Beyond the central bank independence veil: new evidence

(Preliminary; please do not circulate)

Donato Masciandaro
Bocconi University and SUERF

Davide Romelli
Trinity College Dublin and SUERF

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Abstract

This paper uses the new and comprehensive index of central bank independence in Romelli (2022) to re-investigate the link between central bank independence and inflation across 65 countries, over the period 1972-2014. This empirical re-investigation of the inflation-central bank independence nexus is proposed by taking into account the endogenous evolution of the degree of central bank independence, which is made thanks to the use of dynamic indices of central bank independence. Our preliminary results confirm the endogeneity of the CBI index and support a negative causal link between central bank independence and inflation non only for advanced economies, but also for developing countries.

Dynamic Central Bank Independence Indices and Inflation Rate: A New Empirical Exploration

Keywords: central bank design, central bank independence, inflation.

JEL classification: E58, G28, N20.

1 Introduction

Over the past four decades, central banks around the world have progressively narrowed their mandate to the goal of price stability. This convergence was prompted by the chronic inflation that characterized advanced economies in the 1970-80s, to which most countries responded by creating independent central banks anchored to an inflation target. In an extensive survey of worldwide developments in monetary institutions since the 1950s, Cukierman (2008) identifies two main global drivers of this trend towards higher central bank independence (CBI). First, a worldwide quest for price stability. This was prompted by the chronic inflation that characterized advanced economies in the 1970-80s, to which most countries responded by creating independent central banks anchored to an inflation target. Second, globalization boosted the degree of independence of monetary authorities since the progressive exposure to foreign trade, investment and the widening of international capital markets have stressed the importance of CBI as a signal of macroeconomic nominal responsibility to domestic and international investors. At the same time, international institutions such as the IMF and the World Bank started recognizing higher levels of independence as a desirable institutional feature and actively promoted central bank reforms in this direction.

Yet, the optimal institutional arrangement for monetary authorities as *independent* central banks anchored to an inflation target has been severely questioned following the Global Financial Crisis of 2008-09 (Alesina and Stella, 2010). For example, many have argued that the narrowing down of the objectives of central banks to inflation targeting has failed to allow monetary policy to react to other macroeconomic developments. Consequently, a growing literature is concerned with understanding if new institutional arrangements are needed for central banks (Issing, 2013; Taylor, 2013). So how does the institutional design of central banks impact the conduct of monetary policy? Can we consider central bank independence as a "free lunch" that can improve economic performance in terms of growth and price stability? While there is a large literature addressing these questions, a limitation of previous studies has been the lack of a comprehensive database on central bank institutional design that can provide a clear documentation of the full set of legislative reforms adduced to monetary policymaking institutions.

To contribute to a better understanding of how central bank institutional design can

affect inflation dynamics across both advanced and developing countries, this paper uses the index of central bank independence proposes (CBIE) in Romelli (2022) to re-investigate the long standing relationship between inflation and CBI for a sample of 65 countries, during the period 1972-2014.[1] The second important distinction from previous efforts of capturing the relationship between CBI and inflation is represented by the dynamic aspect of the index used in this paper. Previous research generally evaluates the degree of CBI of a country at a particular point in time (see Acemoglu et al., 2008), or by focusing on a specific index (see Bodea and Hicks, 2015). On the contrary, our study focuses on a dynamic index of central bank independence that is evaluated in every year in which the central bank legislation has been amended and recomputed whenever a legislative reform induced a change to the degree of independence independence of a country's central bank.

Employing this new index of CBI, this paper proposes a re-examination of the CBI-inflation nexus. Traditional approaches to investigating this relationship consider central bank independence as an effective device to minimize inflation risks and, therefore, generally treat it as an exogenous variable. However, recent research argues that, while political institutions such as central banks determine the choice of economic policies, they themselves evolve in response to changing political and economic conditions (Hayo and Hefeker, 2002; Aghion et al., 2004; Masciandaro and Passarelli, 2013). We follow a similar approach by considering an endogenous index of central bank independence which can potentially be explained by the political or economic characteristics of a country. While some recent research has explicitly considered the endogeneity of CBI, it generally does not provide very strong instruments for the level of independence (Crowe and Meade, 2008; Jacome and Vazquez, 2008). The construction of a dynamic index such as the one used in this paper can overcome many of the challenges faced by previous research and enable the construction of a reliable instrument of CBI. Using this instrument, this paper documents a negative relationship between CBI and inflation in the set of 65 countries.

The paper is organized as follows. Section 2 discusses the characteristics of the index of CBI used in the paper. Section 3 proposes a re-investigation of the CBI-inflation link, while Section 4 concludes.

[1] By May 2022, we will be able to present the results obtained for a sample of 154 countries, over the period 1972-2021.

2 Measures of Central Bank Independence

2.1 Classical measures of Central Bank Independence

This subsection discusses the two most commonly employed indices of central bank independence developed by Grilli et al. (1991), Cukierman (1992) and Cukierman et al. (1992) which include several of the elements of central bank institutional design collected in this database and discussed in the previous section. These two indices also represent the starting point of the newly developed index of CBI proposed in this paper.

2.1.1 The Grilli, Masciandaro, and Tabellini Index

Grilli et al. (1991) construct the first composite index of CBI (hereafter, GMT) through a comprehensive codification of central bank legislations for a group of 18 advanced economies as of 1989.[2] The GMT index is calculated as the sum of central banks' fulfillment of 15 criteria and ranges from zero (least independent) to 16 (most independent). Importantly, this index allows the identification of a political and an economic independence index.

