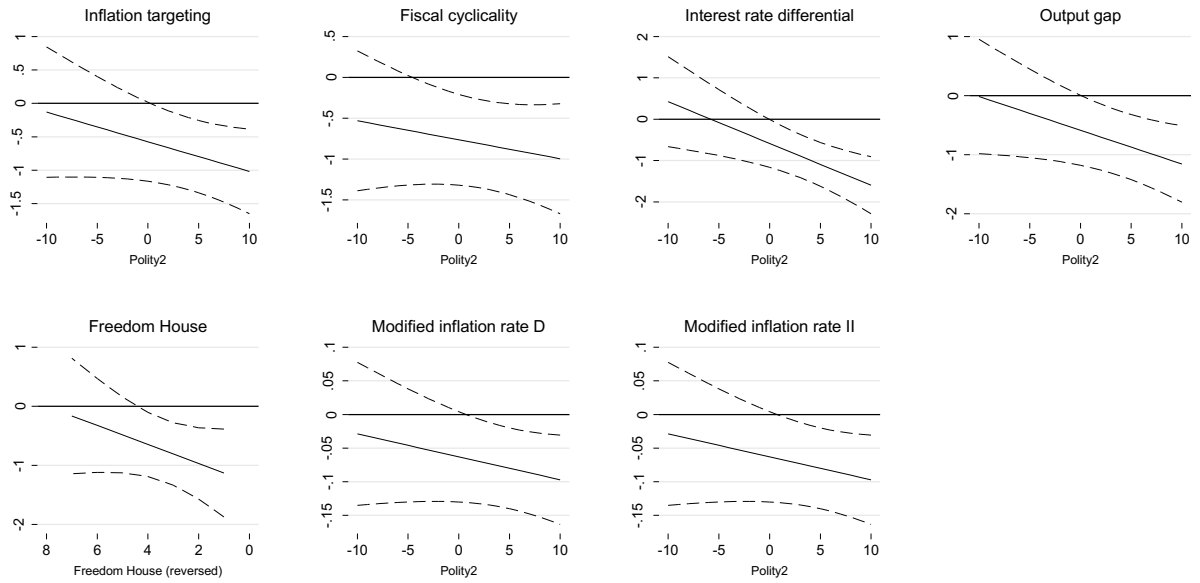
	No lag		Baseline model (as in Table 1)		Contemporaneous and one lag		Contemporaneous and two lags	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
World inflation <sub><i>t</i></sub>	0.069*** (0.010)	0.070*** (0.010)			0.126*** (0.013)	0.127*** (0.013)	0.126*** (0.013)	0.127*** (0.013)
World inflation <sub><i>t-1</i></sub>			-0.046*** (0.015)	-0.045*** (0.015)	-0.110*** (0.018)	-0.109*** (0.018)	-0.129*** (0.024)	-0.128*** (0.023)
World inflation <sub><i>t-2</i></sub>							0.032** (0.015)	0.031** (0.015)
CBI	-0.711** (0.334)	-0.408 (0.367)	-0.823** (0.333)	-0.552 (0.357)	-0.700** (0.330)	-0.389 (0.366)	-0.751** (0.340)	-0.433 (0.376)
Democracy	0.004 (0.007)	0.030** (0.013)	-0.002 (0.007)	0.021 (0.014)	0.001 (0.007)	0.028* (0.014)	0.002 (0.008)	0.030* (0.016)
CBI*Democracy		-0.063* (0.034)		-0.057* (0.033)		-0.066* (0.035)		-0.068* (0.037)
Cap. account openness	-0.552*** (0.111)	-0.521*** (0.111)	-0.553*** (0.110)	-0.525*** (0.111)	-0.573*** (0.116)	-0.540*** (0.116)	-0.588*** (0.124)	-0.555*** (0.124)
Peg	-0.322*** (0.062)	-0.320*** (0.061)	-0.304*** (0.062)	-0.302*** (0.061)	-0.303*** (0.061)	-0.299*** (0.060)	-0.310*** (0.060)	-0.304*** (0.059)
Inflation <sub><i>t-1</i></sub>	0.477*** (0.063)	0.473*** (0.063)	0.501*** (0.062)	0.497*** (0.061)	0.487*** (0.063)	0.483*** (0.062)	0.486*** (0.063)	0.481*** (0.062)
GDP per capita <sub><i>t-1</i></sub>	0.004 (0.118)	-0.016 (0.122)	0.128 (0.126)	0.111 (0.129)	0.154 (0.131)	0.135 (0.134)	0.243 (0.148)	0.225 (0.150)
Trade openness <sub><i>t-1</i></sub>	-0.002 (0.001)	-0.002 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Political instability <sub><i>t-1</i></sub>	0.021*** (0.007)	0.020*** (0.007)	0.019*** (0.007)	0.018** (0.007)	0.023*** (0.007)	0.021*** (0.007)	0.024*** (0.007)	0.023*** (0.007)
R <sup>2</sup>	0.417	0.419	0.417	0.419	0.433	0.435	0.434	0.435
N. observations	2273	2273	2273	2273	2204	2204	2129	2129
N. of countries	108	108	108	108	108	108	108	108

Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .



## Appendix 5 Other sensitivity analyses

Figure A5.1: Marginal effects of CBI on inflation. Sensitivity analyses.



*Note:* These figures plot the results of the interactions shown in Tables 3 and 4.

**Table A5.1: Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Outliers**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

	Jackknife		High inflation dummy		No-high inflation countries <sup>#</sup>	
	(1)	(2)	(3)	(4)	(5)	(6)
CBI	-0.823** (0.355)	-0.552 (0.389)	-0.712*** (0.259)	-0.548** (0.263)	-0.741** (0.329)	-0.623* (0.329)
Democracy	-0.002 (0.007)	0.021 (0.015)	-0.006 (0.006)	0.008 (0.013)	0.002 (0.006)	0.012 (0.015)
CBI*Democracy		-0.057 (0.037)		-0.035 (0.029)		-0.024 (0.032)
Cap. account openness	-0.553*** (0.117)	-0.525*** (0.117)	-0.491*** (0.090)	-0.475*** (0.090)	-0.535*** (0.130)	-0.523*** (0.129)
Peg	-0.304*** (0.065)	-0.302*** (0.064)	-0.244*** (0.055)	-0.243*** (0.054)	-0.228*** (0.062)	-0.228*** (0.061)
Inflation <sub><i>t-1</i></sub>	0.501*** (0.065)	0.497*** (0.065)	0.327*** (0.047)	0.326*** (0.047)	0.332*** (0.061)	0.331*** (0.061)
GDP per capita <sub><i>t-1</i></sub>	0.128 (0.138)	0.111 (0.144)	0.091 (0.128)	0.080 (0.130)	0.001 (0.138)	-0.011 (0.134)
Trade openness <sub><i>t-1</i></sub>	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
World inflation <sub><i>t-1</i></sub>	-0.046*** (0.016)	-0.045*** (0.015)	-0.020 (0.013)	-0.020 (0.012)	-0.018 (0.015)	-0.018 (0.015)
Political instability <sub><i>t-1</i></sub>	0.019*** (0.007)	0.018** (0.007)	0.327*** (0.047)	0.326*** (0.047)	0.016** (0.007)	0.016** (0.007)
High inflation			2.577*** (0.202)	2.568*** (0.201)		
Effect of CBI at Polity2=1		-0.601 (0.375)		-0.583** (0.255)		-0.647** (0.323)
at Polity2=3		-0.723** (0.358)		-0.652*** (0.252)		-0.695** (0.321)
at Polity2=6		-0.894*** (0.360)		-0.756*** (0.269)		-0.766** (0.342)
at Polity2=10		-1.123*** (0.411)		-0.895*** (0.328)		-0.862** (0.405)
R <sup>2</sup>	0.404	0.405	0.507	0.508	0.271	0.271
N. observations	2241	2241	2241	2241	2015	2015
N. of countries	108	108	108	108	100	100

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

# Excluded countries are: Angola, Argentina, Belarus, Bolivia, Brazil, Congo, Nicaragua, and Zimbabwe.

**Table A5.2: Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Omitted Continents**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

