Economic Analysis and Policy 78 (2023) 1320–1341

Contents lists available at ScienceDirect

Economic Analysis and Policy

journal homepage: www.elsevier.com/locate/eap

Analyses of topical policy issues

Central bank independence and inflation volatility in developing countries☆

Ana Carolina Garriga [a,*], Cesar M. Rodriguez [b]

[a] Department of Government, University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, United Kingdom
[b] Department of Economics, Portland State University, Portland, OR 97201, United States of America

ARTICLE INFO

Article history:
Received 20 January 2023
Received in revised form 30 April 2023
Accepted 13 May 2023
Available online 19 May 2023

JEL classification:
E31
E52
E58

Keywords:
Central bank independence
Volatility
Measurement
Democracy
Developing countries

ABSTRACT

This paper analyzes the effects of legal central bank independence (CBI) on inflation volatility in developing countries. We discuss why CBI should curb inflation volatility, independently from its effect via lowering inflation levels. Empirical analyses in a sample of 96 developing countries between 1980 and 2014 show that CBI is directly and unconditionally associated with lower volatility. The magnitude of this effect is larger in more democratic countries even after accounting for the endogeneity of CBI and inflation. Our results are robust to alternative measurements of the main variables, different model specifications, and methodologies.

1. Introduction

Concerns about inflation regained preeminence in the public agenda following the economic consequences of COVID-19, and the governments' attempts to address recessionary forces (Agur et al., 2022). Policymakers, investors, and academics worry not only about increasing levels of inflation, but also about the threat of inflation volatility. Central bankers in developed and developing countries have stressed the welfare losses associated with inflation volatility. For example, Huw Pill, chief economist at the Bank of England, has highlighted that "the welfare losses associated with inflation volatility […] provide a rationale for the stabilization of inflation that underlies the adoption of inflation targeting".[1] Similarly, Michael Patra, deputy governor of the Reserve Bank of India, has emphasized the centrality of controlling for inflation volatility: "minimizing inflation volatility should be the predominant objective of monetary policy in its welfare maximizing role".[2] These concerns have been echoed by investors and financial services providers who think that "inflation volatility is driving a real change in volumes and has become a focus in rates for the first time since 2008".[3]

☆ We thank Richard Higgins, Justin Svec, and Hiro Ito for their helpful suggestions. The British Academy/Leverhulme Trust partially funded Garriga's work for this project (BA/Leverhulme Small Research Grant SRG19\191271).

* Correspondence to: University of Essex, Wivenhoe Park, Colchester, CO4 3SQ, UK.
E-mail addresses: carolina.garriga@essex.ac.uk (A.C. Garriga), cesar.rodriguez@pdx.edu (C.M. Rodriguez).

1 https://www.bankofengland.co.uk/speech/2022/february/huw-pill-speech-at-the-society-of-professional-economists-annual-conference

2 https://www.livemint.com/economy/indias-monetary-policy-financial-inclusive-by-design-says-rbi-deputy-guv-patra-11640341243164.html

3 Statement by Charles Bristow, global head of rates trading at JPMorgan, London. https://www.reuters.com/markets/europe/surging-inflation-spurs-demand-once-rare-linker-bonds-2022-02-08/.

https://doi.org/10.1016/j.eap.2023.05.008
0313-5926/

Investors, thus, "should hedge against inflation volatility — the prospect that the market's psychology switches abruptly from fears of inflation to concerns about deflation, and back again".[4] In such a context, a central bank determined to fight this threat plays a crucial role in promoting stability, and independence allows central bankers to pursue their monetary policy objectives — as Gita Gopinath, first deputy managing director of the International Monetary Fund, has recently stressed.[5]

This paper analyzes the effects of legal central bank independence (CBI) on inflation volatility in developing countries. For several decades now, in most countries, autonomous central banks conduct monetary policy focusing on price stability (Crowe and Meade, 2008; Haan et al., 2018; Garriga, 2016). This trend towards more CBI has been linked with lower levels of inflation in developed and developing countries (Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020; Klomp and de Haan, 2010b), but the effects of CBI on inflation volatility are less clear. This is an important lacuna because the costs of inflation do not only stem from high rates of inflation, but also from the uncertainty associated with inflation volatility. Furthermore, as we argue below, the regulatory framework of central banks may directly contribute to lower inflation volatility.[6] By accounting for the potential endogeneity of the inflation rate, we identify the relationship between CBI and inflation volatility in developing countries.

The notion that inflation volatility can impair real economic activity regardless of the absolute level of inflation was first developed by Okun (1971) and Friedman (1977). More recently, other scholars have analyzed different channels through which inflation volatility affects the real economy (Aisen and Veiga, 2013; Al-Marhubi, 1998; Baharumshah et al., 2016; Demetriades, 1988; Elder, 2004b,a; Judson and Orphanides, 1999; Logue and Willett, 1976; Rother, 2004). Larger inflation variability entails welfare costs stemming from both uncertainty about relative price changes or unanticipated inflation (Ball et al., 1990; Fischer, 1993), and a risk premium for long-term arrangements, raising the costs for hedging against inflation risks (Brunner and Hess, 1993; Rother, 2004). In particular, by contributing to uncertainty about future prices, inflation volatility can affect expectations even when inflation is considered under control (Berument et al., 2009; Kim and Lin, 2012; Rother, 2004). Furthermore, some research also shows that inflation volatility has important political effects, such as providing an opportunity for increased corruption (Braun and Tella, 2004). As mentioned, although low average inflation rates are associated with low variability, inflation volatility is not only a function of the level of inflation. In this paper, we argue that CBI has the potential to have an independent effect on inflation volatility, beyond its effect through lower inflation rates.

We examine the effects of legal CBI on inflation volatility in a sample of 96 developing and emerging economies, between 1980 and 2014 using the dataset coded by Garriga (2016), updated until 2014. Beyond the coverage and frequency of our data, our empirical analysis differs from previous work on inflation volatility because we explicitly account for both political and monetary institutional constraints, and because we explicitly account for the potential endogeneity of CBI and the level of inflation. Our findings suggest that CBI is directly and unconditionally associated with about 64% of a one standard deviation reduction of volatility. The magnitude of this effect is larger at higher levels of democracy, even after controlling for endogeneity. In other words, our findings show how formal, legal reforms of the monetary framework may curb inflation volatility, independently from this framework's anti-inflationary effect. Our results are robust to different model specifications, alternative measurements of the dependent and main independent variables, and a variety of methodologies to take explicitly into account potential bias and endogeneity concerns.

2. Literature review

The empirical literature shows that inflation volatility is associated with a host of economic factors (Weber, 2018), including trade openness (Bowdler and Malik, 2017; Dincer and Eichengreen, 2014), and fixed exchange rates (Bleaney and Fielding, 2002). Beyond economic factors, governments' policies and institutions affect macroeconomic fundamentals including, potentially, inflation volatility. In fact, previous research suggests that inflation volatility results from unstable monetary and fiscal policies (Aisen and Veiga, 2008; Cukierman, 1992; Rother, 2004). For example, Aisen and Veiga (2008) find that political instability – measured as cabinet changes, government crises, and instability indices – ethnic homogeneity, and democracy are associated with higher inflation volatility.

Other studies link characteristics of central banks with inflation volatility. For example, Dincer and Eichengreen (2014) find that central bank transparency is associated with lower volatility — when past inflation is not included in their specifications. Weber (2018) also finds that transparency is negatively associated with volatility, and Berlemann and Hielscher (2016) find that central bank conservativism is negatively associated with inflation volatility and significant for long lags of at least three years.

Regarding the curbing effects of CBI on volatility, the evidence is mixed, especially for developing countries. Aisen and Veiga (2008) find that *de facto* CBI reduces inflation volatility in developing countries, but do not find such an effect in

[4] Statement by Henry Maxey, chief investment officer https://www.reuters.com/breakingviews/global-markets-breakingviews-2022-03-31/ (Chancellor, 2022).

[5] Slide #4 from Gita Gopinath's presentation at the 2021 Jackson Hole Symposium.

[6] Although inflation and its volatility are correlated (Fischer et al., 2002; Kim and Lin, 2012), among others), especially at high levels of inflation, their relationship may not be monotonic (Çekin and Valcarcel, 2020), and the determinants and effects of both variables are not identical (Bleaney and Fielding, 2002; Weber, 2018), what justifies the study of the effects of CBI on both variables.

industrial countries. Using a measure of turnover rate of the governor as a proxy for de facto CBI, Higgins and Qureshi (2021) find a negative unconditional effect in a sample of 21 developing countries from 1985 to 2006 but partial results for developed countries. Focusing on legal or *de jure* CBI, and based on cross sectional analyses or panels with small samples, some scholars suggest an unconditional effect of legal CBI on inflation volatility (Alesina and Summers, 1993; Alpanda and Honig, 2010; Arnone and Romelli, 2013; Cukierman, 1992; Eijffinger and de Haan, 1996; Walsh, 1995). In contrast, others fail to find this unconditional association (Aisen and Veiga, 2008; Bade and Parkin, 1977), or only find it depending on the indicator used to measure CBI (Eijffinger et al., 1996).[7]

In sum, despite the potential negative effects of inflation volatility, the evidence of a relationship between legal CBI and inflation volatility is still inconclusive, especially for developing countries. Furthermore, most of these studies analyzed limited samples, used decade data on CBI, or did not consider the conditioning effect of the institutional framework (see Appendix A), which justifies revisiting this relationship. Hence, this paper unveils the conditions under which legal CBI curbs inflation volatility in developing countries, stressing the importance of the institutional context.

3. How can CBI affect inflation volatility?

In this paper, we define CBI as a series of legal protections that allow central banks to pursue price stability by insulating monetary policy from political influence (Cukierman, 1992). Based on the argument of time-inconsistency of commitments to price stability and their inflationary bias (Kydland and Prescott, 1977), the literature has stressed the benefits of enforced commitments (rules) over discretion (Barro and Gordon, 1983a,b), and Rogoff (1985) made a case for delegating monetary policy to independent central banks. The idea is that once central bankers are insulated from political pressures, commitments to price stability become credible, which helps to control inflation dynamics.

Although research suggests that legal CBI is associated with lower inflation in developing countries (Agur, 2021; Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020), and that inflation and its volatility tend to be correlated especially at high levels of inflation (Fischer et al., 2002), high volatility does not necessarily imply high inflation (Çekin and Valcarcel, 2020). Therefore, it would be misleading to extrapolate from the association between CBI and inflation that CBI and inflation volatility are also associated.

We argue that reforms to central banks' regulatory frameworks that increase CBI have a dual effect on inflation volatility. On the one hand, based on previous findings, we can expect that by delegating the design and implementation of monetary policy to independent central bankers mandated to maintain price stability, countries could not only tame inflation, but they may also reduce its variability.

On the other hand, we also expect a *direct* effect of CBI on inflation volatility for three reasons. First, CBI insulates monetary policy from pressures that originate in the political business cycle (Barro and Gordon, 1983b; Kydland and Prescott, 1977; Rogoff, 1985). However, electoral concerns not only generate inflationary pressures, but they may also influence the variability of the inflation rate. Thus, granting more autonomy to central banks can help achieve the necessary stability of monetary policy that would result in less volatile inflation. This concern can be especially relevant for more democratic countries. However, elections are instances of uncertainty and, potentially, of inflationary pressures even for non-democratic countries (Hyde and Marinov, 2011; Pepinsky, 2007; Schedler, 2002). Therefore, stabilizing the political business cycle should matter for electoral autocracies too.

Second, the focus on price stability makes central bankers especially reactive to deviations from their (formal or informal) inflation targets (Eichengreen et al., 2020). In particular, independent central bankers have incentives to control inflation effectively or risk losing their jobs (Dreher et al., 2008, 2010). These incentives for independent central bankers to react promptly to inflation deviations from the target may curb the magnitude of eventual deviations (Dmitriev and Kersting, 2016), resulting in lower volatility.

Finally, fiscal policy instability is another potential source of inflation volatility. The fiscal side of CBI — the ability of central banks to impose constraints in lending to the government or even participate in the design of the budget — encourages stability on fiscal policy (Bodea and Higashijima, 2017), and can contribute lowering inflation volatility.

Consistent with previous research, we expect the effects of CBI on inflation volatility to be stronger within the context of more democratic political institutions because they enhance the credibility of institutional commitments (Acemoglu et al., 2003; Agur, 2018; Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020). Although democratic institutions strengthen the price stability effects of CBI, they are not the sole determinants of the effectiveness of legal CBI: other incentives may make even less democratic governments preserve the autonomy of their central banks, and make this formal commitment credible to market actors (Guisinger and Andrew Singer, 2010; Bodea et al., 2019).[8] In other words, although democracy is not a necessary condition for CBI to have effects on price stability, democratic institutions strengthen the credibility of governments' commitments, which enhances the effects of CBI on price stability.