The political independence index is based on a binary code assigned to eight different characteristics that sum up the ability of monetary authorities to independently achieve the final goals of their policy. This index captures three main aspects of monetary policy institutions: the procedure for appointing the members of the central bank governing bodies, the relationship between these bodies and the government, and the formal responsibilities of the central bank. Starting from these three aspects, one point is assigned for each of the following criteria, if satisfied: (1) the governor is appointed without government involvement; (2) the governor is appointed for more than five years; (3) the other members of the board of directors are appointed without government involvement; (4) the other board members are appointed for more than five years; (5) there is no mandatory participation of government representatives in the board; (6) no government approval is required for the formulation of monetary policy; (7) the central bank is legally obliged to pursue monetary stability as one of its primary objectives; and (8) there are legal provisions that strengthen

[2] Parkin and Bade (1982) propose a first measure of CBI, by answering three criteria on whether: 1) the government or the central bank is the final monetary policy authority, 2) any government officials are members of the central bank board, and 3) the government appointed all or only some of the board members.

the central bank's position in the event of a conflict with the government.

The economic independence index summarizes the degree of independence of central banks in choosing their monetary policy instruments. Its three main aspects concern: the influence of the government in determining how much it can borrow from the central bank, the nature of the monetary instruments under the control of the central bank and the degree of central bank involvement in banking supervision. Again, one point is assigned for each of the following satisfied criteria: (1) there is no automatic procedure for the government to obtain direct credit from the central bank; (2) when available, direct credit facilities are extended to the government at market interest rates; (3) direct credit facilities are temporary; (4) direct credit facilities are for a limited amount; (5) the central bank does not participate in the primary market for public debt; (6) the central bank is responsible for setting the policy rate; and (7) the central bank has no responsibility for overseeing the banking sector (two points) or shares its responsibility with another institution (one point).

2.1.2 The Cukierman and Cukierman, Webb, and Neyapti Index

The other classical measure of CBI has been developed by Cukierman (1992) and Cukierman et al. (1992) (henceforth, CWN), who investigate the degree of *de jure* independence for 68 countries during the period 1950-1989, therefore including a large number of developing and emerging economies. The CWN index, which varies from 0 to 1 (lowest and highest levels of independence, respectively), is calculated as the sum of central bank's fulfillment of 16 criteria which are grouped under four main headings: 1) central bank governor; 2) policy formulation; 3) objectives of the central bank; and 4) limitations on central bank lending to the government. In particular, this index contains proxies for: (i) the length of the term of office of the governor; (ii) the entity responsible for his/her appointment; (iii) the provisions for his/her dismissal; (iv) the governor's right to hold another office; (v) the entity responsible for formulating monetary policy; (vi) the rules concerning the resolution of conflicts between the central bank and the government; (vii) the degree of the bank's participation in formulating the government budget; (viii) the primary objectives of the central bank monetary policy and the importance assigned to price stability; (ix) the limits on advances to the government; (x) the markets for securitized lending to the

government; (xi) the authority responsible for setting the terms (maturity, interest rate and amount) of lending; (xii) the circle of potential borrowers from the central bank; (xiii) the types of limitations on loans; (xiv) the maturity of loans to the government; (xv) the limitations on interest rates applicable to these loans; and (xvi) the prohibitions on central bank participation in the primary market for government securities.

While the GMT index is based on a binary code assigned to each one of its criteria and its overall value is given by the sum of every single criteria, the CWN index requires a series of furthers steps for its computation. First of all, every question analyzed for the construction of the index is coded from 0 to 1, with lower values indicating a lower independence level and higher values signaling an higher degree of independence. Then the sixteen criteria are aggregated into eight different groups and the obtained values are summed up to obtain a single index that ranges from zero (no independence) to one (maximal independence). Starting from these eight aggregated variables, the authors develop two indices of CBI. In particular, Cukierman (1992) introduces the LVAU measure, obtained as an unweighted average of the eight aggregated variables, while Cukierman et al. (1992) develop the LVAW measure, suggesting different weights for the various aggregations.

The baseline construction of the CWN is also employed in Jacome and Vazquez (2008) who propose an extention of the LVAW index, by introducing some modifications to the subcategories of this index and incorporating an additional category on central bank accountability. Similarly, Dincer and Eichengreen (2014) augment the LVAU and LVAW indices by adding additional aspects of central bank independence such as a measure of limits on the reappointment of the central bank governor, measures of provisions affecting the (re)appointment of other board members similar to those of the governor, restrictions on government representation on the board and intervention of the government in exchange rate policy formulation.

2.2 The Central Bank Independence - Extended (CBIE) Index

Using the GMT and CWN indices as a starting point, (Romelli, 2022) develops a new and comprehensive index of central bank independence that covers a wider range of central bank characteristics. This new index, called the Central Bank Independence - Extended (CBIE) Index, provides, in its most disaggregated format, information on 42 criteria of

central bank institutional design.

The extended index incorporates the characteristics of *both* the GMT and CWN indices. This aggregation aims to overcome the main criticism of these classical measures of CBI, i.e. the fact that only nine characteristics are common to both indices, out of a respective total of 15 in GMT and 16 in CWN (see Mangano, 1998). Apart from integrating these two well-know indices, the CBIE index also includes new criteria able to capture good practices in central bank financial independence and accountability. Appendix Table A.1 presents the summary of the characteristics collected in the GMT and CWN indices, as well as, in the CBIE index.

One important innovation of the CBIE index is represented by the introduction of several criteria on financial independence and accountability (see Appendix Table A.1). The financial independence criterion concerns the conditions for capitalization and recapitalization of the central bank capital, the identification of the authority that determines and approves the central bank's budget, as well as the requirements for profits allocation. These last two features are of particular interest during crises periods, when, as it happened following the global financial crisis of 2008-09, the total amount of central banks' assets increased exponentially. In this context, the presence of limits on the determination of the central banks' budget and on the distribution of their net profits, may limit their capacity to implement their monetary policy. Regarding profits allocation, in particular, Reis (2013) discusses the fact that, under fiscal stress, governments will always be tempted to demand the central bank to generate more profits and transfer them to the Treasury.

Previous literature has also argued that central bank accountability nowadays goes in tandem with central bank independence (Jacome and Vazquez, 2008). The first point on accountability (central bank reporting) clarifies the legal provisions that require central banks to report, on a regular basis, the fulfillment of their policy targets. The second one concerns the publication of the financial statements and the maximum level of independence is reached when the central bank financial statements are published on a regular basis, following international accounting standards, as well as when these statements are certified by an independent auditor.

The CBIE index also expands the GMT political independence index by collecting additional information about the dismissal of the governor and other board members,

as well as by identifying if the governor is legally allowed to hold other offices in the government. Moreover, the GMT economic independence index is augmented by including information on the authority responsible for setting the financial conditions on lending to the government. Finally, it should be also noticed that the CBIE index assigns, similar to the CWN index, values ranging between zero and one to every criteria, with larger values indicating an higher degree of CBI, while the GMT index uses a zero-one codification strategy for each one of its 16 criteria.

While for most of the 42 criteria analyzed in the CBIE index the codification strategy follows closely Cukierman et al. (1992), we depart from their methodology in several ways. First, we collect information on the appointment, terms of office and dismissal of the rest of the board members. Second, in line with GMT, we identify if government's representatives are legally required to become board members. Finally, we assess whether the central bank is the authority responsible for fixing the policy rates and if this institution is also involved in the supervision of the banking sector in the country.

The information collected is used to build a new index of central bank independence which ranges from 0 (no independence) to 1 (full independence). There are, of course, different ways to aggregate the collected data in order to obtain a unique index of central bank independence. For example, Grilli et al. (1991) compute their index by summing up the values obtained from the 15 criteria proposed for the construction of their index. In this case the importance assigned to every dimension of the index is driven by the number of questions. An alternative approach, proposed by Cukierman (1992) and Cukierman et al. (1992) and followed by Jacome and Vazquez (2008) and Dincer and Eichengreen (2014), consists in assigning a set of a priori weights to each dimension and its criteria. However, in this case as well, we might have situations in which a too high (low) weight is assigned to a certain subcategory of the index. In the case of the LVAU index, for example, 62.5% of the weight is assigned to the dimension on the limitations on lending to the government.

Recognizing the importance of the various elements that might influence the degree of central bank independence, the overall CBIE index is constructed assigning an equal weight to its six dimensions.

3 The CBI-inflation nexus: a re-investigation

This section uses the newly created index of CBI in Romelli (2022) to re-investigate the classical CBI-inflation nexus. It also checks the robustness of these results using other common measures of central bank independence but recomputed dynamically using the new database on central bank design developed in this paper.

3.1 Baseline estimations

The baseline estimation follows closely the analysis presented in Jacome and Vazquez (2008) and Arnone and Romelli (2013). However, given that the set of countries analyzed now includes both advanced economies and emerging markets, characterized therefore by very different price dynamics, we standardize inflation rates as follows: $\pi_{i,t}/(1+\pi_{i,t})$. This standardization reduces the risk of assigning a too hight weight to outliers, such as episodes of hyperinflation (see also Cukierman et al., 1992).

The first step consists in reassessing the CBI-inflation link in a classical framework that relates the level of inflation to previous values of central bank independence. Drawing on the large literature of CBI, this simple test is augmented with a set of variables that have been largely found to impact the relationship between CBI and inflation. This set of controls includes (i) a *Financial Crises* dummy to isolate the possible inflationary effects associated with financial distress especially in emerging economies; (ii) a measure of the degree of *Openness to Trade* in line with Campillo and Miron (1997); (iii) an *Exchange Rate Regime* dummy to capture countries which have adopted a fixed exchange rate regime; (iv) an *OECD Member* dummy to account for the level of development of the country since OECD members are generally more industrialized and advanced economies and (v) the average level of *World Inflation* to capture inflationary trends and the effect of the decreasing average inflation rate during the great moderation period (see also Jacome and Vazquez, 2008).

Following Jacome and Vazquez (2008), initial estimations were performed using OLS and with fixed-effects at the country level. However, given the heteroskedasticity across panels and the autocorrelation across observations present in the data, the preferred estimations use Feasible Generalized Least Squares (FGLS) allowing for heteroskedasticity

across countries and a common AR(1) error process.

Table 1: Panel regressions of inflation on CBI (FGLS)

CBI Indices:	CBIE	GMT	LVAU	LVAW	CWNE	CBIU	CBIW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$CBI_{i,t}$	-0.0434***	-0.0308***	-0.0275***	-0.0293***	-0.0382***	-0.0293***	-0.0301***
	(0.010)	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)
Financial Crises	0.0056*	0.0054*	0.0054*	0.0055*	0.0057*	0.0055*	0.0055*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Openness to Trade	0.0001*	0.0001	0.0001	0.0001	0.0001*	0.0001	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exchange Rate Regime	-0.0026	-0.0020	-0.0027	-0.0027	-0.0029	-0.0027	-0.0027
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
OECD Member	-0.0159**	-0.0157**	-0.0172**	-0.0170**	-0.0167**	-0.0167**	-0.0166**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
World Inflation	0.0012***	0.0013***	0.0013***	0.0013***	0.0012***	0.0013***	0.0013***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1,729	1,729	1,729	1,729	1,729	1,729	1,729
Number of countries	57	57	57	57	57	57	57

The dependent variable is inflation scaled as $\pi_{i,t}/(1+\pi_{i,t})$. The coefficients were estimated using Feasible Generalized Least Squares, allowing for heteroscedasticity across countries and an AR(1) autocorrelation structure within countries. The main independent variables are the indices of CBI, measured alternatively by the CBIE, GMT (Grilli et al., 1991), LVAU (Cukierman, 1992), LVAW (Cukierman et al., 1992), CWNE (Jacome and Vazquez, 2008) and CBIU, CBIW (Dincer and Eichengreen, 2014) indices. Financial Crises is a dummy that takes the value one if a country is experiencing a systemic banking crisis in the current year. Openness to Trade is the ratio of the sum of exports and imports to GDP. Exchange Rate Regime is a dummy that takes value one is a country is adopting a fixed exchange rate regime. OECD Member is a dummy that takes the value one if the country is a member of the OECD. World Inflation is the average inflation rate in the world. Constant term and lagged inflation rate included but not reported. Standard errors in parentheses. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

Table 1 presents the results obtained using the FGLS estimations. In particular, Column (1) shows the estimations using the CBIE measure of independence, while Columns (2) to (7) present the estimates pertaining to the alternative measures of independence recomputed dynamically. The coefficients of the different indices of CBI are generally similar and negatively related to inflation at a 1% level. This confirms the results in Arnone and Romelli (2013) that countries characterized by an higher degree of independence of their central bank also experience lower inflation rates.

Looking at the additional set of control variables, results suggest that banking crises are associated with higher inflation, since the liquidity assistance to troubled banks might create inflationary pressures. The degree of openness to trade is only marginally significant for the CBIE and the CWNE index, while, as expected, more industrialized economies (OECD member countries) are associated with lower inflation. Finally, the positive and statistically significant relationship between the dependent variable and world inflation

indicates that inflationary trends worldwide have an influential effect on the inflation rate of the analyzed countries.

While this simple test confirms the negative correlation between inflation and central bank independence it does not, however, imply a causal link. A recent literature on endogenous political institutions argues that central bank independence is not imposed "exogenously", but evolves in response to changing political, social or economic factors. For example, Aghion et al. (2004) consider the case of the German Bundesbank whose statute was modified in 1957 as a result of a strong public aversion towards inflation after periods of hyperinflation in Germany. They argue that, often, central banks have been made more independent, to "insulate" monetary policy in periods of high inflation. Posen (1995) also discusses these issues of causality between CBI and inflation by suggesting that the different levels of CBI reflect differences in countries' financial opposition to inflation. He argues that CBI lead to a reduction of inflation in OECD countries because in these countries a large part of the population actually prefers low and stable inflation. Other cultural characteristics are discussed in de Jong (2002), who finds that the distribution of power in the society and the degree of uncertainty avoidance might also explain differences in CBI. Political systems can be an equally important factor influencing a country's degree of central bank independence. For example, Moser (1999) finds that legal independence is significantly higher in OECD countries with legislative processes characterized by extensive checks and balances. Keefer and Stasavage (2003) look at the *de facto* CBI and show that the monetary policy credibility (lower governor turnover) is enhanced by the presence of multiple veto players in the government. In Alesina and Stella (2010) the fractionalization of the party system might make the delegation of monetary policy to independent experts more cumbersome given the conflicts among groups. Finally, Cukierman and Webb (1995) also find a certain level of endogeneity of the *de facto* index of CBI, by showing that the probability of a change of the central bank governor is more than two times higher in periods within six months after a political transition.

These empirical findings on the endogeneity of CBI are, nonetheless, limited to small samples and sensitive to the choice of CBI indices (see de Haan and van't Hag, 1995, for a critical assessment). Yet, the need to study the determinants of central bank independence is greater in periods in which the design of central banks is put into question (Masciandaro

and Romelli, 2015). The 2008-09 financial crisis has brought into question many of the established facts about monetary policy and its institutions (Alesina and Stella, 2010). For example, Masciandaro and Passarelli (2013) explain the recent developments in central banking by focusing on a political economy model of bailouts. They argue that the distribution of financial wealth among individuals might represent one of the drivers of the decision of a country to maintain or reform its central bank regime.

All these arguments suggest that the level of central bank independence evolves endogenously as a response to a set of social, economic and political factors. The dynamic nature of the new index of CBI proposed in this paper can overcome many of the challenges of previous research and provide a reliable instrument of central bank independence.

3.2 CBI-inflation nexus with endogeneity

To account for the possible endogeneity of the degree of central bank independence, we re-estimate the results presented in Table 1 using an instrumental variable approach. In particular, the degree of central bank independence is instrumented by: i) its lagged value, to account for a time dependence of CBI; ii) the lagged level of the unemployment rate, to control for the short-run trade-off between inflation and unemployment;[3] iii) an indicator of government stability, since we can expect that more stable governments are more likely to adopt reforms, including granting more independence to the monetary policy authority; iv) the level of GDP per capita; and v) a dummy variable for currency unions, which in this sample assumes the value one for the Euro zone countries characterized by a similar degree of central bank independence. The results of the first stage estimation are not reported, but suggest that all the instruments except the government stability one are appropriate, with coefficients significant at the 1% level.

Table 2 presents the results obtained by implementing an instrumental variable estimation for fixed-effects panel data.[4] Importantly, the Hausman test statistic suggests the rejection of the null hypothesis that the endogenous regressor can be treated as exogenous, confirming that the degree of central bank independence is indeed an endogenous variable

[3]Looking at the link between unemployment and CBI, for example, Eijffinger and Schaling (1995) show that a higher natural rate of unemployment is associated with a higher degree of central bank independence.

[4]The Hausman specification test always rejected the null hypothesis of equality between the coefficients of the random and the fixed-effects models in all specification, suggesting therefore that the fixed effect model is more reasonable.

in this analysis.

Column (1) shows the estimations using the instrumented CBIE index, while Columns (2) to (7) look at the instrumented alternative measures of independence. These results confirm the negative and statistically significant (at 1% level) relationship between inflation and the different indices of CBI. More importantly, the point estimates of the instrumented level of CBI are almost twice as big as the estimated coefficients of CBI in Table 1, suggesting an even stronger effect of central bank independence on inflation rates. Furthermore, the results in Table 2 also suggest an important effect of periods of financial distress and inflationary trends around the world. Moreover, now, also the level of openness to trade and the type exchange rate regime of the country are more precisely estimated.

Table 2: Panel regressions of inflation on CBI (IV)

CBI Indices:	CBIE	GMT	LVAU	LVAW	CWNE	CBIU	CBIW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$CBI_{i,t}$	-0.0864***	-0.0667**	-0.0982***	-0.0893***	-0.0814***	-0.0952***	-0.0871***
	(0.030)	(0.029)	(0.021)	(0.022)	(0.026)	(0.022)	(0.022)
Financial Crises	0.0090**	0.0084*	0.0088*	0.0092**	0.0088**	0.0089**	0.0091**
	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.004)
Openness to Trade	0.0005***	0.0004***	0.0005***	0.0005***	0.0005***	0.0005***	0.0005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exchange Rate Regime	-0.0152**	-0.0153**	-0.0120*	-0.0127**	-0.0144**	-0.0125**	-0.0130**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
OECD Member	-0.0101	-0.0142	-0.0075	-0.0109	-0.0112	-0.0074	-0.0107
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
World Inflation	0.0074***	0.0079***	0.0068***	0.0071***	0.0073***	0.0069***	0.0071***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	749	749	749	749	749	749	749
R-squared	0.381	0.377	0.375	0.378	0.381	0.377	0.379
Number of countries	56	56	56	56	56	56	56

The dependent variable is inflation scaled as $\pi_{i,t}/(1+\pi_{i,t})$. The coefficients were estimated using Feasible Generalized Least Squares, allowing for heteroscedasticity across countries and an AR(1) autocorrelation structure within countries. The main independent variables are the indices of CBI, measured alternatively by the CBIE, GMT (Grilli et al., 1991), LVAU (Cukierman, 1992), LVAW (Cukierman et al., 1992), CWNE (Jacome and Vazquez, 2008) and CBIU, CBIW (Dincer and Eichengreen, 2014) indices. Financial Crises is a dummy that takes the value one if a country is experiencing a systemic banking crisis in the current year. Openness to Trade is the ratio of the sum of exports and imports to GDP. Exchange Rate Regime is a dummy that takes value one is a country is adopting a fixed exchange rate regime. OECD Member is a dummy that takes the value one if the country is a member of the OECD. World Inflation is the average inflation rate in the world. Constant term and lagged inflation rate included but not reported.
Standard errors in parentheses. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

The robustness of these results is tested using the Limited Information Maximum Likelihood (LIML) estimation technique. This estimation is more robust in the presence of weak instruments. The results obtained using this alternative technique are presented in

Appendix Table B.4 and are qualitatively similar.

4 Conclusions

The impact of central bank institutional design on real economic outcomes received large attention over the last three decades. For example, Vuletin and Zhu (2011) suggest that around 9000 works have been devoted to the role of CBI in the evolution of inflation as of 2011. The debate on the optimal design of monetary policy authorities has also seen a revived interest in the aftermath of the 2008-09 global financial crisis.

This paper uses a new index of central bank independence to re-investigate the CBI-inflation nexus for a set of 65 countries during the period 1972-2014. We go beyond the simple negative correlation between CBI and inflation by employing an instrumental variable approach where the level of CBI is instrumented by a set of political and economic factors. Results confirm the endogeneity of the CBI index and support a negative causal link between central bank independence and inflation non only for advanced economies, but also for developing countries.

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A Appendices

Table A.1: Institutional characteristics captured by indices of central bank independence

Criteria	GMT	CWN	CBIE
Governor and central bank board			
Who appoints the governor	*	*	*
Term of office of the governor	*	*	*
Reappointment option for the governor			*
Dismissal of governor		*	*
Governor allowed to hold another office in government		*	*
Qualification requirements for governor			*
Who appoints the board members	*		*
Term of office of board members	*		*
Reappointment option for board members			*
Dismissal of board members			*
Board members allowed to hold another office in government			*
Qualification requirements for board members			*
Staggering term of office for board members			*
Government representatives in the board	*		*
Monetary policy and conflicts resolution			
Who formulates monetary policy	*	*	*
Central bank responsible to fix key policy rates	*		*
Banking sector supervision	*		*
Central bank role in government's budget and/or debt	*		*
Final authority in monetary policy	*	*	*
Objectives			
Central bank's statutory goals	*	*	*
Limitations on lending to the government			
Direct credit: not automatic	*	*	*
Direct credit: market for lending		*	*
Who decides financing conditions to government		*	*
Beneficiaries of central bank lending		*	*
Direct credit: type of limit	*	*	*
Direct credit: maturity of loans	*	*	*
Direct credit: interest rates	*	*	*
Prohibition from buying government securities in primary market	*	*	*
Financial independence			
Payment of the initial capital of the central bank			*
Authorized capital of the central bank			*
Central bank financial autonomy			*
Arrangements for automatic recapitalization			*
Transfers of money from the treasury			*
Central bank approves its annual budget			*
Central bank adopt its annual balance sheet			*
Auditing agency			*
Allocation of net profits			*
Allocation of profits to a general reserve fund			*
Partial payments of dividends before the end of the fiscal year			*
Unrealized profits included in the calculation of distributable profits			*
Reporting and disclosure			
Central bank reporting			*
Central bank financial statements			*

Note: The table summarizes the set of information collected in the GMT (Grilli et al., 1991), CWN (Cukierman et al., 1992) and CBIE indices of central bank independence.

B Coding rules for the CBIE index of *de jure* central bank independence and accountability

I. **Governor and Central Bank Board**

I.1) Who appoints the governor?

Board of central bank / shareholders (if different from the government)	1.00
A council of the central bank board, executive and legislative branch	0.75
By legislative branch (congress, king)	0.50
By executive branch collectively (e.g. council of ministers)	0.25
By one or more members of executive branch	0.00

I.2) Term of office of the governor

More than 8 years	1.00
6 to 8 years	0.75
Equal to 5 years	0.50
Equal to 4 years	0.25
Less than 4 years or at the discretion of appointer (no limits or not mentioned)	0.00

I.3) Is there any reappointment option for the governor?

No	1.00
Restricted to two consecutive terms	0.50
Yes	0.00

I.4) Provisions for dismissal of governor

No provision for dismissal	1.00
Only for non-policy reasons (e.g., incapability, or violation of law)	0.83
At the discretion of central bank board	0.67
For policy reasons at legislative branch's discretion	0.50
At legislative branch's discretion	0.33
For policy reasons at executive branch's discretion	0.17
At executive branch's discretion	0.00

I.5) May the governor hold other offices in government?

Prohibited by law	1.00
Not allowed unless authorized by executive branch	0.50
No prohibition for holding another office	0.00

I.6) Is there any qualification requirement for the governor?

Yes	1.00
No	0.00

I.7) Who appoints the rest of the board?

Board of central bank / shareholders (if different from the government)	1.00
A council of the central bank board, executive and legislative branch	0.75
By legislative branch (congress, king)	0.50
By executive branch collectively (e.g. council of ministers)	0.25
By one or more members of executive branch	0.00

I.8) Term of office of the rest of the board

More than 8 years	1.00
6 to 8 years	0.75
Equal to 5 years	0.50
Equal to 4 years	0.25
Less than 4 years or at the discretion of appointer (no limits or not mentioned)	0.00

I.9) Is there any reappointment option for the rest of the board?

No	1.00
Restricted to two consecutive terms	0.50
Yes	0.00

I.10) Provisions for dismissal of the rest of the board

No provision for dismissal	1.00
Only for non-policy reasons (e.g., incapability, or violation of law)	0.83
At the discretion of central bank board	0.67
For policy reasons at legislative branch's discretion	0.50
At legislative branch's discretion	0.33
For policy reasons at executive branch's discretion	0.17
At executive branch's discretion	0.00

I.11) May the rest of the board hold other offices in government?

Prohibited by law	1.00
Not allowed unless authorized by executive branch	0.50
No prohibition for holding another office	0.00

I.12) Is there any qualification requirement for the rest of the board?

Yes	1.00
No	0.00

I.13) Does the legislation require a staggering term of office for the appointment of board members?

Yes	1.00
No	0.00

I.14) No mandatory participation of government representatives in the board

Yes	1.00
No, but without voting rights	0.50
No	0.00

II. Monetary Policy and Conflicts Resolution

II.1) Who formulates monetary policy?

Central bank alone	1.00
Central bank participates, but has little influence	0.67
Central bank only advises government	0.30
Central bank has no say	0.00

II.2) Is the central bank responsible for setting the policy rates?

Yes	1.00
No	0.00

II.3) Is there no responsibility of the central bank for overseeing the banking sector?

Banking supervision not entrusted to the central bank	1.00
Banking supervision not entrusted to the central bank alone	0.50
Banking supervision entrusted to the central bank alone	0.00

II.4) Central Bank given active role in formulation of government's budget and/or debt

Approves government budget and/or debt	1.00
Legally required to provide opinion on technical aspects	0.50
No involvement at all	0.00

II.5) Who has final word in resolution of conflicts?

The central bank, on issues clearly defined in the law as its objectives	1.00
The government, on policy issues not clearly defined as the central bank's goals	0.80
A council of the central bank, executive and legislative branch	0.60
The legislature, on policy issues	0.40
The executive branch on policy issues, subject to due process and possible protest by the bank	0.20
The executive branch has unconditional priority	0.00

III. Objectives

III.1) Price stability objective

Price stability is the single or primary objective	1.00
Price stability together with non-conflicting objectives but without priority	0.75
Price stability and other conflicting goals (i.e. stability of financial system), without priority	0.50
Price stability together with objective of economic growth / development with no priority	0.25
Objectives do not include price stability	0.00

IV. Limitations on Lending to the Government

IV.1) Limitations on advances

Advances to government prohibited	1.00
Advances permitted, but with strict limits (e.g., up to 15 percent of government revenue)	0.67
Advances permitted, and the limits are loose (e.g., over 15 percent of government revenue)	0.33
No legal limits on lending	0.00

IV.2) Lending to government

Not allowed	1.00
In secondary market with restricted limits	0.75
In secondary market with lax or without limits	0.50
In primary market with limits or approved by central bank board with a qualified majority	0.25
In primary market without limits	0.00

IV.3) Who decides financing conditions to government (maturity, interest, amount)?

Central bank defines terms and conditions	1.00
Specified by the bank charter	0.67
Agreed between the central bank and executive	0.33
Decided by the executive branch alone	0.00

IV.4) Potential borrowers from the central bank

Only the government	1.00
Government plus local governments	0.67
All of the above plus public enterprises	0.33
All of the above and to the private sector, also if it is not mentioned otherwise	0.00

IV.5) Limits on central bank lending defined

As an absolute cash amount	1.00
As a percentage of central bank capital or other liabilities	0.67
As a percentage of government revenues	0.33
As a percentage of government expenditure	0.00

IV.6) Maturity of advances

Within 6 months	1.00
Within 1 year	0.67
More than 1 year	0.33
No mention of maturity in the law	0.00

IV.7) Interest rates on advances

At market rates	1.00
Interest rates not specified in law	0.50
At below market rates	0.00

IV.8) Central bank prohibited from buying or selling government securities in the primary market

Yes	1.00
No	0.00

V. **Financial Independence**

V.1) Does the statute describe precisely the provisions relating to the payment of the initial capital?

Yes	1.00
No	0.00

V.2) The Statute quantify precisely the authorized capital of the central bank

Yes	1.00
No	0.00

V.3) Financial autonomy

Government should maintain central capital integrity	1.00
Government is legally allowed to capitalize the central bank	0.67
The law does not allow the government to capitalize the central bank	0.33
The central bank conducts quasi-fiscal operations	0.00

V.4) Are there legal arrangements allowing for an automatic capital contribution upon the request by the central bank (automatic recapitalization)?

Yes	1.00
No	0.00

V.5) How are managed, from a legislative point of view, transfers of money from the treasury to the central bank?

The decision is based on technical criteria	1.00
The transfer requires approval by the treasury	0.50
The transfer requires an act of the legislature	0.00

V.6) The central bank has the exclusive right to determine and approve its annual budget

Yes	1.00
Ex-post approval by the government	0.50
No	0.00

V.7) The adoption of the annual balance sheet of the central bank belongs exclusively to its decision-making bodies

Yes	1.00
No	0.00

V.8) The accounts of the central bank are subject to the control of a state agency of auditing

No	1.00
No, but the external audit agency is appointed by the government	0.50
Yes	0.00

V.9) Allocation of the net profits of the central bank

Prescribed by the central bank statute	1.00
Left at the discretion of the central bank	0.67
A kind of negotiation between the government and the central bank	0.33
Left at the discretion of the government	0.00

V.10) How is the allocation of profits to the general reserve fund handled by the central bank?

An objective criteria established precisely by the central bank statute	1.00
Left at the discretion of the central bank	0.67
Made by the deciding body of the central bank in consultation with the government	0.33
Left at the discretion of the government	0.00

V.11) Can the state or the shareholders receive partial payments before the end of the fiscal year, based on an estimate for that year?

No	1.00
Yes	0.00

V.12) Are unrealized profits included in the calculation of distributable profits?

No	1.00
Yes	0.00

VI. **Central bank reporting and accountability**

VI.1) Central Bank reporting

Reports to executive branch and informs at least annually the congress.	1.00
Reports to the executive once a year and submits an annual report to the congress	0.75
Annual report to the executive. Informs to the executive branch whenever fundamental disequilibria emerge, or reports through the media without specific periodicity	0.50
Issues annual reports at specific time	0.25
Distributes an annual report without establishing particular period of time	0.00

VI.2) Central Bank financial statements

Discloses detailed financial statements at least once a year with a certification of an independent auditor	1.00
Discloses consolidated financial statements at least once a year with seal of the banking superintendent or other public sector authorities	0.75
Discloses financial statements at least once a year, certified by an internal	0.50
Publishes partial financial statements	0.25
Does not publish financial statements or the law authorizes the central bank to deviate from international accounting standards	0.00

Table B.2: Analyzed countries

Countries, year of first analyzed legislation			
Afghanistan	2003	Lithuania	1994
Albania	1992	Luxembourg	1983
Algeria	1962	Malaysia	1982
Argentina	1935	Malta	1994
Australia	1959	Mexico	1960
Austria	1955	Mongolia	1996
Bahrain	1973	Montenegro	2005
Belgium	1948	Morocco	1959
Bosnia and Herzegovina	1997	Netherlands	1948
Brazil	1964	New Zealand	1933
Bulgaria	1991	Norway	1966
Canada	1954	Poland	1997
Chile	1953	Portugal	1962
China	1995	Qatar	1993
Croatia	1991	Romania	1991
Cyprus	1963	Russia	1992
Czech Republic	1991	Saudi Arabia	1957
Denmark	1942	Singapore	1991
Estonia	1993	Slovakia	1992
Finland	1966	Slovenia	1991
France	1936	South Korea	1950
Germany	1957	Spain	1962
Greece	1959	Sweden	1966
Hungary	1991	Switzerland	1953
Iceland	1966	Thailand	1942
India	1934	Trinidad and Tobago	1964
Indonesia	1953	Turkey	1970
Iran	1972	Ukraine	1991
Ireland	1942	United Arab Emirates	1980
Italy	1948	United Kingdom	1946
Japan	1957	United States of America	1951
Kuwait	1968	Venezuela	1939
Latvia	1992		

Table B.3: Information on the criteria of the CBIE index (as of 2014)

Variable	Mean	Median	St. Dev.	Min	Max
I. Governor and Central Bank Board					
I.1) Who appoints the governor?	0.504	0.500	0.394	0	1
I.2) Term of office of the governor	0.600	0.750	0.211	0	0.75
I.3) Reappointment option for the governor	0.362	0.000	0.446	0	1
I.4) Dismissal of governor	0.741	0.830	0.259	0	1
I.5) Governor's other offices in government	0.915	1.000	0.273	0	1
I.6) Qualification requirement for the governor	0.708	1.000	0.458	0	1
I.7) Who appoints the rest of the board	0.546	0.500	0.410	0	1
I.8) Term of office of the rest of the board	0.531	0.750	0.308	0	1
I.9) Reappointment option for the rest of the board	0.377	0.000	0.451	0	1
I.10) Dismissal of the rest of the board	0.723	0.830	0.276	0	1
I.11) Rest of the board's other offices in government	0.769	1.000	0.415	0	1
I.12) Qualification requirement for the rest of the board	0.815	1.000	0.391	0	1
I.13) Staggering term for the board members	0.477	0.000	0.503	0	1
I.14) No participation of government representatives in the board	0.723	1.000	0.451	0	1
II. Monetary Policy and Conflicts Resolution					
II.1) Who formulates monetary policy	0.857	1.000	0.250	0	1
II.2) Central bank responsible for setting policy rates	0.969	1.000	0.174	0	1
II.3) Banking sector supervision	0.315	0.000	0.410	0	1
II.4) Central bank's role government's budget and/or debt	0.015	0.000	0.124	0	1
II.5) Final word in resolution of conflicts	0.751	1.000	0.414	0	1
III. Objectives					
III.1) Price stability objective	0.742	1.000	0.319	0	1
IV. Limitations on Lending to the Government					
IV.1) Limitations on advances	0.759	1.000	0.375	0	1
IV.2) Lending to government	0.696	1.000	0.404	0	1
IV.3) Financing conditions to government	0.815	1.000	0.324	0	1
IV.4) Potential borrowers from the central bank	0.820	1.000	0.364	0	1
IV.5) Limits on central bank lending defined	0.676	1.000	0.429	0	1
IV.6) Maturity of advances	0.795	1.000	0.352	0	1
IV.7) Interest rates on advances	0.750	1.000	0.367	0	1
IV.8) Government's securities in the primary market	0.662	1.000	0.477	0	1
V. Financial Independence					
V.1) Payment of the initial capital	0.877	1.000	0.331	0	1
V.2) Authorized capital of the central bank	0.815	1.000	0.391	0	1
V.3) Financial autonomy	0.272	0.000	0.387	0	1
V.4) Automatic recapitalization	0.369	0.000	0.486	0	1
V.5) Transfers of money from the treasury	0.162	0.000	0.344	0	1
V.6) Central bank's annual budget	0.838	1.000	0.332	0	1
V.7) Adoption of annual balance sheet	0.831	1.000	0.378	0	1
V.8) Auditing	0.723	1.000	0.386	0	1
V.9) Allocation of the net profits	0.867	1.000	0.288	0	1
V.10) Profits to general reserve fund	0.810	1.000	0.358	0	1
V.11) Partial payments of dividends	0.954	1.000	0.211	0	1
V.12) Unrealized profits distribution	0.985	1.000	0.124	0	1
VI. Central Bank Reporting and Accountability					
VI.1) Central bank reporting	0.954	1.000	0.197	0	1
VI.2) Central bank financial statements	0.881	1.000	0.242	0	1

Table B.4: Panel regressions of inflation on CBI (IV with LIML)

CBI Indices:	CBIE	GMT	LVAU	LVAW	CWNE	CBIU	CBIW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$CBI_{i,t}$	-0.0880***	-0.0685**	-0.1005***	-0.0911***	-0.0830***	-0.0974***	-0.0889***
	(0.030)	(0.030)	(0.021)	(0.023)	(0.027)	(0.022)	(0.023)
Financial Crises	0.0090**	0.0084*	0.0088*	0.0092**	0.0088**	0.0089**	0.0091**
	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Openness to Trade	0.0005***	0.0004***	0.0005***	0.0005***	0.0005***	0.0005***	0.0005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exchange Rate Regime	-0.0151**	-0.0152**	-0.0119*	-0.0126**	-0.0143**	-0.0125**	-0.0129**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
OECD Member	-0.0100	-0.0142	-0.0073	-0.0107	-0.0111	-0.0072	-0.0105
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.015)
World Inflation	0.0073***	0.0078***	0.0068***	0.0071***	0.0073***	0.0069***	0.0071***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	749	749	749	749	749	749	749
R-squared	0.381	0.377	0.374	0.377	0.380	0.377	0.379
Number of countries	56	56	56	56	56	56	56

The dependent variable is inflation scaled as $\pi_{i,t}/(1+\pi_{i,t})$. The coefficients were estimated using Feasible Generalized Least Squares, allowing for heteroscedasticity across countries and an AR(1) autocorrelation structure within countries. The main independent variables are the indices of CBI, measured alternatively by the CBIE, GMT (Grilli et al., 1991), LVAU (Cukierman, 1992), LVAW (Cukierman et al., 1992), CWNE (Jacome and Vazquez, 2008) and CBIU, CBIW (Dincer and Eichengreen, 2014) indices. Financial Crises is a dummy that takes the value one if a country is experiencing a systemic banking crisis in the current year. Openness to Trade is the ratio of the sum of exports and imports to GDP. Exchange Rate Regime is a dummy that takes value one is a country is adopting a fixed exchange rate regime. OECD Member is a dummy that takes the value one if the country is a member of the OECD. World Inflation is the average inflation rate in the world. Constant term and lagged inflation rate included but not reported.

Standard errors in parentheses. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.