Omitted continent	Eastern Europe		Caribbean & Central America		South America	
	(1)	(2)	(3)	(4)	(5)	(6)
CBI	-0.950*** (0.283)	-0.840*** (0.281)	-0.591** (0.268)	-0.410 (0.273)	-0.413 (0.271)	-0.323 (0.293)
Democracy	-0.003 (0.006)	0.006 (0.013)	-0.006 (0.007)	0.011 (0.014)	-0.007 (0.007)	0.004 (0.016)
CBI*Democracy		-0.023 (0.028)		-0.041 (0.031)		-0.028 (0.034)
Cap. account openness	-0.479*** (0.091)	-0.466*** (0.091)	-0.605*** (0.122)	-0.595*** (0.122)	-0.313*** (0.079)	-0.300*** (0.078)
Peg	-0.231*** (0.056)	-0.232*** (0.056)	-0.205*** (0.055)	-0.205*** (0.055)	-0.245*** (0.064)	-0.242*** (0.063)
Inflation <sub><i>t-1</i></sub>	0.363*** (0.044)	0.362*** (0.043)	0.317*** (0.051)	0.314*** (0.051)	0.252*** (0.051)	0.252*** (0.051)
GDP per capita <sub><i>t-1</i></sub>	0.044 (0.143)	0.035 (0.146)	0.079 (0.136)	0.071 (0.139)	0.068 (0.146)	0.057 (0.147)
Trade openness <sub><i>t-1</i></sub>	0.000 (0.001)	0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)
World inflation <sub><i>t-1</i></sub>	-0.012 (0.012)	-0.011 (0.012)	-0.017 (0.014)	-0.016 (0.014)	-0.004 (0.014)	-0.004 (0.014)
Political instability <sub><i>t-1</i></sub>	0.017** (0.006)	0.016** (0.007)	0.015** (0.007)	0.014** (0.007)	0.010 (0.008)	0.010 (0.008)
Effect of CBI at Polity2=1		-0.863*** (0.275)		-0.451* (0.266)		-0.350 (0.282)
at Polity2=3		-0.908*** (0.273)		-0.533** (0.263)		-0.406 (0.271)
at Polity2=6		-0.977*** (0.291)		-0.656** (0.285)		-0.488* (0.286)
at Polity2=10		-1.068*** (0.348)		-0.821**** (0.351)		-0.599* (0.354)
R <sup>2</sup>	0.552	0.552	0.493	0.494	0.368	0.369
N. observations	1954	1954	1935	1935	1882	1882
N. of countries	87	87	97	97	96	96

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

**Table A5.2 (cont.): Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Omitted Continents**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

Omitted continent	North Africa and Middle East		Sub-Saharan Africa		Asia	
	(7)	(8)	(9)	(10)	(11)	(12)
CBI	-0.690** (0.273)	-0.507 (0.306)	-0.793*** (0.268)	-0.611** (0.267)	-0.686** (0.292)	-0.480* (0.282)
Democracy	-0.005 (0.006)	0.009 (0.014)	-0.004 (0.006)	0.010 (0.015)	-0.011 (0.007)	0.007 (0.014)
CBI*Democracy		-0.034 (0.033)		-0.036 (0.031)		-0.041 (0.031)
Cap. account openness	-0.520*** (0.102)	-0.503*** (0.103)	-0.480*** (0.092)	-0.459*** (0.093)	-0.559*** (0.102)	-0.543*** (0.102)
Peg	-0.255*** (0.057)	-0.254*** (0.057)	-0.256*** (0.068)	-0.256*** (0.067)	-0.294*** (0.061)	-0.290*** (0.061)
Inflation <sub>t-1</sub>	0.324*** (0.051)	0.323*** (0.051)	0.346*** (0.053)	0.344*** (0.053)	0.336*** (0.053)	0.334*** (0.053)
GDP per capita <sub>t-1</sub>	0.139 (0.128)	0.130 (0.130)	0.021 (0.120)	-0.004 (0.115)	0.202 (0.162)	0.209 (0.163)
Trade openness <sub>t-1</sub>	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.002)	-0.001 (0.002)	0.000 (0.001)	0.000 (0.001)
World inflation <sub>t-1</sub>	-0.026* (0.013)	-0.025* (0.013)	-0.029** (0.014)	-0.028* (0.014)	-0.033** (0.015)	-0.033** (0.015)
Political instability <sub>t-1</sub>	0.011 (0.007)	0.010 (0.007)	0.013* (0.007)	0.012* (0.007)	0.014* (0.007)	0.013* (0.007)
Effect of CBI at Polity2=1		-0.542* (0.293)		-0.646*** (0.260)		-0.521* (0.276)
at Polity2=3		-0.611** (0.276)		-0.718*** (0.257)		-0.604** (0.276)
at Polity2=6		-0.715** (0.278)		-0.825*** (0.279)		-0.728*** (0.300)
at Polity2=10		-0.852*** (0.329)		-0.968*** (0.348)		-0.893*** (0.369)
R <sup>2</sup>	0.524	0.525	0.529	0.530	0.545	0.546
N. observations	1974	1974	1701	1701	1816	1816
N. of countries	91	91	80	80	91	91

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

**Table A5.3: Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Democracy**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