Note that our argument differs from the idea that democratic institutions are more stable, and therefore, this institutional stability translates into less macroeconomic variability (Aisen and Veiga, 2008), and is in line with work

[7] Appendix A summarizes the most relevant recent literature on the relation between central bank independence and inflation volatility.

[8] These incentives range from better market access (Bodea and Hicks, 2015a; Garriga, 2022; Maxfield, 1997), or lower risk ratings (Bodea and Hicks, 2018), to explicit conditions included in IMF programs (Kern et al., 2019; Reinsberg et al., 2021).

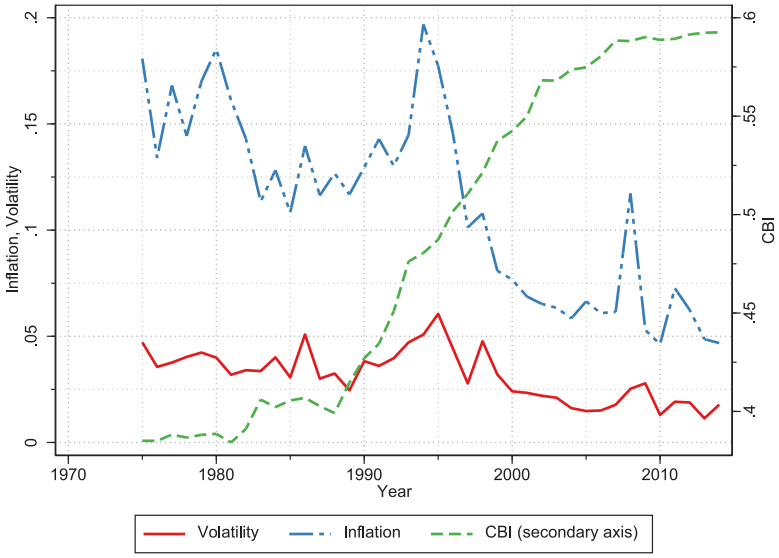


Fig. 1. Yearly average of inflation, inflation volatility, and CBI. Developing countries.
Note: All variables follow the definitions of this section. Extreme outliers were removed.

showing that under certain conditions, democracy is associated with higher inflation (Desai et al., 2003; Gasiorowski, 2000; Lim, 2021; Mijiyawa, 2011), potentially increasing inflation volatility too.

In what follows, we test two main ideas. First, that CBI is associated with lower inflation volatility, with democratic institutions strengthening that negative effect. Second, that the effect of CBI on inflation volatility survives after controlling for the potential endogeneity of the inflation rate. It is not uncommon to presume that the level of inflation could be explaining inflation volatility. Hence, we show that our main effect of CBI on inflation volatility is independent of the level of inflation and survives this control.

4. Data and methods

4.1. Inflation volatility

We measure inflation volatility (*Volatility*) as the standard deviation of a 12-month rolling window of the monthly inflation rate. This strategy follows the literature that measures inflation volatility as the standard deviation of the inflation rate within a time frame, accounting for all the transitory variations.[9] However, for robustness purposes, we also consider (i) the standard deviation of the residual from an inflation regression on a linear trend following Pritchett (2000) and Lensink and Morrissey (2006), and (ii) the standard deviation of the cyclical component of the Hodrick–Prescott filter following Hnatkovska and Loayza (2005) and Afonso and Furceri (2010). In the latter case, by decomposing trend and cycle, we can isolate the short-term fluctuations of inflation. The monthly data on inflation to compute volatility come from the *International Financial Statistics* (International Monetary Fund, 2018). They are later aggregated at the annual frequency for our regression analyses.

On average, countries have experienced a steady decline in inflation and inflation volatility (see Fig. 1). This decline correlates with the trend towards increasing CBI over time, although the correlation is neither high nor monotonic. Descriptive data, although suggestive, do not disentangle a causal interpretation of this relationship.

4.2. Our measurement of CBI

We measure legal CBI using country-year data from Garriga (2016), updated and corrected until 2014.[10] This indicator follows Cukierman's (1992) criteria, to elaborate an index that ranges from 0 (minimum) to 1 (maximum) independence. The index weighs four components, also measured from 0 to 1: the regulation of the central bank's chief executive officer's

[9] Among others, see Ilzetki et al. (2020) and Giovanni and Levchenko (2012).

[10] The updated dataset from Garriga (2016) includes 182 countries, from 1970 to 2014, on a country-year basis. However, since we exclude developed countries and countries that have regional central banks, and we control for a variety of factors that may not have data for all observations, our final dataset comprises 96 countries. Appendix C lists the countries included in the analyses.

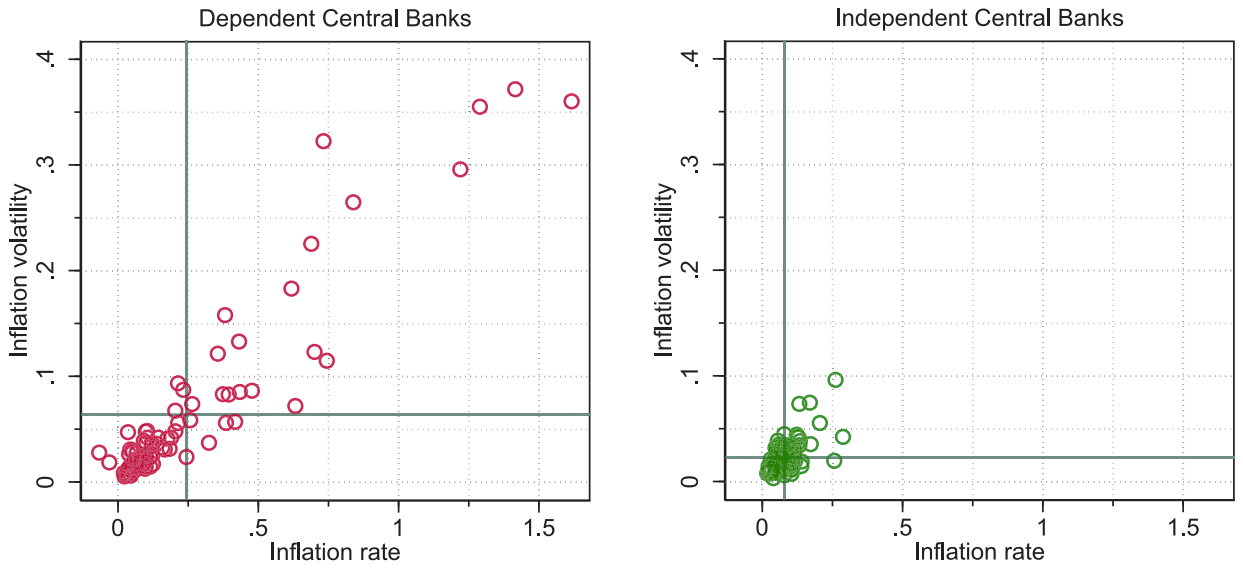


Fig. 2. Inflation volatility and inflation, for developing countries with dependent and independent central banks.
Note: The gray lines represent averages for each variable, for dependent and independent central banks.

tenure, the bank's policy formulation, its objectives, and the limitations on lending to the public sector — or the central bank fiscal powers. Coding rules are in Appendix B.

We use an indicator of legal CBI because it allows us to compare central banks' features across countries and time. Although de jure indicators cannot reflect behavior that deviates from the rules, they are accurate and comparable measures of policy decisions — in this case, the delegation of monetary policy to an autonomous central bank, and the legal protections to the central bank board members.[11] For robustness purposes, we also use Dreher et al.'s (2008) turnover rate of the heads of central banks, a common measure of de facto CBI.

Descriptive data suggest a general negative correlation between CBI and inflation volatility and also the association between them (see Fig. 1). Fig. 2 shows the association between inflation and its volatility between 1980 and 2014, for countries with independent and dependent central banks.[12] This figure suggests that countries with independent central banks generally have lower inflation and lower volatility than those with dependent central banks — see gray lines in Fig. 2, indicating sample means. These data, although suggestive, do not control for a series of confounding factors, analyzed in the following section.

4.3. Additional variables

The literature shows the conditioning effect of different measures of democracy or rule of law on CBI (Acemoglu et al., 2008; Aisen and Veiga, 2008; Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020). Hence, our models include Polity2, a proxy for democracy (*Democracy*), both as a control and interacted with CBI. The Polity2 score ranges from −10 to 10 (Marshall and Jaggers, 2012). Countries scoring ≥ 6 are normally considered democratic.

Our specifications include a series of control variables from the literature on inflation volatility. First, we control for lagged *Inflation* (Fischer et al., 2002) because we want to estimate the effect of CBI on volatility independently from its potential effect through inflation. We also include *Real GDP per capita,* and *Trade openness* – the sum of exports and imports as a share of GDP – as in Dincer and Eichengreen (2014) and Bowdler and Malik (2017). These data are from the *World Development Indicators* (World Bank, 2018). A country's exchange rate regime may condition the ability of monetary policy to affect inflation and its volatility (Bleaney and Fielding, 2002). Thus, we include *Peg,* a dichotomous variable indicating the existence of a fixed exchange rate regime, based on the updated *de facto* exchange rate regime classification by Reinhart and Rogoff (2004).[13] Following the literature on inflationary processes and autonomy of central banks, we control for periods of high inflation (as in Aisen and Veiga, 2006; Klomp and de Haan, 2010b). At high levels of

[11] Furthermore, legal independence works in practice as a necessary condition for de facto independence (Freedman and Öther-Robe, 2010).

[12] We use a 0 to 1 index of CBI (Cukierman et al., 1992; Garriga, 2016). For the purposes of this figure, we consider a central bank independent if the country scores $\geq$ 0.5 in the index in a given year, and dependent if it scores < 0.5.

[13] *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.

inflation, the economy faces pressures to its fundamentals which contribute to a higher degree of volatility. We control for the 10 percent of observations with the highest levels of inflation with the dummy variable *High Inflation*. Countries can also adopt inflation targeting as an additional way to increase their level of commitment and credibility to achieve price stability (Armand, 2017; Ftiti and Hichri, 2014; Lin and Ye, 2012, 2009; Mishkin, 2004; Ogrokhina and Rodriguez, 2019, 2018). Hence, we include a dummy variable, *Inflation targeting*, to capture the central banks that have adopted an inflation-targeting framework, with starting dates coming from Hammond (2012) and Roger (2010), updated until 2014.

To analyze the sensitivity of our main results, we control for additional effects. First, to account for other policy choices that can contribute to inflation volatility, we include the Chinn and Ito (2008) measure of *Capital account openness*. This normalized measure takes the value from 0 (maximum capital controls) to 1 (no restrictions to capital mobility). Furthermore, Acemoglu et al. (2003) and Aizenman et al. (2010), among others, argue that a procyclical fiscal policy can be a contributing factor of economic volatility. To capture this effect, we include *Fiscal spending*, measured as the expenditure of the general government as a percentage of GDP. These data are from the IMF's *World Economic Outlook*. We also control for sources of political instability following Aisen and Veiga (2006) and Desai et al. (2003). From Banks and Wilson (2021), we use *Political instability* (a weighted yearly measure of the number of assassinations, strikes, guerrilla warfare, major crises, purges, riots, revolutions, and anti-government demonstrations); a measure of *Government crises* (that counts the number of crises); and *Cabinet changes* (that counts the number of times a new premier is appointed and/or that 50% of the cabinet are occupied by new ministers). Additionally, Goodhart and Lastra (2018) and Agur (2018) argue that populist – defined as national identity politics – political movements may pressure the central bank, affecting its independence and ultimately, its targets. To account for this effect, we follow Agur (2018) to construct a nationalism index based on the nationalism characteristic of the chief executive, the largest government party, and the largest opposition party. This index is an unweighted sum that ranges between 0 and 3. All these institutional variables come from the *Database of Political Institutions* from the World Bank. Finally, to capture the effect of price changes in the rest of the world, following Bodea and Hicks (2015b) we include *World inflation*, the median yearly percentage change in the consumer price index of all countries. This measure works as an informative year-fixed effect. These data come from the *World Development Indicators* (World Bank, 2018).

4.4. Estimation strategy

We analyze the relationship between CBI and inflation volatility in a sample of 96 developing and emerging economies, between 1980 and 2014. To focus our analysis at the country level, we exclude observations pertaining to regional central banks (Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020). Our baseline specification can be represented as follows:

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

where y_{it} and y_{it-1} are inflation volatility for country i at time t and time $t-1$, respectively; CBI_{it-1} is our measure of central bank independence at time $t-1$; Dem_{it-1} is our measure of democracy at time $t-1$.[14] The inclusion of the interaction term enables the analysis of the effect of CBI on volatility at different levels of democracy. X_{it-1} is a vector of time-varying control variables commonly used in the literature; ξ_t is a period-specific constant to control for common shocks; η_i is an unobserved country-specific effect that captures all time-invariant factors that affect the outcome; and ε_{it} is the error term.

As our baseline specification, we estimate a dynamic panel model with fixed effects to account for the serial correlation in the idiosyncratic error term. The inclusion of a lagged dependent variable in this type of setup may introduce a bias (Nickell, 1981), especially when the number of time-series observations (T) is small (Wooldridge, 2002). However, given the number of time-series and cross-sectional units in our panel, the Nickell bias is significantly reduced and small (Beck and Katz, 2011; Beck and Mignozzetti, 2014).[15]

5. Results

Table 1 presents the main results. We keep our sample size constant across specifications to facilitate comparisons across models.[16] As expected, the coefficient associated with *CBI* is negative and statistically significant in models without interaction and additional controls (column 1), including the interaction with *Democracy* (column 2), and with multiple

[14] To account for potential simultaneity in CBI and democracy, following Clemens et al. (2012) and Blackwell and Glynn (2018), we include these variables lagged in our baseline specification.

[15] When T is twenty or more, Beck and Katz (2011) suggest this approach over the bias-corrected within-groups estimators proposed by Kiviet (1995), Judson and Owen (1999), and Bun and Kiviet (2003), which are more suitable for small samples. In fact, Beck and Mignozzetti (2014) argue that when T is at least thirty, the bias is considerably reduced. In our robustness checks, we relax this methodology and consider other approaches, including the bias-corrected estimator by Breitung et al. (2021) that accounts for the estimation of dynamic fixed-effects models.

[16] Our sample covers up to 96 countries, between 1980 and 2014. However, not all countries are covered throughout the entire sample span. Several countries enter in the sample "later" because their central banks were created after 1980 (e.g., post-Soviet countries), or they become OECD members a few years after the central bank creation or first available legislation (e.g., Czech Republic, Slovakia, Hungary, or Poland, all with <6 observations in our sample). The average number of observations (years) per country in the sample is 23.9. Thus, the main models include 32 countries for the full sample (35 years) where all the data are available for that time span.

Table 1
CBI and volatility, 1980-2014.
Dependent variable: Inflation volatility.

	(1)	(2)	(3)
CBI_{t-1}	−1.249*	−0.940*	−0.786**
	(0.673)	(0.492)	(0.381)
Democracy $_{t-1}$	0.037**	0.087**	0.077*
	(0.019)	(0.044)	(0.041)
CBI_{t-1}*Democracy $_{t-1}$		−0.119*	−0.096*
		(0.063)	(0.052)
Volatility $_{t-1}$	0.258***	0.255***	−0.058
	(0.078)	(0.078)	(0.252)
Inflation $_{t-1}$			0.197
			(0.205)
GDP per capita $_{t-1}$			0.368**
			(0.180)
Trade openness $_{t-1}$			−0.004
			(0.003)
Peg			−0.274
			(0.166)
Inflation Targeting			0.045
			(0.144)
High Inflation			0.778**
			(0.348)
Effect of CBI			
at Polity2=1 (autocracy)		−1.059*	−0.881**
		(0.544)	(0.425)
at Polity2=6 (democracy)		−1.654**	−1.361**
		(0.827)	(0.666)
at Polity2=10 (full democracy)		−2.129**	−1.745**
		(1.066)	(0.867)
R^2	0.119	0.121	0.150
N. observations	2290	2290	2290
N. of countries	96	96	96

Notes: Robust standard errors in parentheses. All specifications include a constant term, country, and decade fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

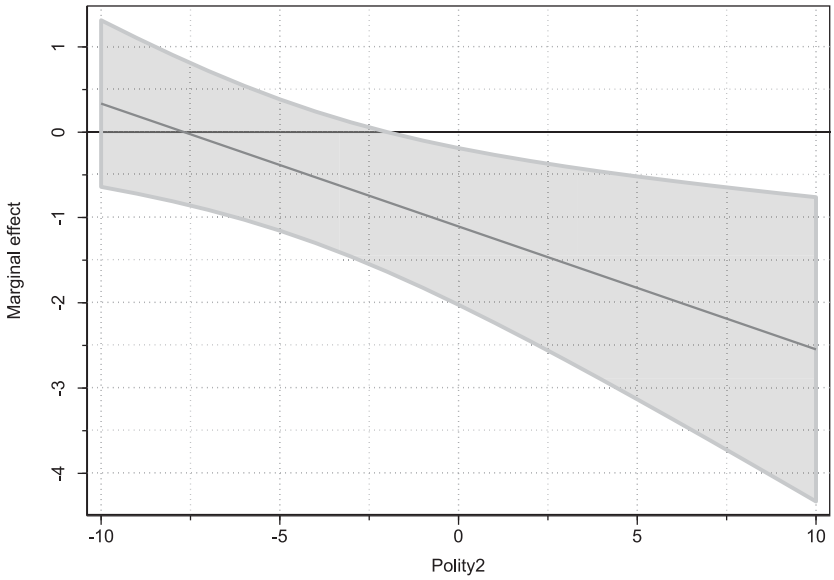
control variables (column 3). Notice that the negative sign of CBI on inflation volatility does not rely on the interaction effect (see column (1)). Among the control variables, the coefficients associated with *GDP per capita* and *High Inflation* are positive, as expected, and statistically significant. This implies that, other things constant, inflation volatility increases with the level of income and when countries experience periods of relatively high inflation. Other controls do not achieve statistical significance.

Our baseline specification includes a conditioning effect of democratic institutions. The coefficient associated with *Democracy* is positive and statistically significant across the three models, suggesting that other things constant, more democratic countries have higher inflation volatility. This contrasts Weber's (2018) findings for developed countries, and with the idea that democracies have more stable policies that translate into less volatility (Aisen and Veiga, 2008). However, this is consistent with other authors' findings (Desai et al., 2003; Gasiorowski, 2000; Lim, 2021). The coefficient associated with the interaction term is negative and significant in columns (2) and (3). The joint effects of CBI and the interaction term indicate that for more democratic countries the curbing effect of CBI on volatility is stronger — the bottom part of Table 1 reports the marginal effect of CBI at three different levels of democracy to illustrate the magnitude of this effect.[17] Additionally, Fig. 3a shows the joint effect of CBI on volatility for all levels of democracy. The marginal effect of CBI is significantly negatively associated with inflation volatility even for non-democratic countries (Polity2 > −2). However, it is much larger for democracies (Polity2 = 6) and increases on Polity2 scores.

Eq. (1) explicitly assumes a linear relationship in the marginal effect. One way to flexibly estimate the functional form of the marginal effect is by using a series of local effects with a kernel reweighting scheme. Following Hainmueller et al. (2019), we use a kernel smoothing estimator of the marginal effect. This approach is based on a semiparametric specification where smooth functions of Polity2 capture the marginal effect of CBI on volatility. By applying this method, we do not impose linearity, but the structure can vary freely across the range of Polity2. Fig. 3b shows the results of the kernel estimator applied to a modified Eq. (1), where bandwidths were selected using Hainmueller et al. (2019) 5-fold

[17] The point estimates reported in the lower section of Table 1 are the linear combination of CBI and the interaction term at different levels of Polity2. The standard errors were obtained using the delta method. As mentioned above, our measure for democracy ranges from −10 (closed autocracies) to 10 (full democracies), with countries scoring ≥ 6 considered to be democracies.

a. Marginal effect of CBI at different levels of Polity2



b. Kernel smoothed estimates of the marginal effect of CBI at different levels of Polity2

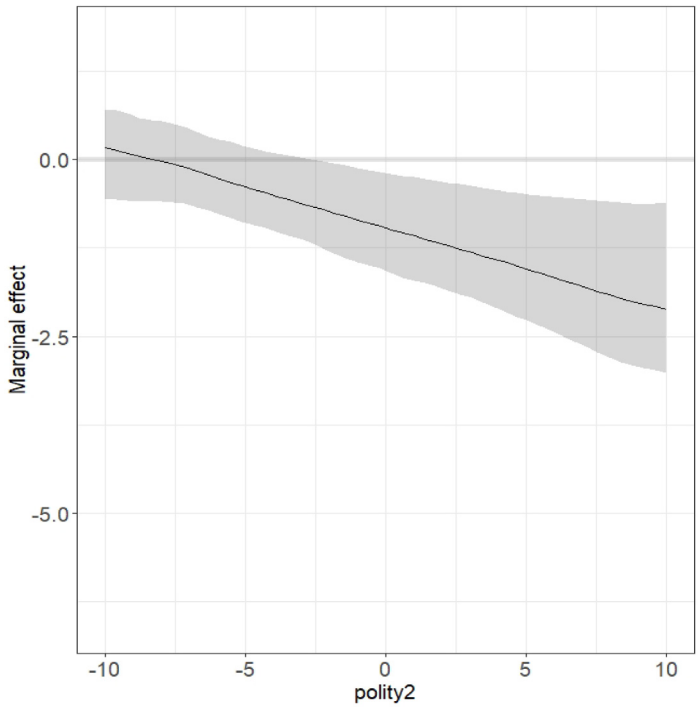


Fig. 3. Conditional effect of democratic institutions.
Note: Both figures represent the marginal effects of shifting from a dependent central bank to an independent one at different levels of democracy, with the specification of column (2) in Table 1.

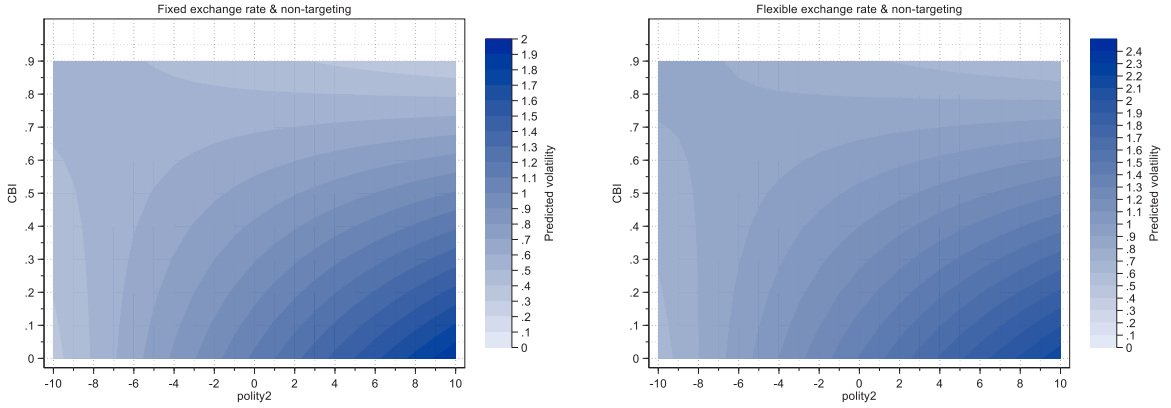


Fig. 4. Predicted inflation volatility. *Note*: Both figures are constructed with the specification of column (2) in Table 1.

cross-validation procedure, and the confidence intervals generated using bootstrap. Interestingly, Fig. 3b shows a result very similar to 3a — in which we assumed a linear structure.

Substantively, based on the point estimates in column (3) and holding other things constant, a shift from a dependent central bank to a fully independent one is associated with a 0.79 percent point reduction in volatility – about 35% of a one standard deviation of *Volatility* (sample standard deviation = 2.25) – when Polity2 = 0. For democracies (Polity2 = 6) and full democracies (Polity2 = 10), the substantive effect of the same increase ranges between 60% and 78% of a one standard deviation, respectively.

The conditional effect of *Democracy* on the inflation volatility-curbing effect of CBI can also be shown with different scenarios. Fig. 4 illustrates the predicted inflation volatility at different levels of CBI and Polity2, in non-inflation targeting countries with fixed and floating exchange rate regimes, holding other variables at their means. Notice that not all combinations of these scenarios are equally likely to be observed in reality, and that not all combinations of CBI and Polity2 are statistically significant, mostly due to the number of observations for some of those combinations.

Consistent with the coefficients reported in Table 1 and with our main hypothesis, the figures show that, holding everything else constant, at any level of democracy, higher CBI is associated with lower predicted volatility. Furthermore, increases in CBI are associated with larger effects on predicted volatility at higher levels of Polity2 — as mentioned above, democracies are predicted to have higher inflation volatility, holding other variables, constant. These larger effects are more marked in countries with fixed exchange rates.

5.1. Robustness checks

Our results are robust to the inclusion of additional controls, to the use of alternative measurements for the dependent and main independent variables, and to different estimation methodologies. First, results hold when we control for potential domestic and international sources of volatility. We control for different measures of *political instability* (Aisen and Veiga, 2008), *nationalism* (Agur, 2018; Goodhart and Lastra, 2018), and *fiscal spending* (Aizenman and Jinjarak, 2010; Cukierman, 1992; Dmitriev and Kersting, 2016; Rother, 2004). We also include controls for external shocks that could affect inflation volatility, such as *capital account openness* (Chinn and Ito, 2008), *world inflation* (Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020), and *US volatility* (Altansukh et al., 2017; Rey, 2015). Table 2 shows that, except for political instability, none of these controls achieve statistical significance, while our main results and marginal effects hold with significantly similar magnitudes.

Second, our results also hold when using two alternative measures of volatility. In Table 3, column (1) uses the standard deviation of the residual from an inflation regression on a linear trend following Pritchett (2000) and Lensink and Morrissey (2006); and in column (2) we use the standard deviation of the cyclical component of inflation after applying the Hodrick–Prescott filter (Afonso and Furceri, 2010; Hnatkovska and Loayza, 2005). As in Table 1, the coefficients associated with CBI and their interactions with *Democracy* in columns (1) and (2) in Table 3 are significantly negative. Additionally, the negative effect on inflation volatility from shifting from a dependent central bank to an independent one increases at higher levels of Polity2.

Our baseline specification controls for inflation to account for the effect of CBI on volatility independently from its potential effect through inflation. However, since developing countries usually deal with periods of high and persistent inflation, in this section we include an alternative measure of inflation, commonly used in the literature. To take into account hyperinflation episodes and ameliorate potential heteroscedasticity, we define a transformed inflation rate as

Table 2
CBI and volatility, 1980-2014. Robustness checks: Additional regressors.
Dependent variable: Inflation volatility.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CBI_{t-1}	−0.852**	−0.814**	−0.807**	−1.008*	−0.857**	−0.699**	−0.942**	−0.784**	−0.786**
	(0.408)	(0.406)	(0.392)	(0.531)	(0.416)	(0.353)	(0.453)	(0.396)	(0.381)
Democracy $_{t-1}$	0.076*	0.080*	0.077*	0.079*	0.077*	0.085*	0.059	0.077*	0.077*
	(0.040)	(0.041)	(0.042)	(0.045)	(0.041)	(0.044)	(0.038)	(0.040)	(0.040)
CBI_{t-1}*Democracy $_{t-1}$	−0.089*	−0.101*	−0.095*	−0.088	−0.094*	−0.120*	−0.065	−0.096*	−0.096*
	(0.051)	(0.053)	(0.053)	(0.056)	(0.053)	(0.066)	(0.047)	(0.051)	(0.052)
Volatility $_{t-1}$	−0.058	−0.058	−0.060	−0.068	−0.058	−0.092	−0.374	−0.058	−0.058
	(0.253)	(0.252)	(0.252)	(0.257)	(0.251)	(0.250)	(0.292)	(0.252)	(0.253)
Inflation $_{t-1}$	0.197	0.197	0.198	0.199	0.196	0.215	0.470*	0.197	0.197
	(0.205)	(0.206)	(0.206)	(0.208)	(0.205)	(0.204)	(0.266)	(0.205)	(0.205)
GDP per capita $_{t-1}$	0.395**	0.437**	0.380**	0.409	0.386*	0.356*	0.110	0.368**	0.368*
	(0.189)	(0.185)	(0.188)	(0.365)	(0.195)	(0.200)	(0.128)	(0.180)	(0.202)
Trade openness $_{t-1}$	−0.005	−0.005	−0.005	−0.006	−0.005	−0.004	−0.001	−0.004	−0.004
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)
Peg	−0.268	−0.279	−0.276	−0.423*	−0.284	−0.284	−0.243	−0.274*	−0.274*
	(0.164)	(0.180)	(0.171)	(0.234)	(0.175)	(0.171)	(0.159)	(0.165)	(0.164)
Inflation Targeting	0.063	0.038	0.040	−0.221	0.021	0.181	0.079	0.045	0.045
	(0.148)	(0.157)	(0.141)	(0.192)	(0.149)	(0.193)	(0.118)	(0.145)	(0.150)
High Inflation	0.762**	0.802**	0.768**	0.714**	0.788**	0.859**	0.528	0.778**	0.778**
	(0.344)	(0.362)	(0.352)	(0.349)	(0.353)	(0.390)	(0.384)	(0.353)	(0.347)
Political instability	0.025**								
	(0.012)								
Nationalism		−0.047							
		(0.174)							
Government crises			0.095						
			(0.171)						
Cabinet changes				−0.027					
				(0.072)					
Elections					0.199				
					(0.150)				
Fiscal spending						−0.044			
						(0.029)			
Cap. account openness							−0.599		
							(0.425)		
World inflation								0.001	
								(0.025)	
US Volatility									0.099
									(13.814)
Effect of CBI									
at Polity2=1	−0.941**	−0.914**	−0.902**	−1.096**	−0.951**	−0.819**	−1.001**	−0.880**	−0.882**
(autocracy)	(0.449)	(0.446)	(0.435)	(0.562)	(0.458)	(0.407)	(0.484)	(0.440)	(0.426)
at Polity2=6	−1.387**	−1.418**	−1.377**	−1.537**	−1.424**	−1.416**	−1.331**	−1.361**	−1.361**
(democracy)	(0.675)	(0.678)	(0.674)	(0.763)	(0.692)	(0.707)	(0.669)	(0.677)	(0.664)
at Polity2=10	−1.743**	−1.878**	−1.758**	−1.890**	−1.801**	−1.895**	−1.591*	−1.745**	−1.745**
(full democracy)	(0.868)	(0.878)	(0.876)	(0.953)	(0.891)	(0.960)	(0.835)	(0.874)	(0.864)
R^2	0.150	0.151	0.149	0.142	0.150	0.157	0.183	0.150	0.150
N. observations	2210	2077	2210	1627	2120	2216	2246	2290	2290
N. of countries	96	85	96	92	96	96	93	96	96

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

$\pi/(1+\pi)$ where π is the inflation rate.[18] This standardization produces a smoother dynamic of the inflation rate Cukierman et al. (1992), Jacome and Vázquez (2008), Vuletin and Zhu (2011).[19] Column (3) in Table 3 shows that our main results hold with this alternative measure of inflation: There is a negative relationship of CBI with volatility, with a stronger effect the higher the level of democracy.

Although our argument relies on legal CBI, we also test two alternative approaches by replacing our measurement of de jure CBI for two kinds of de facto threats to CBI: (i) the turnover rate of the central bank head in the past five years (Dreher et al., 2008, 2010), and (ii) public political pressure to the central bank (Binder, 2021), in columns (4) and (5), respectively, in Table 3. Notice that, in both cases, higher turnover rates and the presence of political pressures proxy reductions in de

[18] When there is a price increase, this *transformed* inflation rate takes a value from 0 to 1, while for a price decrease it ranges between −1 and 0.

[19] We also considered a second transformation of the inflation rate following Lim (2021), using the inverse hyperbolic sine for the inflation rate to moderate the effects of outliers. Results –not presented here – are consistent with our baseline specification and are available upon request.

Table 3
CBI and volatility, 1980-2014. Robustness checks: Alternative measures for volatility, inflation, and central bank independence. Dependent variable: Inflation volatility.

	(1)	(2)	(3)	(4)	(5)
	Volatility as SD of residual	Volatility as SD of cyc. comp	Inflation (transformed)	Turnover rate (TOR)	Public political pressure (PPP)
CBI_{t-1}	−0.782**	−0.881**	−0.726**		
	(0.384)	(0.417)	(0.365)		
TOR (5 past years)				0.581*	
				(0.310)	
Political pressure (PPP)					0.009**
					(0.004)
Democracy $_{t-1}$	0.077*	0.085*	0.066*	−0.033*	0.001
	(0.041)	(0.045)	(0.037)	(0.018)	(0.001)
CBI_{t-1}*Democracy $_{t-1}$	−0.094*	−0.115*	−0.064		
	(0.053)	(0.065)	(0.046)		
TOR*Democracy				0.185**	
				(0.084)	
Pol pressure *Democracy					−0.001**
					(0.001)
Volatility $_{t-1}$	−0.043	−0.034	0.210***	−0.207	0.128
	(0.253)	(0.251)	(0.077)	(0.211)	(0.094)
Inflation $_{t-1}$	0.185	0.178	1.821	0.261	−0.077
	(0.206)	(0.190)	(1.375)	(0.184)	(0.103)
GDP per capita $_{t-1}$	0.374**	0.230	0.379**	0.130	−0.047***
	(0.183)	(0.156)	(0.180)	(0.090)	(0.017)
Trade openness $_{t-1}$	−0.004	−0.003	−0.003	−0.003*	0.000
	(0.003)	(0.002)	(0.003)	(0.002)	(0.000)
Peg	−0.270	−0.281*	−0.290*	−0.205	−0.037*
	(0.164)	(0.161)	(0.170)	(0.135)	(0.019)
Inflation Targeting	0.049	−0.003	0.084	0.055	0.003
	(0.157)	(0.181)	(0.204)	(0.142)	(0.002)
High Inflation	0.790**	0.708**	0.571*	0.524**	0.125
	(0.355)	(0.313)	(0.342)	(0.256)	(0.079)
Effect of CBI/TOR/PPP					
at Polity2=1	−0.876**	−0.996*	−0.789**	0.767**	0.007**
(autocracy)	(0.429)	(0.476)	(0.397)	(0.380)	(0.004)
at Polity2=6	−1.347**	−1.573**	−1.106*	1.693**	0.002
(democracy)	(0.672)	(0.785)	(0.585)	(0.775)	(0.002)
at Polity2=10	−1.724**	−2.034**	−1.361*	2.435**	0.003
(full democracy)	(0.875)	(1.038)	(0.754)	(1.105)	(0.003)
R^2	0.146	0.152	0.152	0.154	0.461
N. observations	2235	2290	2290	2456	339
N. of countries	94	96	96	95	69

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Column (3) uses a *transformed* inflation rate, computed as $\pi/(1+\pi)$, where π is the inflation rate. Columns (4) and (5) use the contemporary measures for CBI and Democracy given that TOR is a 5-year measure, and PPP to the central bank have a more immediate effect (compared to our reference measure) on price stability.

facto CBI. Higher turnover rates (less independence) are associated with more volatility, and the magnitude of this effect is larger for more democratic countries (consistent with Higgins and Qureshi, 2021). In contrast, attacks to the central banks are associated with more volatility in non-democratic countries. For democratic countries, these attacks do not seem to imply more inflation volatility. These results are consistent with the logic of our argument.

Finally, our results are also robust to different estimation techniques (Table 4). First, we re-estimate the baseline model omitting the lagged dependent variable as suggested by Klomp and de Haan (2010a). Although we obtain similar results, the point estimates in column (1) may be less precise than in the baseline model since omitting the lag may increase the variance (Mizon, 1995) due to a specification error — given the known persistence of volatility over time (Ahmad and Staveley-O'Carroll, 2017).

Second, although our baseline specification includes lagged independent variables, endogeneity and reverse causality concerns associated with CBI may remain as countries with higher volatility might be more likely to reform their central banks and grant them independence (Reed, 2015). Therefore, in column (2), Table 4, we re-estimate the model using an instrumental variables approach. On the one hand, Jacome and Vázquez (2008) and Bodea and Hicks (2015b) use the lagged values of the CBI index as an instrument for CBI. On the other hand, the literature suggests that one of the main drivers of CBI is regional diffusion (Bodea and Hicks, 2015a; Polillo and Guillén, 2005). The main argument is that CBI shows a regional diffusion pattern that is not necessarily directly impacting inflation volatility. Hence, following Aklin

Table 4
CBI and volatility, 1980-2014. Robustness checks: Alternative methodologies.
Dependent variable: Inflation volatility.

	(1) No lagged DV	(2) IV for CBI	(3) Dynamic GMM	(4) Bias-corrected method of moments	(5) Within-group correlation	(6) Driscoll- Kraay SE
CBI_{t-1}	−0.752**	−0.707**	−1.126**	−0.895**	−1.104**	−0.786**
	(0.366)	(0.332)	(0.549)	(0.450)	(0.477)	(0.372)
Democracy $_{t-1}$	0.076*	0.076**	0.159*	0.071*	0.085*	0.077***
	(0.041)	(0.038)	(0.085)	(0.043)	(0.045)	(0.023)
CBI_{t-1}*Democracy $_{t-1}$	−0.092*	−0.096	−0.154	−0.088*	−0.108*	−0.096**
	(0.053)	(0.059)	(0.105)	(0.051)	(0.059)	(0.039)
Volatility $_{t-1}$		−0.059	−0.049	−0.089	−0.193	−0.058
		(0.381)	(0.254)	(0.460)	(0.240)	(0.178)
Inflation $_{t-1}$	0.162**	0.197	0.183	0.300	0.214	0.197
	(0.073)	(0.245)	(0.209)	(0.371)	(0.183)	(0.166)
GDP per capita $_{t-1}$	0.362**	0.377*	0.115	0.038	0.345	0.368
	(0.181)	(0.221)	(0.160)	(0.116)	(0.242)	(0.237)
Trade openness $_{t-1}$	−0.004	−0.005*	−0.002	0.000	−0.005	−0.004
	(0.003)	(0.003)	(0.002)	(0.001)	(0.003)	(0.003)
Peg	−0.276*	−0.286**	0.018	−0.329*	−0.363*	−0.274*
	(0.165)	(0.143)	(0.109)	(0.191)	(0.210)	(0.152)
Inflation Targeting	0.032	0.035	−0.376*	−0.045	−0.009	0.045
	(0.177)	(0.168)	(0.227)	(0.114)	(0.168)	(0.156)
High Inflation	0.786**	0.800***	1.529**	0.645	0.755**	0.778***
	(0.332)	(0.309)	(0.597)	(0.462)	(0.340)	(0.229)
Effect of CBI						
at Polity2=1	−0.844**	−0.804**	−1.279**	−0.983**	−1.212**	−0.882**
(autocracy)	(0.411)	(0.364)	(0.545)	(0.493)	(0.525)	(0.399)
at Polity2=6	−1.305**	−1.285**	−2.049***	−1.421**	−1.752**	−1.361**
(democracy)	(0.654)	(0.592)	(0.779)	(0.725)	(0.787)	(0.558)
at Polity2=10	−1.673*	−1.670**	−2.665**	−1.771*	−2.185**	−1.745**
(full democracy)	(0.858)	(0.807)	(1.119)	(0.919)	(1.010)	(0.699)
R^2	0.150					0.150
N. observations	2297	2181	2282	2160	2244	2290
N. of countries	96	95	96	85	93	96
F-Statistic (first stage)		7039				
Hansen test (*p-value*)			0.999			
Second order serial correlation (*p-value*)			0.154			
Pesaran's (2015) CD test						7.171***

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Column (4) uses the two-step system GMM estimator with Windmeijer (2005) small sample robust correction.

et al. (2021) we construct an instrument for CBI (and its interaction term with democracy) from the interaction of the lagged value of CBI with the average level of CBI in the country's region.[20] Column (2) presents results consistent with our baseline specification. The joint F-statistic of the first stage is greater than the Staiger and Stock's (1997) rule of thumb of ten, implying that the instruments are relevant.

Additionally, we address the joint endogeneity of all explanatory variables by estimating a dynamic panel regression using a system general method of moments (GMM) estimator (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998), which may also mitigate potential biases induced by fixed effects. Our data comply with the two main assumptions of this model: absence of serial correlation in the second order differences, and the Hansen test shows the validity of the instruments. Column (3) presents results consistent with our baseline specification. Interestingly, Bun and Windmeijer (2010) argue that in practice, the system GMM estimator suffers from the weak-instruments problem when the individual variance is larger than that of the idiosyncratic errors. To overcome this issue, and directly correct the dynamic panel data bias of the fixed effect estimator, Breitung et al. (2021) propose a bias-corrected estimator derived as a method of moments estimator. Column (4) reports results that are consistent with our baseline specification, and with the other methodologies.

When dealing with large panels, the time dimension plays an important role. To address the possibility that the dependent variable embeds a time-series property, which would show up in the error term, we re-estimate our baseline specification considering an AR(1) disturbance. Column (5) presents results of this estimation that are consistent with our baseline.

[20] To compute this regional average for each country, we exclude that individual country. Hence, this measure will have variation across years and countries of the same region.

The instruments used in column (2), and the increasing economic global integration, highlight the possibility of cross-sectional dependency among countries. Given that our panel has more cross-sections than time periods, Pesaran (2004, 2015) highlights the potential bias when the error cross-section dependence is ignored. However, Pesaran (2015) also explains that weak cross-sectional dependence should not be a matter of concern. To determine the existence of (weak) cross-sectional dependence, we perform Pesaran's (2015) CD test. Column (6) in Table 4 presents the result of the CD test where we reject the null hypothesis, confirming the presence of cross-sectional dependence in the panel. In this context, to get consistent and robust results, we apply the Driscoll and Kraay (1998) standard errors to account for the cross-sectional correlation in the panels. Column (6) in Table 4 shows that the results are almost identical, with higher statistical significance, to our baseline specification. This means that the cross-sectional dependency is not concerning and does not change the baseline results. In fact, the latter estimates are more conservative.[21] In sum, the negative coefficient associated with CBI, and the effect of CBI at different levels of democracy, are significant across methodologies.

5.2. The role of inflation

The panel data regression analyses of the previous subsections characterized the relationship of inflation volatility with the degree of CBI by exploiting the co-movements between both variables. This implicitly assumes that there is no reverse causality, running from CBI to volatility. To address potential endogeneity concerns, column (2) in Table 4 includes an instrumental variables analysis for the inflation rate. Those results are reassuring but the role of inflation might still require further clarification.

In Tables 1–4, we almost never find a significant coefficient for the level of inflation in our volatility regressions.[22] However, to formally address the potential endogeneity bias in this relationship, we also use an instrumental variables framework for the level of inflation. Clarida et al. (2000) and Auray and Fève (2008), among others, suggest using lags of the inflation rate as instruments for inflation. Acknowledging the potential limitations of this approach, we take the squared terms of the three lags of the inflation rate as instruments. The rationale in this case is that a non-linear transformation of the three lags of inflation (Staiger and Stock, 1997) can minimize the direct effect on inflation volatility. Column (1) in Table 5 presents the results. Additionally, to account for potentially competing effects, we simultaneously instrument CBI and inflation using their respective instruments: for CBI, we use the interaction of the lagged value of CBI and the average level of CBI in the country's region, while for the inflation rate, we use the squared terms of the three lags of the inflation rate. Column (2) in Table 5 presents the results. In both columns, the first stage F-value is above the conventional level of ten, and our results remain virtually identical when compared to the baseline specification. In other words, our main results survive when we adopt an instrumental variables framework for both CBI and inflation. We still find a negative coefficient associated with CBI, and significant effects of CBI at different levels of democracy. Given that the recent research shows that CBI is associated with lower inflation rate in developing countries (Bodea and Hicks, 2015b; Garriga and Rodriguez, 2020), our results also suggest that the effect of CBI on volatility runs independently from its effect on the level of inflation.

To further investigate the role of inflation in the relationship between CBI and inflation volatility, we condition our main variables of interest and their interaction by the inflation rate. That is, based on (1), we consider the following three-way interaction specification,

$$\begin{aligned} y_{it} = {} & \varphi y_{it-1} + \beta_1 CBI_{it-1} + \beta_2 Dem_{it-1} + \beta_3 Infl_{it-1} + \beta_4 CBI_{it-1} * Dem_{it-1} + \beta_4 CBI_{it-1} * Infl_{it-1} + \\ & + \beta_5 Dem_{it-1} * Infl_{it-1} + \beta_6 CBI_{it-1} * Dem_{it-1} * Infl_{it-1} + \delta X_{it-1} + \xi_t + \eta_i + \varepsilon_{it} \end{aligned} \tag{2}$$

With this specification, we explicitly allow for the effect of CBI and democracy to differ across different levels of inflation. The results are presented in Fig. 5.[23] The vertical axis measures the combined marginal effect of CBI, while the horizontal axes measure the degree of democracy and the inflation rate. The top and bottom shaded plains represent the 95% confidence intervals while the middle plain represents the estimate of the total effect. From this figure, the following is worth pointing out. First, consistent with our previous results, this figure shows a negative effect on inflation volatility when shifting from a dependent central bank to an independent one. Second, such effect is stronger at high levels of democracy. Furthermore, such effect is even more negative at low levels of inflation. In other words, the combination of a low inflation rate with the shift to an independent central bank is associated with the largest reduction on volatility.

Overall, these results highlight the curbing effect of CBI on volatility when conditioning on inflation and democracy, and provide additional evidence supporting our main hypothesis.

[21] From a policy perspective, we prefer more conservative estimates as our baseline results.

[22] Out of the 21 specifications presented in Tables 1 through 4, *Inflation* is statistically significant in only two cases (column (7) in Table 2; column (1) in Table 4).

[23] The full regression analysis is not presented here to save space, but is available upon request.

Table 5
CBI and volatility, 1980-2014. The role of inflation.
Dependent variable: Inflation volatility.

	(1) IV for Inflation	(2) IV for Inflation and CBI
CBI_{t-1}	−0.883**	−0.933**
	(0.448)	(0.474)
Democracy $_{t-1}$	0.079*	0.073*
	(0.042)	(0.040)
CBI_{t-1}*Democracy $_{t-1}$	−0.080	−0.068
	(0.059)	(0.060)
Volatility $_{t-1}$	0.921	0.916
	(0.954)	(0.952)
Inflation $_{t-1}$	−0.439	−0.436
	(0.555)	(0.554)
GDP per capita $_{t-1}$	0.180	0.180
	(0.169)	(0.175)
Trade openness $_{t-1}$	0.000	0.000
	(0.001)	(0.002)
Peg	−0.372*	−0.391*
	(0.195)	(0.206)
Inflation Targeting	−0.235	−0.261
	(0.226)	(0.234)
High Inflation	1.291**	1.320**
	(0.572)	(0.587)
Effect of CBI		
at Polity2=1	−0.963**	−1.001**
(autocracy)	(0.489)	(0.503)
at Polity2=6	−1.366*	−1.340*
(democracy)	(0.735)	(0.709)
at Polity2=10	−1.687*	−1.612*
(full democracy)	(0.953)	(0.912)
R^2		
N. observations	2127	2020
N. of countries	95	94
Instruments	Inflation squared (3 lags)	Inflation squared (3 lags), CBI_{t-1} * CBI *regional*$_{t-1}$
F-Statistic (first stage)	39.36	23.47

Robust standard errors in parentheses. All specifications include a constant term, country, and decade fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

5.3. The timing of inflation: Contemporaneous effects[24]

Although the simple correlations shown in Fig. 1 suggest a strong association between inflation and its volatility, our models do not show a generally significant correlation between them. However, the challenging aspect of analyzing a possible contemporaneous relationship between these variables is that both inflation and its volatility can be endogenously and jointly determined. To uncover interactions between inflation and volatility, we follow Lewbel's (2012) estimator for fully simultaneous systems when key identifying assumptions are violated. We use an instrumental variables approach that exploits the presence of heteroscedasticity in the regression residuals to construct a set of internal instruments that allows the identification of a causal relationship when external instruments are not available — identification through heteroscedasticity (IH).[25] Through this approach we mitigate, and possibly overcome, concerns regarding reverse causality. We apply this methodology considering the following specification[26]:

$$y_{it} = \gamma_1 z_{it} + \alpha_1 CBI_{it} + \alpha_2 Dem_{it} + \alpha_3 CBI_{it} * Dem_{it} + \alpha_4 V_{it-1} + \xi_t + \eta_i + \varepsilon_{1it} \quad (3)$$

24 We thank an anonymous reviewer for encouraging us to explicitly explore the possibility of contemporaneous effects, and for suggesting this particular statistical approach.

25 This methodology, developed by Rigobon (2003), Lewbel (2012) and Baum and Lewbel (2019), has recently been applied by Kim and Lin (2012), Arcand et al. (2015), Dietrich and Wright (2015), Gründler and Potrafke (2019), Hasan et al. (2021), Dutta and Meierrieks (2021), among others.

26 Lewbel (2012) considers a structural simultaneous model of the form:

$$Y_1 = X'\beta_1 + Y_2\gamma_1 + \varepsilon_1$$
$$Y_2 = X'\beta_2 + Y_1\gamma_2 + \varepsilon_2$$

where Y_1 and Y_2 are endogenous variables, X is a vector of observed exogenous variables and $\varepsilon = (\varepsilon_1, \varepsilon_2)$ unobserved errors (that may be correlated with each other).

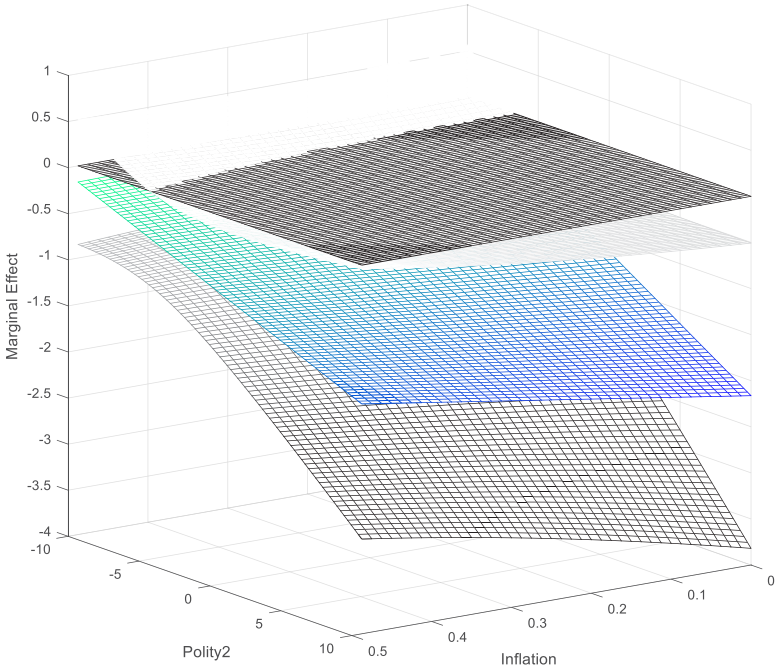


Fig. 5. Marginal effect of CBI on volatility at different levels of democracy and inflation.

$$z_{it} = \gamma_2 y_{it} + \beta_1 CBI_{it} + \beta_2 Dem_{it} + \beta_3 CBI_{it} * Dem_{it} + \beta_4 V_{it-1} + \xi_t + \eta_i + \varepsilon_{2it} \quad (4)$$

where y_{it} and z_{it} are inflation volatility and inflation for country i at time t, respectively. V_{it-1} is a vector of time-varying control variables; ξ_t is a period-specific constant to control for common shocks; η_i is an unobserved country-specific effect that captures all time-invariant factors that affect the outcome; and $\varepsilon_{1_{it}}$ and $\varepsilon_{2_{it}}$ are unobserved errors. Notice that V_{it-1} – common in both equations – slightly differs from X_{it-1} in (1) since the former matrix does not contain the variable *Inflation* anymore. For this exercise, inflation is one of the variables of interest, therefore, we include it outside of this matrix of covariates. Additionally, notice that for this analysis we are considering contemporaneous effects of both inflation and its volatility. Hence, both variables – as well as CBI and democracy – enter the specification at time t.

This approach has two potential downsides. First, since this methodology requires a common set of controls in both the volatility and the inflation equations, we need to drop the dynamic structure used in previous sections. Second, as Baum and Lewbel (2019) explain, the conditions for the validity of this estimator have been analyzed for only one endogenous regressor. This means, that despite the endogeneity from CBI did not prove to change our results (Table 4), for this analysis we are not explicitly controlling for such effect. Thus, following Lewbel's (2012) methodology, as long as we have heteroscedasticity in the data, $V_{it-1*}\ \varepsilon_{2_{it}}$ can be used as an instrument for z_{it}, because the assumption of serially uncorrelated errors will ensure that $V_{it-1*}\ \varepsilon_{2_{it}}$ is uncorrelated with $\varepsilon_{1_{it}}$ but correlated with $\varepsilon_{2_{it}}$ and thus with z_{it}.. Given the number of regressors we have, the parameters of interest will be obtained using GMM.

Table 6 reports the results for IH. Column (1) presents the results with a simplified set of controls – shown in the table – while column (2) uses the full set of regressors from our previous analyses. In both columns our estimates are significant and show the expected signs: consistent with Kim and Lin (2012), the inflation rate enters the volatility equation positively while volatility enters the inflation equation in a positive way. This coexistence effect seems robust to the set of regressors, and supports our argument that the effect of CBI is larger at higher levels of democracy. In sum, for the purposes of our research question, and consistent with our previous findings (Tables 1–5), after accounting for the contemporaneous effect of inflation, we conclude that CBI is associated with reduced volatility. The magnitude of this effect is stronger in more democratic countries.

6. Final remarks

Although the negative relationship between CBI and inflation is widely documented, the evidence of a relationship between CBI and volatility is scarce and partial. This is an important lacuna, given the economic and political effects of inflation volatility, especially in developing countries. Our study complements the literature by examining the effectiveness of legal CBI as a tool to reduce volatility in a broad panel of developing countries.

Table 6
Volatility, Inflation, and CBI, 1980-2014. Contemporaneous effects.

	(1)	(2)
(1) *Volatility*		
CBI	−0.969***	−0.394***
	(0.108)	(0.137)
Democracy	0.057***	0.033***
	(0.006)	(0.009)
CBI*Democracy	−0.092***	−0.034*
	(0.013)	(0.020)
Inflation	0.431***	0.527***
	(0.007)	(0.018)
(2) *Inflation*		
CBI	−2.301***	−0.538***
	(0.157)	(0.201)
Democracy	0.080***	0.011
	(0.011)	(0.015)
CBI*Democracy	−0.123***	0.084***
	(0.022)	(0.032)
Volatility	1.044***	1.422***
	(0.012)	(0.038)
Controls	No	Yes
N. observations	2327	2327
N. of countries	96	96
Eq (1): Effect of CBI		
at Polity2=1	−1.061***	−0.428***
(autocracy)	(0.107)	(0.142)
at Polity2=6	−1.521***	−0.598***
(democracy)	(0.125)	(0.197)
at Polity2=10	−1.889***	−0.735***
(full democracy)	(0.159)	(0.262)

Notes: Robust standard errors in parentheses. All specifications include a constant term, country and decade fixed effects. Column (2) includes the covariates defined in the baseline. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

In this paper, we provide robust evidence of the curving effects of CBI on volatility, and how this effect is conditional on institutional contexts. The span of our sample – 96 developing countries between 1980 and 2014 – gives us confidence that selection of cases or choices regarding periodization is not affecting our findings. Our results are robust to the inclusion of additional control variables, different measurements of inflation volatility and CBI, and to different estimation techniques. Although more democratic institutions are generally associated with more volatility, democratic institutions also strengthen the curbing effects of CBI on volatility. This suggests that statutory independence may have stronger effects in emerging democracies that otherwise would be especially affected by inflation volatility.

Consistent with our priors, we find an effect of CBI on volatility that is independent of its effect through inflation. Additionally, we find that the combination of a low level of inflation with a shift to an independent central bank is associated with the largest curbing effect on volatility.

Our findings suggest new avenues for research. First, although we argue that there are three channels that plausibly link CBI and inflation volatility – insulation of monetary policy decisions from the political business cycle, stronger incentives for central bankers to react promptly to deviations from inflation targets, and fiscal policy stability – we do not test them directly. Nevertheless, the robustness of our results to the inclusion of controls for electoral years and fiscal spending suggests that these channels might be operating simultaneously. Further research can shed light on the specific mechanisms linking CBI and inflation volatility, and under what conditions some of them may take preeminence over the others.

Second, although our focus is on legal CBI, our analyses show that de facto CBI, and political pressure to central banks may be associated with inflation volatility under certain conditions. This opens a series of questions regarding how legal protections interact with the stability of the central bank leadership, and the political support they receive from the government.

Overall, our results show that CBI is a powerful tool for price stability in developing countries. It is not only associated with lower levels of inflation, but also with reduced inflation volatility, independent from the level of inflation. This evidence contributes to recent debates regarding the appropriate tools to stabilize the economy (Ilzetki et al., 2020), and broader discussions regarding the role and effectiveness of independent central banks (Agur, 2018; Ilzetki et al., 2020; Summers, 2017).

Appendix A. Summary of the recent literature on the relationship between CBI and inflation volatility

Authors	Findings	Volatility (measurement)	Sample
Aisen and Veiga (2008)	*Legal* CBI (CWN) not associated with volatility *De facto* CBI (TOR, CWN) reduces volatility	Logarithm of the standard deviation of inflation for the 3-year period	160 countries, 1960–1999 (13 non-overlapping 3-year periods)

Authors	Findings	Volatility (measurement)	Sample
Alesina and Summers (1993)	*Legal* CBI (BP-GMT average) not associated with volatility	Not described	16 OECD countries, 1955–1988
Alpanda and Honig (2010)	*De facto* ranking of CBI reduces volatility *Legal* CBI (CWN+) not associated with volatility *De facto* CBI (TOR, CWN+) not associated with volatility	Standard deviation of inflation	52 countries, 1972–2001
Arnone and Romelli (2013), 393)	*Legal* CBI (own index) reduces volatility	3-year moving standard deviation of the inflation rate	10 OECD countries, 1995–2000
Bade and Parkin (1977)	*Legal* CBI (own index) reduces volatility	Not described	12 OECD countries
Eijffinger et al. (1996)	The relationship between *legal* CBI and volatility depends on the index. Only GMT is significant. *Empirical* CBI is associated with lower volatility	Not described	10 OECD countries, third quarter of 1977(3Q)- 1990 (4Q)
Higgins and Qureshi (2021)	*De facto* CBI (TOR) associated with lower volatility	4-year moving standard deviation of the inflation rate	21 developed and 21 developing countries, 1985–2006
Weber (2018)	*Legal* CBI (DE) not associated with volatility	Standard deviation of inflation (three measures)[a]	13 to 54 countries, 1998–2010

Notes: BP = Bade and Parkin (1977) 1-4 scale of CBI; CWN = Cukierman et al. (1992) country-decade measure; CWN+ = CWN expanded; DE = Dincer and Eichengreen (2014); GMS = Grilli et al. (1991); TOR = Turnover rate
[a]The three measures are (1) monthly inflation rates in a year; (2) month-to-month CPI inflation rates per year, and (2) annual inflation over the last 12 months for every month.

Appendix B. CBI index: Variables included, and their weights (Cukierman et al., 1992)

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

Appendix C. Countries included in the analyses

Albania	Guatemala	Nepal
Algeria	Guyana	Nicaragua
Argentina	Haiti	Nigeria
Armenia	Honduras	Pakistan
Azerbaijan	Hungary	Panama
Bahrain	India	Papua New Guinea
Bangladesh	Indonesia	Paraguay
Belarus	Iran, Islamic Rep.	Peru
Bolivia	Iraq	Philippines
Botswana	Israel	Poland
Brazil	Jamaica	Romania
Bulgaria	Jordan	Russian Federation
Burundi	Kazakhstan	Rwanda
Cabo Verde	Kenya	Saudi Arabia
Cambodia	Korea, Rep.	Serbia
Chile	Kuwait	Singapore
China	Kyrgyz Republic	Slovak Republic
Colombia	Lao PDR	Slovenia
Congo, Dem. Rep.	Latvia	Solomon Islands
Costa Rica	Lesotho	South Africa
Croatia	Libya	Sri Lanka
Cyprus	Lithuania	Sudan
Czech Republic	Macedonia, FYR	Suriname
Dominican Republic	Madagascar	Tanzania
Ecuador	Malawi	Thailand
Egypt, Arab Rep.	Malaysia	Trinidad and Tobago
El Salvador	Mauritania	Tunisia

Estonia	Mauritius	Uganda
Ethiopia	Mexico	Ukraine
Fiji	Moldova	Uruguay
Georgia	Mongolia	Vietnam
Ghana	Morocco	Zambia

References

Acemoglu, Daron, Johnson, Simon, Querubin, Pablo, Robinson, James A., 2008. When Does Policy Reform Work?. The Case of Central Bank Independence.

Acemoglu, Daron, Johnson, Simon, Robinson, James, Thaicharoen, Yunyong, 2003. Institutional causes, macroeconomic symptoms: Volatility, crises and growth. J. Monetary Econ. 50 (1), 49–123. http://dx.doi.org/10.1016/S0304-3932(02)00208-8.

Afonso, António, Furceri, Davide, 2010. Government size, composition, volatility and economic growth. Eur. J. Political Econ. 26 (4), 517–532. http://dx.doi.org/10.1016/j.ejpoleco.2010.02.002.

Agur, Itai, 2018. Populism and central bank independence: Comment. Open Econ. Rev. 29 (3), 687–693. http://dx.doi.org/10.1007/s11079-018-9497-9.

Agur, Itai, 2021. Central bank independence and low inflation: Who leads the dance? Appl. Econ. Lett. 28 (6), 477–481. http://dx.doi.org/10.1080/13504851.2020.1761525.

Agur, Itai, Capelle, Damien, Dell'Ariccia, Giovanni, Sandri, Damiano, 2022. Monetary Finance: Do Not Touch, Or Handle with Care? Departmental Papers 2022, p. 001.

Ahmad, Yamin S., Staveley-O'Carroll, Olena M., 2017. Exploring international differences in inflation dynamics. J. Int. Money Finance 79 (December), 115–135. http://dx.doi.org/10.1016/j.jimonfin.2017.09.002.

Aisen, Ari, Veiga, Francisco José, 2006. Does political instability lead to higher inflation? A panel data analysis. J. Money Credit Bank. 38 (5), 1379–1389.

Aisen, Ari, Veiga, Francisco José, 2008. Political instability and inflation volatility. Public Choice 135 (3), 207–223. http://dx.doi.org/10.1007/s11127-007-9254-x.

Aisen, Ari, Veiga, Francisco José, 2013. How does political instability affect economic growth? Eur. J. Political Econ. 29 (March), 151–167. http://dx.doi.org/10.1016/j.ejpoleco.2012.11.001.

Aizenman, Joshua, Chinn, Menzie D., Ito, Hiro, 2010. The emerging global financial architecture: Tracing and evaluating new patterns of the trilemma configuration. J. Int. Money Finance 29 (4), 615–641. http://dx.doi.org/10.1016/j.jimonfin.2010.01.005.

Aizenman, Joshua, Jinjarak, Yothin, 2010. De Facto Fiscal Space and Fiscal Stimulus: Definition and Assessment. National Bureau of Economic Research.

Aklin, Michaël, Kern, Andreas, Negre, Mario, 2021. Does Central Bank Independence Increase Inequality?. Policy Research Working Paper Series 9522, World Bank, Washington, DC.

Al-Marhubi, Fahim, 1998. Cross-country evidence on the link between inflation volatility and growth. Appl. Econ. 30 (10), 1317–1326. http://dx.doi.org/10.1080/000368498324931.

Alesina, Alberto, Summers, Lawrence H., 1993. Central bank independence and macroeconomic performance: Some comparative evidence. J. Money Credit Bank. 25 (2), 151–163.

Alpanda, Sami, Honig, Adam, 2010. Political monetary cycles and a de facto ranking of central bank independence. J. Int. Money Finance 29 (6), 1003–1023. http://dx.doi.org/10.1016/j.jimonfin.2010.02.001.

Altansukh, Gantungalag, Becker, Ralf, Bratsiotis, George, Osborn, Denise R., 2017. What is the globalisation of inflation? J. Econom. Dynam. Control 74 (January), 1–27. http://dx.doi.org/10.1016/j.jedc.2016.09.006.

Arcand, Jean Louis, Berkes, Enrico, Panizza, Ugo, 2015. Too much finance? J. Econ. Growth 20 (2), 105–148.

Arellano, Manuel, Bond, Stephen, 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Rev. Econom. Stud. 58 (2), 277–297.

Arellano, Manuel, Bover, Olympia, 1995. Another look at the instrumental variable estimation of error-components models. J. Econometrics 68 (1), 29–51. http://dx.doi.org/10.1016/0304-4076(94)01642-D.

Armand, Fouejieu, 2017. Inflation targeting and financial stability in emerging markets. Econ. Model. 60 (Supplement C), 51–70. http://dx.doi.org/10.1016/j.econmod.2016.08.020.

Arnone, Marco, Romelli, Davide, 2013. Dynamic central bank independence indices and inflation rate: A new empirical exploration. J. Finan. Stab. 9 (3), 385–398. http://dx.doi.org/10.1016/j.jfs.2013.03.002.

Auray, Stéphane, Fève, Patrick, 2008. On the observational (non) equivalence of money growth and interest rate rules. J. Macroecon. 30 (3), 801–816. http://dx.doi.org/10.1016/j.jmacro.2007.05.004.

Bade, Robin, Parkin, Michael, 1977. Central bank laws and monetary policy: A preliminary investigation. London, ON. a. https://ir.lib.uwo.ca/cgi/viewcontent.cgi?article=1548&context=economicsresrpt.

Baharumshah, Ahmad Zubaidi, Slesman, Ly, Wohar, Mark E., 2016. Inflation, inflation uncertainty, and economic growth in emerging and developing countries: Panel data evidence. Econ. Syst. 40 (4), 638–657. http://dx.doi.org/10.1016/j.ecosys.2016.02.009.

Ball, Laurence, Cecchetti, Stephen G., Gordon, Robert J., 1990. Inflation and uncertainty at short and long horizons. Brook. Pap. Econ. Act. 1990 (1), 215–254. http://dx.doi.org/10.2307/2534528.

Banks, Arthur S., Wilson, Kenneth A., 2021. Cross-national time-series data (cnts). databanks international. jerusalem, israel. see https://www.cntsdata.com/.

Barro, Robert J., Gordon, David, 1983a. A positive theory of monetary policy in a natural rate model. J. Polit. Econ. 91, 589–610.

Barro, Robert J., Gordon, David, 1983b. Rules, discretion and reputation in a model of monetary policy. J. Monetary Econ. 12 (1), 101–121.

Baum, Christopher F., Lewbel, Arthur, 2019. Advice on using heteroskedasticity-based identification. Stata J. 19 (4), 757–767.

Beck, Nathaniel, Katz, Jonathan N., 2011. Modeling dynamics in time-series–cross-section political economy data. Annu. Rev. Political Sci. 14, 331–352.

Beck, Nathaniel Jonathan N. Katz, Mignozzetti, Umberto G., 2014. Of nickell bias and its cures: Comment on gaibulloev, sandler, and sul. Polit. Anal. 22 (2), 274–278. http://dx.doi.org/10.1093/pan/mpu004.

Berlemann, Michael, Hielscher, Kai, 2016. Measuring effective monetary policy conservatism of central banks: A dynamic approach. Ann. Econ. Finance 17 (1).

Berument, Hakan, Yalcin, Yeliz, Yildirim, Julide, 2009. The effect of inflation uncertainty on inflation: Stochastic volatility in mean model within a dynamic framework. Econ. Model. 26 (6), 1201–1207. http://dx.doi.org/10.1016/j.econmod.2009.05.007.

Binder, Carola, 2021. Political pressure on central banks. J. Money Credit Bank. 53 (4), 715–744. http://dx.doi.org/10.1111/jmcb.12772.

Blackwell, Matthew, Glynn, Adam, 2018. How to make causal inferences with time-series cross-sectional data under selection on observables. Am. Polit. Sci. Rev. 112 (4), 1067–1082. http://dx.doi.org/10.1017/S0003055418000357.

Bleaney, Michael, Fielding, David, 2002. Exchange rate regimes, inflation and output volatility in developing countries. J. Dev. Econ. 68 (1), 233–245. http://dx.doi.org/10.1016/S0304-3878(02)00002-0.
Blundell, Richard, Bond, Stephen, 1998. Initial conditions and moment restrictions in dynamic panel data models. J. Econometrics 87 (1), 115–143. http://dx.doi.org/10.1016/S0304-4076(98)00009-8.
Bodea, Cristina, Garriga, Ana Carolina, Higashijima, Masaaki, 2019. Economic institutions and autocratic breakdown: Monetary constraints and fiscal spending in dominant-party regimes. J. Polit. 81 (2), 601–615. http://dx.doi.org/10.1086/701831.
Bodea, Cristina, Hicks, Raymond, 2015a. International finance and central bank independence: Institutional diffusion and the flow and cost of capital. J. Polit. 77 (1), 268–284.
Bodea, Cristina, Hicks, Raymond, 2015b. Prie stability and central bank independence: Discipline credibility, and democratic institutions. Int. Organ. 69 (01), 35–61. http://dx.doi.org/10.1017/S0020818314000277.
Bodea, Cristina, Hicks, Raymond, 2018. Sovereign credit ratings and central banks: Why do analysts pay attention to institutions? Econ. Polit. 30 (3), 340–365. http://dx.doi.org/10.1111/ecpo.12113.
Bodea, Cristina, Higashijima, Masaaki, 2017. Central bank independence and fiscal policy: Can the central bank restrain deficit spending? Br. J. Polit. Sci. 47 (1), 47–70. http://dx.doi.org/10.1017/S0007123415000058.
Bowdler, Christopher, Malik, Adeel, 2017. Openness and inflation volatility: Panel data evidence. North Am. J. Econ. Finance 41 (July), 57–69. http://dx.doi.org/10.1016/j.najef.2017.03.008.
Braun, Miguel, Tella, Rafael Di, 2004. Inflation, inflation variability, and corruption. Econ. Polit. 16 (1), 77–100. http://dx.doi.org/10.1111/j.1468-0343.2004.00132.x.
Breitung, Jörg, Kripfganz, Sebastian, Hayakawa, Kazuhiko, 2021. Bias-corrected method of moments estimators for dynamic panel data models. Econometr. Stat..
Brunner, Allan D., Hess, Gregory D., 1993. Are higher levels of inflation less predictable? A state-dependent conditional heteroscedasticity approach. J. Bus. Econom. Statist. 11 (2), 187–197. http://dx.doi.org/10.1080/07350015.1993.10509947.
Bun, Maurice J.G., Kiviet, Jan F., 2003. On the diminishing returns of higher-order terms in asymptotic expansions of bias. Econom. Lett. 79 (2), 145–152. http://dx.doi.org/10.1016/S0165-1765(02)00299-9.
Bun, Maurice J.G., Windmeijer, Frank, 2010. The weak instrument problem of the system GMM estimator in dynamic panel data models. Econom. J. 13 (1), 95–126. http://dx.doi.org/10.1111/j.1368-423X.2009.00299.x.
Çekin, Semih Emre, Valcarcel, Victor J., 2020. Inflation volatility and inflation in the wake of the great recession. Empir. Econ. 59 (4), 1997–2015. http://dx.doi.org/10.1007/s00181-019-01724-2.
Chancellor, Edward, 2022. Chancellor: The battle for investment survival. In: Reuters 2022. https://www.reuters.com/breakingviews/global-markets-breakingviews-2022-03-31/.
Chinn, Menzie, Ito, Hiro, 2008. A new measure of financial openness. J. Comparat. Policy Anal. 10 (3), 309–322.
Clarida, Richard, Galí, Jordi, Gertler, Mark, 2000. Monetary policy rules and macroeconomic stability: Evidence and some theory*. Q. J. Econ. 115 (1), 147–180. http://dx.doi.org/10.1162/003355300554692.
Clemens, Michael A., Radelet, Steven, Bhavnani, Rikhil R., Bazzi, Samuel, 2012. Counting chickens when they hatch: Timing and the effects of aid on growth. Econ. J. 122 (561), 590–617. http://dx.doi.org/10.1111/j.1468-0297.2011.02482.x.
Crowe, Christopher, Meade, Ellen E., 2008. Central bank independence and transparency: Evolution and effectiveness. Eur. J. Political Econ. 24 (4), 763–777. http://dx.doi.org/10.1016/j.ejpoleco.2008.06.004.
Cukierman, Alex, 1992. Central Bank Strategy, Credibility and Independence: Theory and Evidence. The MIT Press, Cambridge, MA.
Cukierman, Alex, Webb, Steven B., Neyapti, Bilin, 1992. Measuring the independence of central banks and its effect on policy outcome. World Bank Econ. Rev. 6 (1), 353–398.
Demetriades, Panikos, 1988. Macroeconomic aspects of the correlation between the level and variability of inflation. Econom. Lett. 26 (2), 121–124. http://dx.doi.org/10.1016/0165-1765(88)90025-0.
Desai, Raj M., Olofsgard, Anders, Yousef, Tarik M., 2003. Democracy, inequality, and inflation. Am. Polit. Sci. Rev. 97 (3), 391–406. http://dx.doi.org/10.1017/S0003055403000765.
Dietrich, Simone, Wright, Joseph, 2015. Foreign aid allocation tactics and democratic change in Africa. J. Polit. 77 (1), 216–234.
Dincer, N. Nergiz, Eichengreen, Barry, 2014. Central bank transparency and independence: Updates and new measures. Int. J. Central Bank. 10 (1), 189–253.
Dmitriev, Mikhail, Kersting, Erasmus K., 2016. Inflation level and inflation volatility: A seigniorage argument. Econom. Lett. 147 (October), 112–115. http://dx.doi.org/10.1016/j.econlet.2016.08.034.
Dreher, Axel, Sturm, Jan-Egbert, de Haan, Jakob, 2008. Does high inflation cause central bankers to lose their job? Evidence based on a new data set. Eur. J. Political Econ. 24 (4), 778–787.
Dreher, Axel, Sturm, Jan-Egbert, de Haan, Jakob, 2010. When is a central bank governor replaced? Evidence based on a new data set. J. Macroecon. 32 (3), 766–781. http://dx.doi.org/10.1016/j.jmacro.2010.04.001.
Driscoll, John C., Kraay, Aart C., 1998. Consistent covariance matrix estimation with spatially dependent panel data. Rev. Econ. Stat. 80 (4), 549–560. http://dx.doi.org/10.1162/003465398557825.
Dutta, Nabamita, Meierrieks, Daniel, 2021. Financial development and entrepreneurship. Int. Rev. Econ. Finance 73, 114–126.
Eichengreen, Barry, Gupta, Poonam, Choudhary, Rishabh, 2020. Inflation Targeting in India: An Interim Assessment. VOX blog, p. 2020, https://voxeu.org/article/inflation-targeting-india-interim-assessment.
Eijffinger, Sylvester, de Haan, Jakob, 1996. The political economy of central bank independence. In: Presented At the Princeton Special Papers in International Economics, no. 19. Princeton, NJ.
Eijffinger, Sylvester, Van Rooij, Maarten, Schaling, Eric, 1996. Central bank independence: A panel data approach. Public Choice 89 (1), 163–182. http://dx.doi.org/10.1007/bf00114284.
Elder, John, 2004a. Another perspective on the effects of inflation uncertainty. J. Money Credit Bank. 36 (5), 911–928.
Elder, John, 2004b. Some empirical evidence on the real effects of nominal volatility. J. Econ. Finance 28 (1), 1–13. http://dx.doi.org/10.1007/bf02761450.
Fischer, Stanley, 1993. The role of macroeconomic factors in growth. J. Monetary Econ. 32 (3), 485–512. http://dx.doi.org/10.1016/0304-3932(93)90027-D.
Fischer, Stanley, Sahay, Ratna, Végh, Carlos A., 2002. Modern hyper- and high inflations. J. Econ. Lit. 40 (3), 837–880. http://dx.doi.org/10.1257/002205102760273805.
Freedman, Charles, Öther-Robe, Inci, 2010. Important Elements for Inflation Targeting for Emerging Markets. IMF Working Papers 10, p. 113.
Friedman, Milton, 1977. Nobel lecture: Inflation and unemployment. J. Polit. Econ. 85 (3), 451–472. http://dx.doi.org/10.1086/260579.
Ftiti, Zied, Hichri, Walid, 2014. The price stability under inflation targeting regime: An analysis with a new intermediate approach. Econ. Model. 38 (February), 23–32. http://dx.doi.org/10.1016/j.econmod.2013.11.033.
Garriga, Ana Carolina, 2016. Central bank independence in the world: A new data set. Int. Interact. 42 (5), 849–868.
Garriga, Ana Carolina, 2022. Central banks and civil war termination. J. Peace Res. 59 (4), 508–525. http://dx.doi.org/10.1177/00223433211038194.

Garriga, Ana Carolina, Rodriguez, Cesar M., 2020. More effective than we thought: Central bank independence and inflation in developing countries. Econ. Model. 85 (1), 87–105. http://dx.doi.org/10.1016/j.econmod.2019.05.009.
Gasiorowski, Mark J., 2000. Democracy and macroeconomic performance in underdeveloped countries. An empirical analysis. Comparat. Polit. Stud. 33 (3), 319–349.
Giovanni, Julian di, Levchenko, Andrei, 2012. The risk content of exports: A portfolio view of international trade. NBER Int. Sem. Macroecon. 8 (1), 97–151. http://dx.doi.org/10.1086/663622.
Goodhart, Charles A.E., Lastra, Rosa, 2018. Populism and central bank independence. Open Econ. Rev. 29 (1), 49–68. http://dx.doi.org/10.1007/s11079-017-9447-y.
Grilli, Vittorio, Masciandaro, Donato, Tabellini, Guido, 1991. Political and monetary institutions and public financial policies in the industrial countries. Econ. Policy 34, 1–92.
Gründler, Klaus, Potrafke, Niklas, 2019. Corruption and economic growth: New empirical evidence. Eur. J. Political Econ. 60, 101810.
Guisinger, Alexandra, Andrew Singer, David, 2010. Exchange rate proclamations and inflation-fighting credibility. Int. Organ. 64 (2), 313–333.
Haan, Jakob de, Bodea, Cristina, Hicks, Raymond, Eijffinger, Sylvester, 2018. Central bank independence before and after the crisis. Comparat. Econ. Stud. 60 (2), 183–202. http://dx.doi.org/10.1057/s41294-017-0050-4.
Hainmueller, Jens, Mummolo, Jonathan, Xu, Yiqing, 2019. How much should we trust estimates from multiplicative interaction models? Simple tools to improve empirical practice. Polit. Anal. 27 (2), 163–192. http://dx.doi.org/10.1017/pan.2018.46.
Hammond, Gill, 2012. State of the art of inflation targeting. In: Handbooks, fourth ed. Centre for Central Banking Studies, Bank of England, https://EconPapers.repec.org/RePEc:ccb:hbooks:29.
Hasan, Mostafa Monzur, Lobo, Gerald J., Qiu, Buhui, 2021. Organizational capital, corporate tax avoidance, and firm value. J. Corp. Finance 70, 102050.
Higgins, C. Richard, Qureshi, Irfan, 2021. Central bank independence and time-varying monetary policy rules.
Hnatkovska, Victoria, Loayza, Norman, 2005. Volatility and Growth in J. Aizenman, Pinto, B., Eds. Managing Economic Volatility and Crises: A Practitioner's Guide. Cambridge University Press, Cambridge.
Hyde, Susan D., Marinov, Nikolay, 2011. Which elections can be lost? Polit. Anal. http://dx.doi.org/10.1093/pan/mpr040.
Ilzetki, Ethan, Reinhart, Carmen M., Rogoff, Kenneth, 2020. Will the Secular Decline in Exchange Rate and Inflation Volatility Survive COVID-19?. National Bureau of Economic Research Working Paper Series Working Paper 28108.
International Monetary Fund, 2018. International financial statistics. 2018.
Jacome, Luis I., Vázquez, Francisco, 2008. Is there any link between legal central bank independence and inflation? Evidence from latin America and the Caribbean. Does Central Bank Indep Still Matter? 24 (4), 788–801. http://dx.doi.org/10.1016/j.ejpoleco.2008.07.003.
Judson, Ruth, Orphanides, Athanasios, 1999. Inflation, volatility and growth. Int. Finance 2 (1), 117–138. http://dx.doi.org/10.1111/1468-2362.00021.
Judson, Ruth A., Owen, Ann L, 1999. Estimating dynamic panel data models: A guide for macroeconomists. Econom. Lett. 65 (1), 9–15. http://dx.doi.org/10.1016/S0165-1765(99)00130-5.
Kern, Andreas, Reinsberg, Bernard, Rau-Göhring, Matthias, 2019. IMF conditionality and central bank independence. Eur. J. Political Econ. 59, 212–229. http://dx.doi.org/10.1016/j.ejpoleco.2019.03.002.
Kim, Dong-Hyeon, Lin, Shu-Chin, 2012. Inflation and inflation volatility revisited. Int. Finance 15 (3), 327–345. http://dx.doi.org/10.1111/j.1468-2362.2013.12001.x.
Kiviet, Jan F., 1995. On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. J. Econometrics 68 (1), 53–78. http://dx.doi.org/10.1016/0304-4076(94)01643-E.
Klomp, Jeroen, de Haan, Jakob, 2010a. Inflation and central bank independence: A meta-regression analysis. J. Econ. Surv. 24 (4), 593–621.
Klomp, Jeroen, de Haan, Jakob, 2010b. Central bank independence and inflation revisited. Public Choice 144 (3), 445–457. http://dx.doi.org/10.1007/s11127-010-9672-z.
Kydland, Finn E., Prescott, Edward C., 1977. Rules rather than discretion: The inconsistency for optimal plans. J. Polit. Econ. 85, 473–491.
Lensink, Robert, Morrissey, Oliver, 2006. Foreign direct investment: Flows, volatility, and the impact on growth*. Rev. Int. Econ. 14 (3), 478–493. http://dx.doi.org/10.1111/j.1467-9396.2006.00632.x.
Lewbel, Arthur, 2012. Using heteroscedasticity to identify and estimate mismeasured and endogenous regressor models. J. Bus. Econom. Statist. 30 (1), 67–80.
Lim, Jamus Jerome, 2021. The limits of central bank independence for inflation performance. Public Choice 186 (3), 309–335.
Lin, Shu, Ye, Haichun, 2009. Does inflation targeting make a difference in developing countries? J. Dev. Econ. 89 (1), 118–123. http://dx.doi.org/10.1016/j.jdeveco.2008.04.006.
Lin, Shu, Ye, Haichun, 2012. What to target? Inflation or exchange rate. Southern Econ. J. 78 (4), 1202–1221. http://dx.doi.org/10.4284/0038-4038-78.4.1202.
Logue, Dennis E., Willett, Thomas D., 1976. A note on the relation between the rate and variability of inflation. Economica 43 (170), 151–158. http://dx.doi.org/10.2307/2553204.
Marshall, Monty G., Jaggers, Keith, 2012. Polity IV dataset. 2012.
Maxfield, Sylvia, 1997. Gatekeepers of Growth: The International Political Economy of Central Banking in Developing Countries. Princeton University Press, Princeton, NJ.
Mijiyawa, Abdoul Ganiou, 2011. Fighting inflation in developing countries: Does democracy help? An empirical investigation. J. Int. Dev. 23 (5), 656–696. http://dx.doi.org/10.1002/jid.1671.
Mishkin, Frederic S., 2004. Can Inflation Targeting Work in Emerging Market Countries?. NBER Working Paper 10646, National Bureau of Economic Research.
Mizon, Grayham E., 1995. A simple message for autocorrelation correctors: Don't. J. Econometrics 69 (1), 267–288. http://dx.doi.org/10.1016/0304-4076(94)01671-L.
Nickell, Stephen, 1981. Biases in dynamic models with fixed effects. Econometrica 49 (6), 1417–1426. http://dx.doi.org/10.2307/1911408.
Ogrokhina, Olena, Rodriguez, Cesar M., 2018. The role of InflationTargeting in international debt denomination in developing countries. J. Int. Econ. 114, 116–129.
Ogrokhina, Olena, Rodriguez, Cesar M., 2019. The effect of inflation targeting and financial openness on currency composition of Sovereign international debt. J. Int. Money Finance 97, 1–18.
Okun, Arthur M., 1971. The mirage of steady inflation. Brook. Pap. Econ. Act. 1971 (2), 485–498.
Pepinsky, Thomas, 2007. Autocracy, elections, and fiscal policy: Evidence from Malaysia. Stud. Comparat. Int. Dev. 42 (1), 136–163. http://dx.doi.org/10.1007/s12116-007-9006-4.
Pesaran, M. Hashem, 2004. General Diagnostic Tests for Cross Section Dependence in Panels. IZA Discussion Paper No. 1240, Institute for the Study of Labor IZA.
Pesaran, M. Hashem, 2015. Testing weak cross-sectional dependence in large panels. Econometric Rev. 34 (6–10), 1089–1117. http://dx.doi.org/10.1080/07474938.2014.956623.
Polillo, Simone, Guillén, Mauro F., 2005. Globalization pressures and the state: The global spread of central bank independence. Am. J. Sociol. 110 (6), 1764–1802.

Pritchett, Lant, 2000. Understanding patterns of economic growth: Searching for hills among plateaus, mountains, and plains. World Bank Econ. Rev. 14 (2), 221–250. http://dx.doi.org/10.1093/wber/14.2.221.
Reed, William Robert, 2015. On the practice of lagging variables to avoid simultaneity. Oxf. Bull. Econ. Stat. 77 (6), 897–905. http://dx.doi.org/10.1111/obes.12088.
Reinhart, Carmen M., Rogoff, Kenneth S., 2004. The modern history of exchange rate arrangements: A reinterpretation. Q. J. Econ. 119 (1), 1–48.
Reinsberg, Bernhard, Kern, Andreas, Rau-Göhring, Matthias, 2021. The political economy of IMF conditionality and central bank independence. Eur. J. Political Econ. 68 (June), 101987. http://dx.doi.org/10.1016/j.ejpoleco.2020.101987.
Rey, Hélène, 2015. Dilemma Not Trilemma: The Global Financial Cycle and Monetary Policy Independence. National Bureau of Economic Research.
Rigobon, Roberto, 2003. Identification through heteroskedasticity. Rev. Econ. Stat. 85 (4), 777–792.
Roger, Scott, 2010. Inflation targeting turns 20: A growing number of countries are making a specific inflation rate the primary goal of monetary policy, with success. Finance Dev. 47 (001).
Rogoff, Kenneth S., 1985. The optimal degree of commitment to an intermediate monetary target. Q. J. Econ. 100, 1169–1189.
Rother, Philipp C., 2004. Fiscal Policy and Inflation Volatility. Working Paper Series (317) Frankfurt am Main, European Central Bank.
Schedler, Andreas, 2002. Elections without democracy: The menu of manipulation. J. Democracy 13 (2), 36–50.
Staiger, Douglas, Stock, James H., 1997. Instrumental variables regression with weak instruments. Econometrica 65 (3), 557–586. http://dx.doi.org/10.2307/2171753.
Summers, Lawrence H., 2017. Central Bank Independence. Bank of England, Independence—20 Years On. September 28, 2017 http://larrysummers.com/2017/09/28/central-bank-independence/.
Vuletin, Guillermo, Zhu, Ling, 2011. Replacing a 'disobedient' central bank governor with a 'Docile' one: A novel measure of central bank independence and its effect on inflation. J. Money Credit Bank. 43 (6), 1185–1215. http://dx.doi.org/10.1111/j.1538-4616.2011.00422.x.
Walsh, Carl E., 1995. Central bank independence and the short-run output-inflation trade-off in the European community. In: Eichengreen, Barry, Frieden, Jeffry A., von Hagen, Jürgen (Eds.), Monetary and Fiscal Policy in an Integrated Europe. Springer, Berlin Heidelberg, pp. 12–37.
Weber, Christoph S., 2018. Central bank transparency and inflation (volatility) – new evidence. Int. Econ. Econ. Policy 15 (1), 21–67.
Windmeijer, Frank, 2005. A finite sample correction for the variance of linear efficient two-step gmm estimators. J. Econ. 126 (1), 25–51.
Wooldridge, Jeffrey M., 2002. Econometric Analysis of Cross Section and Panel Data. MIT Press, Cambridge, MA.
World Bank, 2018. World development indicators on-line. 2018.