	-10≤Polity2≤ -6	-5≤Polity2≤ 0	1 ≤Polity2≤ 5	6 ≤Polity2≤ 10
	(1)	(2)	(3)	(4)
CBI	1.093 (0.694)	-1.673* (0.939)	-2.038*** (0.698)	-0.795* (0.443)
Cap. account openness	-0.558*** (0.206)	0.268 (0.190)	-0.467 (0.409)	-0.576*** (0.160)
Peg	-0.080 (0.112)	-0.722*** (0.162)	-0.314 (0.222)	-0.345*** (0.096)
Inflation <sub><i>t-1</i></sub>	0.283*** (0.065)	0.345** (0.130)	0.020 (0.126)	0.552*** (0.064)
GDP per capita <sub><i>t-1</i></sub>	-0.692*** (0.234)	0.558 (0.835)	0.101 (0.305)	0.417** (0.183)
Trade openness <sub><i>t-1</i></sub>	0.007* (0.004)	-0.000 (0.006)	-0.005* (0.003)	-0.002 (0.002)
World inflation <sub><i>t-1</i></sub>	-0.015 (0.024)	-0.049 (0.046)	-0.009 (0.050)	-0.055** (0.022)
Political instability <sub><i>t-1</i></sub>	0.019 (0.016)	0.008 (0.018)	0.002 (0.023)	0.018* (0.010)
R <sup>2</sup>	0.244	0.283	0.118	0.516
N. observations	450	348	347	1096
N. of countries	45	49	43	71

*Notes:* Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

**Table A5.4: Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Income Level**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

Region	High non-OECD		Middle		Low	
	(1)	(2)	(3)	(4)	(5)	(6)
CBI	-0.920 (0.856)	-0.317 (1.503)	-1.116*** (0.401)	-0.856** (0.370)	0.470 (0.679)	0.475 (0.789)
Democracy	-0.016 (0.025)	0.001 (0.036)	0.001 (0.007)	0.025 (0.017)	-0.011 (0.020)	-0.009 (0.039)
CBI*Democracy		-0.063 (0.119)		-0.061 (0.039)		-0.004 (0.109)
Cap. account openness	-0.557* (0.308)	-0.537 (0.312)	-0.579*** (0.133)	-0.543*** (0.136)	-0.706** (0.270)	-0.706** (0.273)
Peg	-0.033 (0.101)	-0.022 (0.105)	-0.358*** (0.078)	-0.357*** (0.077)	-0.187 (0.140)	-0.188 (0.148)
Inflation <sub><i>t-1</i></sub>	0.386** (0.137)	0.388** (0.137)	0.476*** (0.070)	0.472*** (0.071)	0.539*** (0.170)	0.539*** (0.171)
GDP per capita <sub><i>t-1</i></sub>	0.348 (0.401)	0.303 (0.432)	0.135 (0.129)	0.088 (0.129)	0.304 (0.351)	0.304 (0.353)
Trade openness <sub><i>t-1</i></sub>	0.001 (0.009)	0.001 (0.009)	-0.002 (0.002)	-0.002 (0.002)	0.000 (0.002)	0.000 (0.001)
World inflation <sub><i>t-1</i></sub>	-0.053* (0.029)	-0.051 (0.031)	-0.049** (0.020)	-0.049** (0.020)	-0.049* (0.026)	-0.049* (0.024)
Political instability <sub><i>t-1</i></sub>	0.021 (0.031)	0.019 (0.032)	0.023** (0.009)	0.023** (0.009)	-0.002 (0.018)	-0.002 (0.020)
Effect of CBI at Polity2=1		-0.380 (1.406)		-0.916*** (0.370)		0.471 (0.703)
at Polity2=3		-0.507 (1.224)		-1.038*** (0.383)		0.462 (0.558)
at Polity2=6		-0.696 (0.996)		-1.220*** (0.429)		0.450 (0.464)
at Polity2=10		-0.949 (0.845)		-1.463*** (0.524)		0.433 (0.647)
R <sup>2</sup>	0.324	0.325	0.428	0.430	0.330	0.330
N. observations	191	191	1565	1565	380	380
N. of countries	12	12	67	67	22	22

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

**Table A5.5: Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Shorter Time Windows**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

Region	1990-2013		1980-2006	
	(1)	(2)	(3)	(4)
CBI	-0.557** (0.256)	-0.464* (0.260)	-0.814*** (0.268)	-0.667** (0.333)
Democracy	-0.008 (0.008)	0.003 (0.017)	0.000 (0.006)	0.011 (0.015)
CBI*Democracy		-0.023 (0.035)		-0.029 (0.036)
Cap. account openness	-0.497*** (0.122)	-0.490*** (0.122)	-0.529*** (0.109)	-0.514*** (0.109)
Peg	-0.255*** (0.060)	-0.255*** (0.059)	-0.286*** (0.060)	-0.284*** (0.060)
Inflation <sub><i>t-1</i></sub>	0.269*** (0.051)	0.268*** (0.051)	0.331*** (0.045)	0.330*** (0.045)
GDP per capita <sub><i>t-1</i></sub>	0.148 (0.132)	0.146 (0.133)	0.227 (0.184)	0.222 (0.185)
Trade openness <sub><i>t-1</i></sub>	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)
World inflation <sub><i>t-1</i></sub>	-0.031 (0.019)	-0.031 (0.019)	0.040*** (0.012)	0.040*** (0.012)
Political instability <sub><i>t-1</i></sub>	0.015** (0.007)	0.015** (0.007)	0.019*** (0.007)	0.018** (0.007)
Effect of CBI at Polity2=1		-0.487* (0.252)		-0.753** (0.282)
at Polity2=3		-0.533** (0.251)		-0.782*** (0.273)
at Polity2=6		-0.602** (0.283)		-0.839*** (0.269)
at Polity2=10		-0.694* (0.369)		-0.953*** (0.316)
R <sup>2</sup>	0.451	0.451	0.588	0.380
N. observations	1853	1853	1541	1541
N. of countries	108	108	102	102

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space. \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

**Table A5.6: Effect of CBI on inflation, 1980-2013. Additional Robustness Checks: Omitting crises**

Dependent variable: Inflation rate (log)

Estimation: Fixed Effects with robust standard errors

Crises omitted	Bank crises		Currency crises		Debt crises		Any crises	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CBI	-0.655** (0.262)	-0.487* (0.266)	-0.643** (0.256)	-0.431 (0.264)	-0.673** (0.257)	-0.504* (0.261)	-0.547** (0.253)	-0.342 (0.264)
Democracy	-0.006 (0.006)	0.008 (0.013)	-0.005 (0.006)	0.014 (0.013)	-0.006 (0.006)	0.009 (0.014)	-0.005 (0.006)	0.013 (0.013)
CBI*Democracy		-0.037 (0.029)		-0.045 (0.029)		-0.036 (0.029)		-0.045 (0.029)
Cap. account openness	-0.478*** (0.093)	-0.460*** (0.093)	-0.462*** (0.092)	-0.439*** (0.092)	-0.471*** (0.088)	-0.454*** (0.088)	-0.442*** (0.092)	-0.420*** (0.092)
Peg	-0.243*** (0.054)	-0.242*** (0.053)	-0.195*** (0.053)	-0.194*** (0.052)	-0.230*** (0.055)	-0.229*** (0.054)	-0.203*** (0.052)	-0.203*** (0.052)
Inflation <sub>t-1</sub>	0.327*** (0.049)	0.325*** (0.048)	0.330*** (0.050)	0.327*** (0.050)	0.332*** (0.047)	0.330*** (0.047)	0.333*** (0.051)	0.331*** (0.050)
GDP per capita <sub>t-1</sub>	0.064 (0.119)	0.052 (0.120)	0.051 (0.128)	0.037 (0.131)	0.085 (0.129)	0.074 (0.131)	0.031 (0.124)	0.016 (0.127)
Trade openness <sub>t-1</sub>	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
World inflation <sub>t-1</sub>	-0.020 (0.013)	-0.019 (0.013)	-0.022* (0.013)	-0.021 (0.013)	-0.022* (0.013)	-0.021* (0.012)	-0.024* (0.014)	-0.023* (0.014)
Political instability <sub>t-1</sub>	0.013* (0.007)	0.012* (0.007)	0.010 (0.006)	0.009 (0.007)	0.014** (0.006)	0.013* (0.007)	0.010 (0.006)	0.009 (0.007)
Effect of CBI at Polity2=1		-0.523** (0.259)		-0.476* (0.256)		-0.540** (0.254)		-0.386 (0.255)
at Polity2=3		-0.596** (0.255)		-0.567** (0.249)		-0.613** (0.249)		-0.476* (0.247)
at Polity2=6		-0.706*** (0.272)		-0.702*** (0.265)		-0.722*** (0.268)		-0.611*** (0.261)
at Polity2=10		-0.852*** (0.331)		-0.882*** (0.325)		-0.867*** (0.329)		-0.791*** (0.317)
R <sup>2</sup>	0.485	0.485	0.489	0.490	0.508	0.509	0.473	0.474
N. observations	2189	2189	2149	2149	2214	2214	2093	2093
N. of countries	108	108	108	108	108	108	108	108

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects, but we do not report their estimates to preserve space.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .