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bank design: evidence from a new dataset

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# The political economy of reforms in central bank design: evidence from a new dataset

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## Abstract

What accounts for the worldwide changes in central bank design over the past four decades? Using a new dataset on central bank institutional design, this paper investigates the timing, pace and magnitude of reforms in a sample of 154 countries over the period 1972-2017. I construct a new dynamic index of central bank independence and show that initial reforms that increase the level of independence, as well as a regional convergence, represent important drivers of changes in central bank design. Similarly, an external pressure to reform, such as an IMF loan program, also increases the likelihood of reforms, while political factors or crises episodes have little impact. These results are robust to controlling for the direction and size of reforms, alternative indices of central bank independence and estimation strategies.

**Keywords:** Central banks, central bank independence, central bank governance, legislative reforms.

**JEL classification:** E58, G28, N20, P16.

# 1 Introduction

The past four decades have been characterized by significant changes in central bank institutional design, generally towards assigning monetary authorities a higher degree of independence from the executive branch. Yet, despite the large consensus on the optimality of this institutional arrangement in stabilizing inflation rates, the degree of central bank independence still varies considerably across countries. Moreover, the 2008-09 global financial crisis reopened the debate on central bank design, suggesting that new institutional arrangements should be aimed at both price and financial stability (Alesina and Stella, 2010; Brunnermeier and Sannikov, 2012; Cukierman, 2013). As a result, recent years have seen a new wave of reforms concerning, in particular, the involvement of central banks in financial supervision.[1]

This paper investigates why and how central bank reforms, such as the ones that followed the recent crisis, come about. While a considerable body of work has investigated the *consequences* of assigning more independence to monetary policy authorities, the *causes* of reforms in central bank design have received less attention. Two empirical challenges in investigating the drivers of reforms in central banking are represented by (i) the different methodologies of constructing indices of central bank independence (CBI) and, more importantly, (ii) the fact that such indices are generally computed at random points in time and do not capture the entire set reforms.

This paper overcomes these limitations by introducing a large cross-country database on the timing of legislative changes in central banking for a set of 154 countries during the period 1972-2017. It constructs a dynamic measure of central bank independence that allows for a more precise determination than previously possible of the timing and magnitude of reforms in central bank design. This dynamic index builds on the two most common measures of "de jure" central bank independence in Grilli et al. (1991) and Cukierman et al. (1992). However, given that the role of central banks has evolved considerably since the early 1990s, the new measure of CBI proposed extends upon previous ones by capturing new characteristics that can affect the conduct of monetary policy, such as financial independence and accountability.

Employing this dynamic index, I provide the first complete overview of the evolution and timing of reforms in central bank design in most countries around the world. I then follow

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[1]For example, the Dodd-Frank Act of 2010 in the USA increased the responsibilities of the Federal Reserve Bank as financial supervisor. Similar reforms occurred in the UK (2012), Euro Area (2014), New Zealand (2010) or Russia (2013).

a political economy perspective to examine the determinants of reforms in central bank design. This framework provides a useful toolkit for identifying five sources of reforms: (i) learning effects, (ii) crises and shocks, (iii) external inducements, (iv) ideology and political factors and (v) economic conditions. The results points to a strong effect of learning and external inducements on the likelihood of reforms in central banking. In particular, I document a non-linear, inverse U-shaped relationship between past levels of CBI and the probability of reforms, which suggests that countries are less likely to reform at very low or very high levels of central bank independence, where they exhibit a strong status quo bias. Regional convergence has an equally important learning effect, as countries farther away from the average level of independence in their region are more likely to reform. An external pressure to reform also comes from international institutions, as countries receiving an IMF loan or becoming a member of a currency union are also more likely to increase the independence of their monetary policy institutions.

On the other hand, there is little support for the idea that reforms are triggered by "shocks" that change the balance of power of decision-making bodies. Using several proxies for adverse conditions, including financial crises, inflationary episodes or recession periods, I find that crises do not explain the probability of reforming central bank independence. Similarly, changes in the government's political orientation do not impact the probability of implementing changes to the level of CBI. Yet, the results obtained provide strong support for the alternative argument, i.e. that periods of growth are more inducive to reforms, especially in developing countries, as potential losers from the policy change can recover the losses incurred more easily (see also Giuliano et al., 2013).

The index constructed also allows for a more granular analysis into the magnitude and direction of reforms. This highlights important differences in the reform process. For instance, I find that financial crises are generally followed by reforms that decrease the level of central bank financial independence, while external inducements, regional convergence and status quo bias only matter for reforms that increase the level of independence, but not those that decrease it.

The robustness of these results is checked along several lines. First, I employ several estimation strategies and alternative definitions and proxies for the main determinants of reforms. Next, I control for the sign and magnitude of reforms, as well as the different dimensions along which central bank legislation can be amended. I also perform various split sample analyses and control for other reform processes such as democratic reforms. The

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results are robust to all these alternative specifications and provide the first comprehensive picture of the determinants and timing of reforms in central bank design over the last four decades.

The paper is organized as follows. Section 2 reviews previous literature on central banking. Section 3 discusses the methodology followed in building the new index of central bank independence and identifying reforms. Section 4 discusses the political economy arguments of reforming monetary policy institutions and the explanatory variables used. Section 5 presents the empirical strategy and results, while Section 6 concludes.

## 2 Related literature

Theoretically, the concept of central bank independence is rooted in the time inconsistency problem put forward by Kydland and Prescott (1977) and formalized in Rogoff (1985), who first suggested the delegation of monetary policy to institutions with a clear objective of price stability. Since then, this concept has not only shaped the design of central banks around the world, but has also spurred a prolific research agenda into the effectiveness of independent central banks in stabilizing inflation rates. A first step in this endeavor has been the creation of measures that capture the degree of independence of a central bank from the executive branch. Parkin and Bade (1982), Grilli et al. (1991) and Cukierman et al. (1992) proposed the first indices of central bank independence (CBI) based on the legal statutes of central banks.

Following the development of these measures, a large empirical literature has tested the effectiveness of CBI in lowering inflation.[2] Overall, while most research supports a negative correlation between the level of central bank independence and inflation rates, this link is not always robust across countries, time periods or when different controls are included.[3] One explanation for these heterogeneous results might rest in the construction of the various indices. For example, the two most common measures of CBI, the Grilli et al. (1991) and the Cukierman et al. (1992) indices, capture quite different information: 40 percent of the criteria collected in the former are not present in the latter (see Mangano, 1998).

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[2]See, among others, Grilli et al. (1991), Cukierman et al. (1992), Alesina and Summers (1993) and Siklos (2008). For extensive reviews of this literature, see Arnone et al. (2006); Cukierman (2008); Klomp and de Haan (2010).

[3]For example, Cukierman et al. (2002) look at former socialist economies and find that CBI is unrelated to inflation during the early stages of liberalization, but the link becomes significant when countries become more liberalized. Similarly, Campillo and Miron (1997) and Oatley (1999) show that CBI has no effect on inflation when they control for the degree of openness, political instability or historical levels of debt and inflation. See also Posen (1995) and Brumm (2000).

A different argument is that *de jure* measures, which look at legislative reforms, do not represent actual levels of central bank independence, in particular in developing countries where written rules are often circumvented by *de facto* procedures. A common measure of *de facto* independence is the turnover rate of the central bank governor (Cukierman et al., 1992). However, the link between this measure and inflation dynamics is also not very robust (see, for example, Crowe and Meade, 2007).

A more recent stream of literature discusses the issue of causality and the endogenous evolution of central banks. A typical example is the German Bundesbank, whose statute was modified in 1957 as a result of a strong public aversion towards inflation following periods of hyperinflation (Alesina and Stella, 2010). Thus, it might be that CBI is not imposed "exogenously", but rather evolves in response to changing political, social or economic factors. A more general literature on "endogenous political institutions" makes a similar argument. For example, Aghion et al. (2004) argue that central banks have been made more independent in order to "insulate" monetary policy in periods of high inflation. Posen (1995) argues that the different levels of CBI across the world reflect differences in countries' preferences for low and stable inflation (see also de Haan and van't Hag, 1995). 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 explain differences in CBI.

Political systems can be an equally important factor influencing the degree of central bank independence. For instance, Moser (1999) finds that legal independence is 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 monetary policy credibility (lower governor turnover) is enhanced by the presence of multiple veto players in the government, while Cukierman and Webb (1995) show that governor turnover is higher within six months of a political transition. 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. Similarly, Masciandaro and Passarelli (2013) employ a political economy model of bailouts to show that the distribution of financial wealth among individuals can influence the decision to maintain or reform a central bank regime.

The arguments above have created avenues for a recent stream of research that looks at the timing of reforms in central bank legislation. For example, Bodea and Hicks (2015)

build a dummy variable that takes value one in years in which the Cukierman et al. (1992) index has been modified. They find that the competition between countries for international capital increases the likelihood of reforms. Berggren et al. (2016) investigate the effect of social trust on central bank legislative reforms, where reforms information are collected from a questionnaire sent to central banks. Finally, Crowe and Meade (2008) look at the change in the degree of central independence between the index computed by Cukierman et al. (1992) in 1989 and its recomputed value in 2003. However, this approach does not take into account the timing of reforms and may under/overestimate the magnitude of changes given the potentially different interpretations of the central bank charters. These empirical findings on the endogeneity of CBI are, nonetheless, limited to small samples, sensitive to the choice of CBI indices and are mainly concerned with the probability of reforms and not the magnitude or direction of changes.

This paper overcomes these empirical challenges by building a comprehensive survey of the timing and pace of reforms in central bank design. As such, it also relates to a broader and recent literature that looks at the determinants of institutional reform processes. Closely related to this paper is Abiad and Mody (2005) who look at the determinants of financial liberalization reforms, or Giuliano et al. (2013) who study the effect of democracy on the adoption of financial and product market reforms. Similarly, Gokmen et al. (2017) look at reforms that liberalize trade, agriculture, network industries and financial markets and find that, contrary to conventional belief, crises are followed by fewer structural reforms. Mian et al. (2014) also find that financial crises can result in legislative stalemates that are not conducive to meaningful macroeconomic reforms. This paper complements this recent work, by providing the first comprehensive study of the determinants of the timing and magnitude of reforms in central bank institutional design.

## 3  Data and stylized facts

This section describes the new index of central bank independence proposed in this paper. It also provides some new stylized facts about the evolution of central bank design over the last four decades in a sample of 154 countries.[4]

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[4]See Appendix Table A1 for the full set of countries and information on data availability.

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## 3.1 Indices of Central Bank Independence

This paper constructs a new and comprehensive index of central bank independence covering a wide range of central bank characteristics based on their charters.[5] This approach captures, in an objective way, three key characteristics that define the institution's political and economic independence. The construction of the index uses as a starting point the two most commonly employed indices of legal independence, namely the Grilli et al. (1991) (GMT) and Cukierman et al. (1992) (CWN) indices.[6] The new index, called Extended Central Bank Independence (ECBI) index, provides, in its most disaggregated format, information on 42 criteria of central bank institutional design across six dimensions: 1) Governor and central bank board, 2) Monetary policy and conflicts resolution, 3) Objectives, 4) Limitations on lending to the government, 5) Financial independence and 6) Reporting and accountability.

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 (see Mangano, 1998). The ECBI index expands the GMT political independence index by collecting additional information on the dismissal of the governor and other board members, in addition to 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.

Apart from integrating these two indices, one important innovation of the ECBI index is the inclusion of new criteria that capture good practices in central bank financial independence and accountability. 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 budget of the central bank, as well as the requirements for profit allocation. These last two features are particularly important during periods in which central banks assets increase exponentially, as it has been the case fol-

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[5]Classical measures of CBI are built using two different methodologies: i) *de jure*, and ii) *de facto* measures of independence. The first consists in the codification of central banks' statutes. *De facto* indices, on the other hand, associate the independence of central banks to the autonomy of its governor, i.e. higher turnover rates of central bank governors are associated with a lower independence of the central bank. *De facto* indices, however, are known to suffer from important limitations such as the fact that the reasons behind the dismissal of the governor are not considered or the fact that they focus on the governor only and overlook the entire board of directors (see, among others Dreher et al., 2008). I thus focus my analysis on *de jure* CBI indices.

[6]For an extended explanation of these indices and a literature review, see Eijffinger and de Haan (1996); Arnone et al. (2006); Arnone and Romelli (2013); Masciandaro and Romelli (2015, 2019).

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

| Criteria | GMT | CWN | ECBI |
|---|:---:|:---:|:---:|
| ***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 accountability*** | | | |
| Central bank reporting | | | * |
| Central bank financial statements | | | * |

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

lowing the global financial crisis of 2008-09. In this context, the presence of on the central bank budget and the distribution of their profits, may reduce their capacity to implement monetary policy. Regarding profits allocation, in particular, Reis (2013) argues that governments under fiscal stress will 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). Accountability refers to central bank reporting, i.e. the legal provisions that require central banks to report, on a regular basis, the fulfilment of their policy targets. Accountability also concerns the publication of financial statements. A higher independence should be associated with a regular publication of central bank financial statements that follow international accounting standards, and are certified by an independent auditor.

Table 1 presents the summary of the characteristics collected in the GMT and CWN indices, as well as, the new characteristics added by the ECBI index. The guiding principles for the creation of this new index of central bank independence are summarized in Appendix A, while its structure is presented in Appendix B. The codification strategy follows closely Cukierman et al. (1992) and the points assigned to each answer to the 42 questions that construct the ECBI index range between 0 (no independence) and 1 (full independence). An overall score is for each of the six dimensions of the index is obtained by assigning equal weights to each question in a given dimension. Then, the overall index is computed as the average of the scores across these six dimensions. This guarantees that all dimensions are given the same weight in determining the level of independence. The resulting index is normalized over the interval [0;1].[7]

## 3.2 Central Bank legislative reforms

To identify the full set of reforms in central bank design, I identify, for each country, all the years in which the central bank charter has been changed or amended.[8] A total number of 2490 changes to central bank legislation have been identified in the sample, over the period 1972-2017; with 1303 reforms in the form of complete changes of statutes or reprints

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[7]There are, of course, different ways to aggregate the collected data. For example, Grilli et al. (1991) sum up the values obtained from the 15 questions included in their index. In this case, the importance assigned to each criteria depends on their total number. Cukierman et al. (1992), Jacome and Vazquez (2008) and Dincer and Eichengreen (2014), assign a set of a priori weights to each dimension and criteria. However, in this case as well, one might assign a too high (low) weight to a certain subcategory of the index. For instance, in the Cukierman (1992) index, 62.5% of the weight is assigned to the dimension on the limitations on lending to the government. The construction of the ECBI index follows a conservative approach and assigns an equal weight to its six dimensions. Appendix Figure B.1 presents a bar chart that compares the weights assigned to different dimensions across various indices of CBI in the literature. The figure shows the the degree of "subjectivity" in calculating the different indices of central bank independence and motivates the approach in this paper to assign equal weights to its six dimensions. Nonetheless, robustness tests are performed using alternative weighting methods.

[8]The full list of the analyzed documents was obtained from central bank websites or by directly contacting the central bank and can be made available upon request.

Table 2: Measures of Central Bank Independence and Reforms

| Paper | Index Name | Variables | Countries | Period | Nr. of reforms |
|-------|-----------|-----------|-----------|--------|----------------|
| Grilli et al. (1991) | GMT | 16 | 18 | 1989 | – |
| Cukierman et al. (1992) | CWN | 16 | 72 | 1950-1989 | 35 |
| Cukierman et al. (2002) | CWN | 16 | 26 | 1991-1998 | 9 |
| Polillo and Guillén (2005) | CWN | 16 | 91 | 1989-2000 | 60 |
| Crowe and Meade (2008) | CWN | 16 | 99 | 2003 | – |
| Jacome and Vazquez (2008) | CWNE | 17 | 24 | 1990-2002 | 13 |
| Acemoglu et al. (2008) | CWN | 16 | 52 | 1972-2005 | 40 |
| Arnone et al. (2009) | GMT | 16 | 162 | 2003 | – |
| Dincer and Eichengreen (2014) | CBIU | 24 | 85 | 1998-2010 | 44 |
| Bodea and Hicks (2015) | CWN | 16 | 83 | 1972-2010 | 108 |
| **This paper** | **ECBI** | **42** | **154** | **1972-2017** | **286** |

Note: This table shows the number of countries and reforms in central bank independence identified in previous works and in this paper.

of central bank charters, and 1187 in the form of legislative amendments. This implies that countries have, on average, modified their legislation about 16 times over the analyzed period. Yet these legislative changes may not necessarily modify, in a significant way, the institutional design of central banks. To gauge the magnitude and significance of these legislative changes, I focus my attention on reforms that modify the degree of central bank independence, which has been long considered the optimal institutional design for modern central banks.

For each year in which a change to the central bank charter has occurred, I calculate the value of the ECBI index. A reform is then defined as a date in which the level of the ECBI index changes. The information collected also allows me to construct the dynamic evolution of other indices of central bank independence proposed in the literature. Table 2 shows that the new index introduced in this paper captures the highest number of reforms: out of the 2490 changes in legislation collected, 286 have changed the degree of CBI. This large number of identified reforms is due to the fact that I recompute the index in *every* year a legislative change takes place, while in previous works, reforms are mainly identified by computing the change in an index of CBI between two random (usually distant) moments in time. For example, Acemoglu et al. (2008) build a dummy variable that captures reforms in CBI by looking at the CWN index computed at different points in time. They identify 40 major central bank legislative reforms in a sample of 52 countries over 1972-2005. This approach, however, overlooks the fact that significant changes in CBI might have occurred between the dates when the indexes are computed. While this might be less important when looking at long-run inflation outcomes as they do, capturing the exact timing and magnitude of reforms is crucial in understanding the reform process. Indeed, by looking at the full set of legislative changes, I identify 286 reforms that modify the degree of CBI in

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Figure 1: Central Bank legislative reforms (1972-2017)
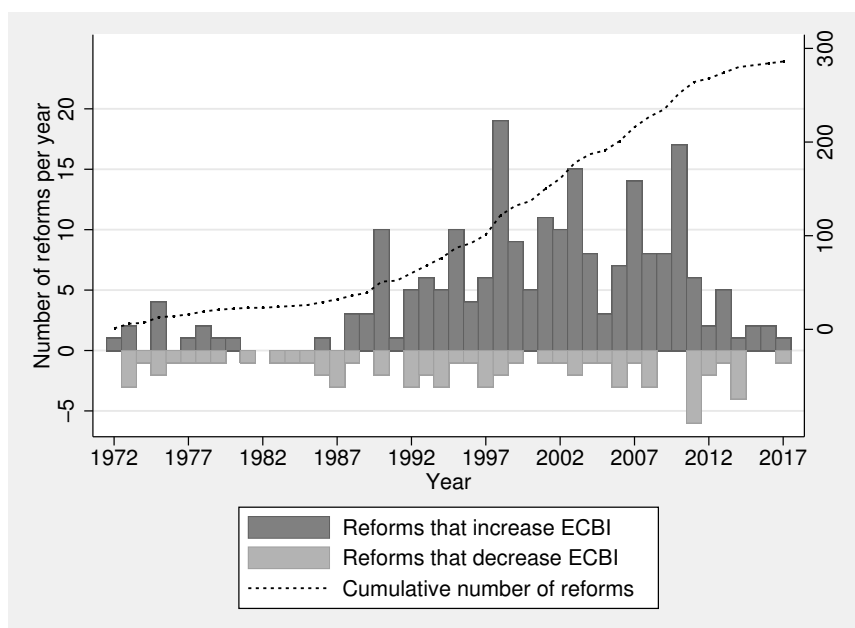


Notes: This figure shows the frequency of reforms that increased/decreased the ECBI index, together with the cumulative number of reforms in central bank independence between 1972 and 2017.

a sample of 154 countries. This shows that CBI indices are rather dynamic over time and motivates the main empirical investigation in which I aim at understanding the triggers behind these many reforms.[9]

Figure 1 shows the distribution of reforms over time. A large number of reforms occurred during the 1990s, with a peak in 1998, when the countries joining the Euro Area adopted a unique monetary policy authority.[10] Yet, a new reform wave can also be noticed following the 2007-08 financial crisis, with a significant higher number of reforms that decrease the level of central bank independence in this later period. These reforms are mainly related to an increased level of central bank involvement in financial supervision, which is associated with less independence (Masciandaro and Romelli, 2018).

Figure 2 compares the level of central bank independence proxied by the ECBI index in 1972 (or the first year available) and 2017. As most countries cluster above the 45 degree line, there is a clear tendency towards adopting higher levels of central bank independence. One of the countries with the highest level of independence is Finland, while the lowest is

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[9]Since the ECBI index also captures some new central bank characteristics, in robustness checks I employ the re-computed indices of Grilli et al. (1991) and Cukierman et al. (1992) to check that the results presented in this paper are not exclusively driven by the reforms along the new dimensions considered.

[10]Many former socialist economies have also adopted new central bank legislation over the 1990s (Cukierman et al., 2002). However, since the legislation prior to 1990 was not available, most of these reforms are not captured in this dataset. Hence, the first index of central bank independence for these countries corresponds to the one in the post-reform period.

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Figure 2: Evolution of Central Bank Independence
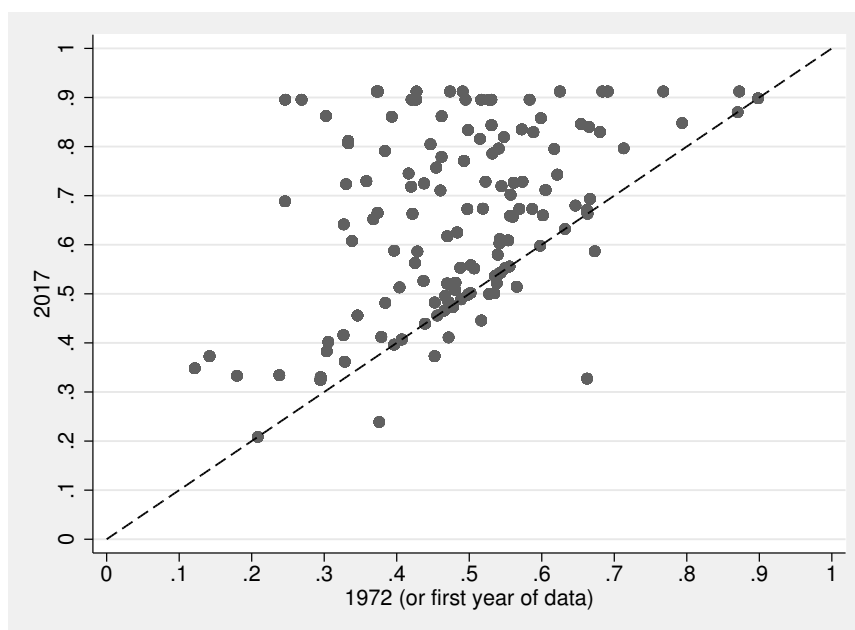


Notes: This figure compares the level of central bank independence proxied by
the ECBI index in 1972 (or the first year available) and 2017.

in Macao. The highest drop in independence is recorded in Vietnam, which moved from
0.38 to 0.24, after a reform that took place in 1997. Similarly, Figure 3 shows the evolution
of the average index of CBI by regional clusters. Several regions appear to lag behind in
the reform process such as South and East Asia, the Middle East and North Africa. The
empirical results will confirm this regional clustering that is visually apparent in Figure 3.

# 4 The political economy of reforms

This section uses a political economy perspective to highlight some potential drivers of the
timing and pace of reforms in central bank design over the past half of century. Motivated
by these theoretical arguments, it also describes the set of variables that proxy the potential
determinants of reforms.

A classical political economy framework to study reform processes is the war of attrition
model (Alesina and Drazen, 1991). The essence of this model is that a political conflict
between two different social groups, such as political parties, can delay the implementation
of reforms. In Alesina and Drazen (1991), fiscal stabilization following a negative shock
to government revenues is delayed because political parties disagree on how to allocate
the costs of stabilization. They will thus engage in a war of attrition that delays the
implementation of reforms until the passage of time reveals which group bears a higher

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Figure 3: Evolution of ECBI by regions
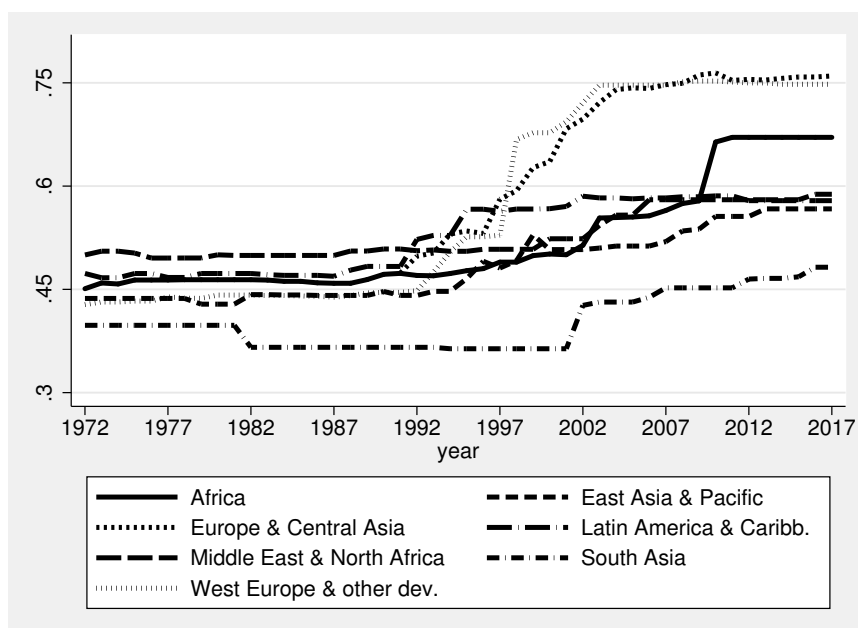


Notes: This figure shows the evolution of the average index of CBI by regional clusters.

cost of waiting.

A similar mechanism can explain reforms in central bank legislation if one assumes that an established interest group benefits from maintaining the existing level of CBI. For example, the conventional view that left-wing governments are less receptive to market-oriented reforms suggests that these governments may resist increasing the degree of independence of the central bank since this reduces their ability to monetize fiscal deficits (Alesina and Roubini, 1992). Moreover, uncertainty about the outcome of reforms can also explain why countries prefer maintaining the status quo (Fernandez and Rodrik, 1991). Thus, conflicting political interests coupled with some uncertainty about the cost or benefits of reforming central banks can lead to a war of attrition game that can explain why some countries do *not* reform their central bank legislation. Then what triggers a reform?

Theories of reforms suggest several factors that may explain the timing of reforms as a function of politico-economic characteristics of a country (Drazen, 2000; Alesina et al., 2006; Abiad and Mody, 2005). These include: (i) learning and status quo; (ii) crisis; (iii) external inducement; (iv) ideology, political structure and institutional environment; and (v) economic conditions. I briefly discuss how each of these factors can impact the probability of reforming central bank statutes.

(i) *Learning and status quo.* The possibility of "learning" can result in a better understanding of the costs and benefits of reforming and increases the probability of adopting

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a reform. This is particularly the case if reforms are a multistage process: early reforms can reveal information about the policy regime in place and, in turn, diminish the political opposition to reforming (Abiad and Mody, 2005). Learning can take different forms. For instance, countries might converge to an ideal level of central bank independence, say full independence (corresponding to an ECBI index of 1). If so, policy changes might be driven by how far countries are from this desired level, i.e., the distance between the status quo and the desired level. I refer to this effect as *domestic* learning. Following Abiad and Mody (2005), domestic learning is captured by a simple reduced form process: $ECBI_{i,t-1}(1-ECBI_{i,t-1})$, where $ECBI_{i,t-1}$ is the level of independence of country $i$ prior to a reform in year $t$. This specification allows for a non-linear, inverse U-shaped relationship between previous levels of CBI and the probability of reforming. Countries with very low levels of independence are more likely to have a strong status quo bias and resist reforms. Similarly, countries with very high levels of independence are also less likely to adopt further reforms. Therefore, the probability of reforming is the strongest in countries with an average degree of independence.

Learning can also be influenced by non-domestic factors. Evidence of spatial or regional clustering is often found for various reform processes such as democratic and liberal economic policies (Simmons and Elkins, 2004; Elhorst et al., 2013; Giuliano et al., 2013; Acemoglu et al., 2018). As such, countries might also reform their central bank design when other countries in their region are adopting higher levels of independence. I refer to this effect as *regional* learning. To capture this effect, I assume that the farther a country is from the average level of CBI in a region, the higher the impetus for reforms to catch-up. Hence, regional learning is computed as: $(REG_{i,t-1} - ECBI_{i,t-1})$, where $REG$ refers to geo-political areas as defined in Appendix Table A1.

(ii) *Crisis.* Conventional wisdom states that "it takes a crisis to reform". The prevailing view is that economic and financial crises lower the cost of reforming structural problems as the public is more willing to bear the pains associated with such reforms (Drazen, 2000; Masciandaro et al., 2008). For example, numerous country studies highlight the importance of episodes of hyperinflation in shaping monetary policy institutions (Alesina and Summers, 1993; Hayo, 1998). Similarly, in the wake of financial crises, uncertainty about monetary policy might increase uncertainty about the financial sector, worsening the crisis. As a result, policymakers could modify the degree of independence of the central bank as a way of stabilizing the economy (Alesina and Stella, 2010). For example, following

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the 2008-09 financial crisis, many governments have increased the involvement of central banks in banking and financial sector supervision (Masciandaro and Romelli, 2018). In line with these theoretical arguments, Alesina et al. (2006) find that countries are more likely to stabilize their government deficits during crisis periods, while Abiad and Mody (2005) show that financial sector liberalization reforms tend to occur following balance-of-payments crises, but are less likely after banking crises episodes. Gokmen et al. (2017), on the other hand, find no evidence for the crisis hypothesis in driving economic and financial reforms.

I control for three types of crises. First, a financial crisis dummy variable takes the value of one in the two years following a systemic banking crisis (including the crisis year). Second, I include a dummy variable that captures the presence of an inflation crisis in the country, i.e. annual inflation rates higher than 40% in the two years prior to a reform (see Reinhart and Rogoff, 2004). Finally, I build a recession dummy that takes the value of one in the two years following the start of an economic recession.

(iii) *External inducement.* International institutions or foreign aids can provide an equally important incentive to reform. For example, binding agreements with international lenders like the IMF or World Bank often require countries to commit to a particular set of policies. Among these, granting more independence to the central bank is often suggested (Gutierrez, 2003; Rodrik and Bank, 2006). Empirical evidence on the ability of such international institutions to provide the incentives to implement long-lasting reforms is mixed. For example, Alesina et al. (2006) find weak support for fiscal stabilization reforms following IMF programs, while Abiad and Mody (2005) and Gokmen et al. (2017) find a positive impact of IMF programs on the probability of undertaking reforms to liberalize financial markets or international trade.

I employ two proxies for external inducement. A dummy variable for IMF programs that takes value one in the two years following an IMF agreement. A second variable is represented by a currency union dummy that takes value one in the five years prior to joining a currency union. This second proxy is motivated by the reform process that took place in the EU, as prior to joining the European Monetary Union, countries are required to grant more independence to their central bank in order to align with the charter of the European Central Bank that follows the best practices in central bank independence.

(iv) *Ideology, political structure and institutional environment.* Reforms are also more likely following elections that lead to a political consolidation or to changes in the political

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orientation of the government. For example, only four days after the start of Tony Blair's mandate on May 6 1997, his new Chancellor, Gordon Brown, announced the intention of the government to implement the "most radical internal reform to the Bank of England since it was established in 1694". The level of democracy has also been shown to have a positive impact on the likelihood of implementing economic reforms in a country (see Giuliano et al., 2013, among others). Similarly, one can also argue that common law systems, which rely less on legislative processes or regulations issued by the executive branch, are less likely to reform their level of central bank independence (see La Porta et al., 1999; Masciandaro et al., 2008). To capture the political orientation of the government, I use a dummy variable for left-wing executive parties, while a proxy for democracy is taken from the Polity IV database.

(v) *Economic conditions.* Finally, while crises or periods of instability can potentially reduce the costs of reforms, the opposite view might apply as well. Reforms could also occur during periods of growth since wealthier economies may find it easier to compensate potential losers from the reform (Giuliano et al., 2013). Similarly, the degree of internationalization of a country and/or its willingness to attract international capital, may influence the likelihood of reforms. To capture countries' economic conditions, I use measures of GDP growth, openness to trade and an index of globalization.[11]

I describe the construction of all these variables in Appendix Table C1. Appendix Table C2 provides some summary statistics.

# 5   Determinants of reforms in central bank design

A reform in central bank design is defined as a change in the ECBI index over time: $\Delta ECBI_{i,t} = ECBI_{i,t} - ECBI_{i,t-1}$. Given the discrete, ordinal nature of the index (which is bounded between 0 – no independence – and 1 – full independence), the baseline estimation uses an ordered logit model that allows for multiple discrete outcomes to be ranked.[12] The

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[11]Previous findings such as Cukierman et al. (2002) suggest that the negative relationship between CBI and inflation is connected to the implementation of other sound economic policies together with central bank legislative reforms. Thus, countries characterized by a higher index of globalization and more open economies may also be more likely to reform their level of CBI. For example, Bodea and Hicks (2015) suggest that governments' decision to reform central bank legislation might be connected to the willingness of a country to attract more foreign investors. In such an environment, one might expect that the benefits of reforming are higher in economies more open to trade and/or globalized.

[12]As countries can also implement reforms that change the level of independence by only a small degree, I set the thresholds for the changes in ECBI to 0.05. This implies that a reform in central bank independence corresponds to a change in the index of, at least, 0.05. This slightly reduces the total number of reforms considered to 221. The results presented remain unchanged if all discrete changes in ECBI are considered.

baseline model is:

$$\Delta ECBI_{i,t} = \beta_1 ECBI_{i,t-1}(1 - ECBI_{i,t-1}) + \beta_2(REG_{t-1} - ECBI_{i,t-1}) +$$

$$\beta_3' \phi^{Crisis} + \beta_4' \phi^{International} + \beta_5' \phi^{Pol+} + \beta_6' \phi^{Econ} + \epsilon_{i,t}, \qquad (1)$$

where $ECBI_{i,t-1}(1 - ECBI_{i,t-1})$ is the proxy of domestic learning; $REG_{t-1} - ECBI_{i,t-1}$ is the proxy of regional learning; $\phi^{Crisis}$ is the vector of crisis variables; $\phi^{International}$ is the vector of external inducement variables; $\phi^{Pol}$ is a vector of political characteristics; and $\phi^{Econ}$ is the vector of economic variables. Most variables enter with a lag in the equation and reflect how conditions prior to the reform impacted the probability of a policy change.

The results of this baseline specification are presented in Table 3. Columns (1) to (4) gradually add the sets of covariates discussed in Section 4. Column (1) shows that countries exhibit a strong learning effect in adopting reforms. The coefficient of $ECBI_{i,t-1}(1 - ECBI_{i,t-1})$ is positive and significant, confirming the inverse U-shaped relationship between policy changes and the previous level of central bank independence. Thus, countries with a moderate level of ECBI have the highest likelihood of reforming their central bank legislation, while countries at the lower/higher end of the independence spectrum have the strongest status quo bias and are less likely to reform. Regional pressure appears equally important. The positive and significant sign of $REG_{i,t-1} - ECBI_{i,t-1}$ suggests that countries farther from the regional average level of CBI are more likely to reform their legislation. Column (2) considers the effect of crises/shocks. Contrary to popular belief, but in line with Gokmen et al. (2017), I find no evidence suggesting that harsh economic environments drive reforms. Column (3) adds the external inducement proxies and shows that legislative changes are more likely to happen within the two years following an IMF loan program. This is in line with expectations as the IMF is known to provide technical assistance to borrowing countries in order to help them adopt the best institutional standards (Lybek, 1999). For example, Gutierrez (2003) discusses how, in Latin America, central bank legislative reforms were often one of the conditions imposed by the IMF or the World Bank for the disbursement of loans.[13] The results presented in this paper confirm this anecdotical evidence and provide the first cross-sectional evidence of the importance of these international institutions in influencing institutional reforms over a large period

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[13]In robustness checks, I also consider a dummy variable for World Bank loan programs, however this variable is not included in the baseline specification due to its high collinearity with the IMF programs. These additional results are available upon request.

Table 3: Drivers of reforms in central bank design: ordered logit estimates

|  | | Full sample | | | Advanced | Developing |
|---|---|---|---|---|---|---|
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| $ECBI_{t-1}(1- ECBI_{t-1})$ | 2.404* | 2.506* | 4.503*** | 8.065*** | 8.378*** | 9.842*** |
|  | (1.456) | (1.410) | (1.180) | (1.561) | (2.421) | (2.380) |
| $REG_{t-1}- ECBI_{t-1}$ | 2.238*** | 2.242*** | 3.326*** | 3.157*** | 2.580*** | 3.824*** |
|  | (0.477) | (0.477) | (0.456) | (0.474) | (0.910) | (0.510) |
| Financial crisis |  | 0.189 | -0.006 | -0.103 | -0.348 | -0.022 |
|  |  | (0.256) | (0.247) | (0.250) | (0.540) | (0.285) |
| Inflation crisis |  | 0.097 | 0.084 | 0.134 | 0.562 | -0.030 |
|  |  | (0.236) | (0.265) | (0.270) | (0.632) | (0.303) |
| Recession |  | 0.027 | -0.085 | -0.011 | 0.191 | -0.068 |
|  |  | (0.156) | (0.161) | (0.176) | (0.286) | (0.228) |
| IMF programs |  |  | 0.633*** | 0.814*** | 1.203* | 0.713*** |
|  |  |  | (0.156) | (0.196) | (0.622) | (0.202) |
| Currency union |  |  | 3.312*** | 2.819*** | 2.826*** | 2.982*** |
|  |  |  | (0.189) | (0.223) | (0.343) | (0.332) |
| Left government$_t$ |  |  |  | 0.154 | 0.575* | -0.045 |
|  |  |  |  | (0.171) | (0.298) | (0.224) |
| Polity$_{t-1}$ |  |  |  | 0.024 | -0.137 | 0.033** |
|  |  |  |  | (0.016) | (0.091) | (0.017) |
| Common law |  |  |  | -0.476*** | -0.877*** | -0.344* |
|  |  |  |  | (0.175) | (0.312) | (0.204) |
| GDP growth$_{t-1}$ |  |  |  | 0.025*** | 0.071 | 0.023*** |
|  |  |  |  | (0.008) | (0.055) | (0.009) |
| Openness$_{t-1}$ |  |  |  | -0.001 | -0.002 | -0.001 |
|  |  |  |  | (0.002) | (0.002) | (0.002) |
| Globalization index$_{t-1}$ |  |  |  | 0.011 | 0.020 | 0.015 |
|  |  |  |  | (0.007) | (0.024) | (0.010) |
| Observations | 5,752 | 5,752 | 5,366 | 4,264 | 1,034 | 3,230 |
| Number of countries | 153 | 153 | 151 | 135 | 32 | 111 |

The dependent variable is $\Delta ECBI_{i,t}$. $ECBI_{t-1}(1-ECBI_{t-1})$ and $(REG_{t-1}-ECBI_{t-1})$ are the proxies of domestic and regional learning, respectively. *Financial crisis* is a dummy equal to one in the two years following a systemic banking crisis. *Inflation crisis* is a dummy equal to one if annual inflation rates higher than 40% are registered in the two years prior to a reform in year $t$. *Recession* is a dummy that takes the value of one in the two years following the start of a recession. *IMF programs* is a dummy equal to one in the two years following an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. *Left government* is a dummy that takes the value of one if a left-wing party is in power in year $t$. *Polity* is the Polity2 index of democracy. *Common law* is a dummy that takes value one for countries adopting common law system. *Openness* is the ratio of the sum of exports and imports to GDP. *Globalization index* is the value of the KOF index in the previous year. In Columns (5) and (6), the sample is restricted to advanced and developing countries, respectively. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denote significance at 1, 5 and 10 percent levels, respectively.

of time.[14] The results also confirm the positive relationship between the probability of reforms and the currency union dummy, suggesting that countries joining monetary unions are more likely to implement reforms.

Column (4) includes the full set of politico-economic variables. Governments' political orientation and the level of democracy do not affect the probability of reforming CBI, while, as expected, common law systems are characterized by a lower probability of reforming

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[14]Contrary to these findings, Berggren et al. (2016) find that obtaining an IMF loan increases the time it takes to reform. Their dependent variable is the number of years between 1980 and a reform year, where the reform year is self-reported by central banks through a survey. It is not clear, however, whether this self-reported measure captures the date of the largest reform or the latest reform. It also does not capture the magnitude of reforms as done in this paper.

their *de jure* level of central bank independence. Furthermore, high previous growth levels increase the likelihood of improving the level of CBI. Together with the low explanatory power of the crisis proxies, this evidence provides strong support for the argument that periods of boom foster reforms as richer countries might have more resources to compensate the potential losses from the reform (Giuliano et al., 2013). Lastly, other macroeconomic conditions, such as openness to trade or the level of globalization do not influence the probability of reforming central banks.

In Columns (5) and (6), the sample is split between advanced and developing countries, following the OECD classification. This distinction is useful to understand whether the results obtained are driven by a specific cluster of countries. Two important differences emerge from this split sample analysis. Among advanced economies, the presence of left governments, rather than previous growth levels, seem to matter more in the reform process. On the other hand, when restricting the sample to developing countries in Column (6), it is the level of democracy that is a strong predictor of reforms. This complements the evidence in Giuliano et al. (2013) who employ the Abiad et al. (2010) dataset to show that democracy matters for financial and product market reforms. The results in this paper point to a role of democracy for reforms in central banking, but only among developing countries.

Overall, the evidence presented in Table 3 points to a strong effect of learning and external factors in driving reforms in central bank design, with macroeconomic or political conditions playing a lesser role. To show that these strong effects do not hinder on the construction of the variables, Table 4 considers some alternative definitions for domestic and regional learning.

First, I introduce a more relaxed assumption regarding domestic learning that does not restrict the optimal level of CBI to the maximum value of 1. To still be able to account for a non-linear relationship between past reforms and the probability of policy changes, I include both the past levels of $ECBI_{t-1}$ and its squared value, $ECBI_{t-1}^2$. The results presented in Table 4 remain robust to this alternative specification. The coefficient of $ECBI$ is significant and positive across all specifications and suggests that higher levels of independence increase the likelihood of reforming. Yet, the squared value of the ECBI index is negative and strongly significant, suggesting that this relationship is indeed non-linear, since countries with very high levels of CBI are less likely to reform. Second, in Columns (5) to (8), I employ an alternative definition for the regional learning variable,

Table 4: Drivers of reforms in central bank design: alternative learning proxies

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| $\text{ECBI}_{t-1}$ | 6.287*** | 6.387*** | 8.686*** | 9.733*** | 6.323*** | 6.413*** | 8.544*** | 9.621*** |
| | (2.341) | (2.336) | (2.349) | (2.584) | (2.297) | (2.287) | (2.314) | (2.592) |
| $\text{ECBI}^2_{t-1}$ | -4.592** | -4.670*** | -6.879*** | -8.938*** | -4.480** | -4.549** | -6.690*** | -8.808*** |
| | (1.823) | (1.799) | (1.723) | (1.944) | (1.797) | (1.767) | (1.697) | (1.953) |
| $\text{REG}_{t-1} - \text{ECBI}_{t-1}$ | 3.548*** | 3.572*** | 4.744*** | 3.779*** | | | | |
| | (0.865) | (0.869) | (0.912) | (0.963) | | | | |
| $\text{REG2}_{t-1} - \text{ECBI}_{t-1}$ | | | | | 3.728*** | 3.754*** | 4.792*** | 3.823*** |
| | | | | | (0.894) | (0.899) | (0.937) | (0.973) |
| Financial crisis | | 0.164 | -0.055 | -0.115 | | 0.164 | -0.045 | -0.112 |
| | | (0.259) | (0.256) | (0.253) | | (0.258) | (0.255) | (0.252) |
| Inflation crisis | | 0.083 | 0.059 | 0.119 | | 0.092 | 0.083 | 0.126 |
| | | (0.234) | (0.263) | (0.267) | | (0.230) | (0.260) | (0.260) |
| Recession | | 0.078 | -0.038 | 0.002 | | 0.072 | -0.042 | -0.006 |
| | | (0.156) | (0.163) | (0.178) | | (0.156) | (0.163) | (0.178) |
| IMF programs | | | 0.669*** | 0.803*** | | | 0.647*** | 0.801*** |
| | | | (0.159) | (0.196) | | | (0.158) | (0.196) |
| Currency union | | | 3.263*** | 2.838*** | | | 3.262*** | 2.834*** |
| | | | (0.196) | (0.221) | | | (0.196) | (0.222) |
| Left government$_t$ | | | | 0.155 | | | | 0.152 |
| | | | | (0.169) | | | | (0.169) |
| Polity$_{t-1}$ | | | | 0.025 | | | | 0.024 |
| | | | | (0.016) | | | | (0.016) |
| Common law | | | | -0.470*** | | | | -0.497*** |
| | | | | (0.175) | | | | (0.175) |
| GDP growth$_{t-1}$ | | | | 0.025*** | | | | 0.025*** |
| | | | | (0.008) | | | | (0.008) |
| Openness$_{t-1}$ | | | | -0.001 | | | | -0.001 |
| | | | | (0.002) | | | | (0.002) |
| Globalization index$_{t-1}$ | | | | 0.009 | | | | 0.010 |
| | | | | (0.008) | | | | (0.008) |
| Observations | 5,752 | 5,752 | 5,366 | 4,264 | 5,770 | 5,770 | 5,384 | 4,280 |
| Number of countries | 153 | 153 | 151 | 135 | 153 | 153 | 151 | 135 |

The dependent variable is $\Delta\text{ECBI}_{i,t}$. $REG_{t-1}$ and $REG2_{t-1}$ are the average values of ECBI in the region using two definitions of regional clustering. *Financial crisis* is a dummy equal to one in the two years following a systemic banking crisis. *Inflation crisis* is a dummy equal to one if annual inflation rates higher than 40% are registered in the two years prior to a reform in year $t$. *Recession* is a dummy that takes the value of one in the two years following the start of a recession. *IMF programs* is a dummy equal to one in the two years following an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. *Left government* is a dummy that takes the value of one if a left-wing party is in power in year $t$. *Polity* is the Polity2 index of democracy. *Common law* is a dummy that takes value one for countries adopting common law system. *Openness* is the ratio of the sum of exports and imports to GDP. *Globalization index* is the value of the KOF index in the previous year. In Columns (5) and (6), the sample is restricted to advanced and developing countries, respectively. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denote significance at 1, 5 and 10 percent levels, respectively.

by classifying countries following Abiad and Mody (2005) and narrowing down the number of world regions. The results are unchanged using these alternative definitions. Moreover, the explanatory power of the other determinants of reforms is robust in this alternative specification as well.

Finally, I check the robustness of the baseline results to the econometric model employed. One alternative empirical strategy is to look at the probability of reforming without explicitly considering the size of the reform. More specifically, I estimate the following

model:

$$Prob(Reform_{i,t} = 1) = F(\beta_1 ECBI_{i,t-1}(1 - ECBI_{i,t-1}) + \beta_2(REG_{t-1} - ECBI_{i,t-1}) +$$
$$\beta_3' \phi^{Crisis} + \beta_4' \phi^{International} + \beta_5' \phi^{Pol+} + \beta_6' \phi^{Econ} + \epsilon_{i,t}), \qquad (2)$$

where $Reform_{i,t}$ is a reform dummy variable that takes the value 1 if country $i$ is experiencing a reform in year $t$. The methodology to estimate Equation (2) is determined by the shape of the cumulative distribution function, $F(\cdot)$. Under a standard logit estimation, $F(\cdot)$ is the cumulative logistic distribution, $F(z) = exp(z)/(1 + exp(z))$. However, since episodes of reforms occur irregularly (95% of the sample is zeros), $F(\cdot)$ is asymmetric. As such, a complementary logarithmic (or cloglog) framework is most appropriate by assuming that $F(\cdot)$ is the cumulative distribution function of the extreme value distribution:

$$F(z) = 1 - exp[-exp(z)]. \qquad (3)$$

The results obtained under these alternative econometric specifications are presented in Table 5. Columns (1) and (2) show the clogclog estimations, while Columns (3) and (4) show the logit ones. The two different definitions for domestic learning are also employed for each method. Overall, the results remain unchanged, and, for brevity, some of the politico-economic factors are omitted from Table 5.

Columns (5) and (6) in Table 5 present a simple OLS estimation employing $\Delta ECBI$ as dependent variable. This specification allows me to also control for country and time fixed effects. The results in Column (5) employing the baseline measure of domestic learning are qualitatively the same, while in Column (6) that controls for the lag and squared lag of the ECBI, the learning effect is less precisely estimated.

Overall, the results presented in Tables 4 and 5 show that domestic and regional learning, external pressure and economic growth are still significant drivers of reforms in central bank institutional design when employing a wide array of alternative econometric models and variable definitions. Having confirmed the robustness of the determinants of the timing of reforms, the next section looks more closely at the direction, magnitude and type of reforms.

Table 5: Drivers of reforms in central bank design: alternative specifications

| | Reform | | | | ΔECBI | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Cloglog | | Logit | | OLS | |
| $\text{ECBI}_{t-1}(1-\text{ECBI}_{t-1})$ | 3.693* | | 3.954* | | 0.054** | |
| | (2.011) | | (2.097) | | (0.025) | |
| $\text{ECBI}_{t-1}$ | | 5.393* | | 5.655* | | -0.040 |
| | | (2.910) | | (2.982) | | (0.048) |
| $\text{ECBI}^2_{t-1}$ | | -4.621** | | -4.852** | | -0.009 |
| | | (2.342) | | (2.404) | | (0.029) |
| $\text{REG}_{t-1}-\text{ECBI}_{t-1}$ | 1.979*** | 2.590*** | 2.042*** | 2.681*** | 0.083*** | 0.046** |
| | (0.524) | (0.897) | (0.543) | (0.942) | (0.011) | (0.023) |
| Financial crisis | 0.290 | 0.277 | 0.333 | 0.324 | -0.001 | -0.001 |
| | (0.198) | (0.199) | (0.207) | (0.207) | (0.002) | (0.002) |
| Inflation crisis | 0.074 | 0.059 | 0.086 | 0.071 | -0.001 | -0.001 |
| | (0.305) | (0.305) | (0.314) | (0.314) | (0.004) | (0.004) |
| Recession | -0.056 | -0.042 | -0.045 | -0.029 | 0.001 | 0.001 |
| | (0.174) | (0.175) | (0.181) | (0.182) | (0.001) | (0.001) |
| IMF programs | 0.622*** | 0.607*** | 0.639*** | 0.625*** | 0.004** | 0.004** |
| | (0.189) | (0.189) | (0.195) | (0.195) | (0.002) | (0.002) |
| Currency union | 2.061*** | 2.077*** | 2.231*** | 2.248*** | 0.044*** | 0.044*** |
| | (0.235) | (0.236) | (0.263) | (0.264) | (0.006) | (0.006) |
| GDP growth$_{t-1}$ | 0.017* | 0.017* | 0.019* | 0.018* | 0.001 | 0.001 |
| | (0.010) | (0.010) | (0.011) | (0.011) | (0.001) | (0.001) |
| Additional controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE | | | | | Yes | Yes |
| Year FE | | | | | Yes | Yes |
| Observations | 4,264 | 4,264 | 4,264 | 4,264 | 4,264 | 4,264 |
| R-squared | | | | | 0.104 | 0.106 |
| Number of countries | 135 | 135 | 135 | 135 | 135 | 135 |

The dependent variable in Columns (1)-(4) is *Reform*, a dummy that takes value one in the years in which a reform that modified the degree of the ECBI index took place. In Columns (5)-(6), the dependent variable is *ΔECBI*. *Financial crisis* is a dummy equal to one in the two years following a systemic banking crisis. *Inflation crisis* is a dummy equal to one if annual inflation rates higher than 40% are registered in the two years prior to a reform in year *t*. *Recession* is a dummy that takes the value of one in the two years following the start of a recession. *IMF programs* is a dummy equal to one in the two years following an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. Additional controls include: *Left government*, *Polity*, *Common law*, *Openness* and *Globalization index*. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denote significance at 1, 5 and 10-percent levels, respectively.

## 5.1 Direction and magnitude of reforms

The process of reforming the institutional design of central banks generally unfolds over several stages and a long period of time. The extended index of central bank independence constructed allows me to identify the exact magnitude and direction of reforms at each moment the central bank legislation is amended. As such, a natural question is whether the determinants of reforms, as previously identified, can explain both reforms that increase as well as those that decrease the level of independence. Hence, in Table 6, I estimate Equation (2) for positive and negative changes in ECBI, separately. Columns (1) and (2) look at the probability of implementing a reform that increases the level of ECBI, employing,

Table 6: Sign and magnitude of reforms

| | $Reform > 0$ | | $Reform < 0$ | | $Large\ Reform > 0.10$ | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $ECBI_{t-1}*(1-ECBI_{t-1})$ | 7.761*** | | -3.963 | | 19.220*** | |
| | (2.565) | | (4.146) | | (4.778) | |
| $ECBI_{t-1}$ | | 10.232*** | | -2.785 | | 21.970*** |
| | | (3.575) | | (6.935) | | (5.914) |
| $ECBI^2_{t-1}$ | | -9.150*** | | 3.343 | | -20.788*** |
| | | (2.963) | | (5.113) | | (5.187) |
| $REG_{t-1}-ECBI_{t-1}$ | 3.033*** | 3.871*** | -2.417* | -1.980 | 4.326*** | 5.184*** |
| | (0.591) | (0.993) | (1.451) | (2.496) | (0.825) | (1.332) |
| Financial crisis | 0.103 | 0.082 | 0.777* | 0.774* | 0.005 | -0.018 |
| | (0.230) | (0.231) | (0.402) | (0.402) | (0.299) | (0.300) |
| Inflation crisis | 0.088 | 0.069 | -0.106 | -0.116 | 0.057 | 0.045 |
| | (0.336) | (0.336) | (0.740) | (0.741) | (0.435) | (0.435) |
| Recession | -0.046 | -0.027 | 0.033 | 0.037 | -0.018 | 0.001 |
| | (0.194) | (0.195) | (0.394) | (0.394) | (0.254) | (0.255) |
| IMF programs | 0.922*** | 0.900*** | -0.266 | -0.268 | 1.175*** | 1.156*** |
| | (0.220) | (0.220) | (0.404) | (0.403) | (0.298) | (0.297) |
| Currency Union | 2.509*** | 2.546*** | | | 2.526*** | 2.584*** |
| | (0.257) | (0.260) | | | (0.343) | (0.352) |
| $Polity_{t-1}$ | 0.024 | 0.025 | -0.021 | -0.021 | 0.057** | 0.058** |
| | (0.018) | (0.018) | (0.034) | (0.034) | (0.024) | (0.024) |
| GDP growth$_{t-1}$ | 0.024** | 0.024** | -0.008 | -0.008 | 0.030** | 0.029** |
| | (0.010) | (0.010) | (0.028) | (0.028) | (0.012) | (0.012) |
| Additional controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 4,264 | 4,264 | 4,138 | 4,138 | 4,264 | 4,264 |
| Number of countries | 135 | 135 | 135 | 135 | 135 | 135 |

The dependent variable is a dummy that takes value one in years in which a reform that modified the degree of the ECBI index. Columns (1) and (2) only considers country-years in which a positive change to the level of the ECBI index took place ($Reform > 0$), Columns (3) and (4) focus on reversals in CBI ($Reform < 0$), while the dependent variable in Columns (5) and (6) is a dummy that takes the value one only in years where large reforms in independence occurred ($Large\ Reform > 0.10$). *Financial crisis* is a dummy equal to one in the two years following a systemic banking crisis. *Inflation crisis* is a dummy equal to one if annual inflation rates higher than 40% are registered in the two years prior to a reform in year $t$. *Recession* is a dummy that takes the value of one in the two years following the start of a recession. *IMF programs* is a dummy equal to one in the two years following an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. Additional controls include: *Left government*, *Common law*, *Openness* and *Globalization index*. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denote significance at 1, 5 and 10-percent levels, respectively.

as before, the two alternative specifications for domestic learning. The cloglog model is used, but results are the same under a logit estimation. Give the trend of increasing the levels of CBI across most countries, not surprisingly, I find that the same factors matter for the probability of positive reforms as in the baseline estimations on the entire set of reforms. However, important differences emerge when restricting the attention to reforms that decrease the degree of CBI. First, the status quo bias does not seem to matter for the probability of reversals. Second, regional learning still matters, but with the opposite sign, suggesting that reforms that decrease the degree of central bank independence are less likely to occur in countries that are far away from the average level of independence in the

region. Third, financial crises, which had little impact on the overall likelihood of adopting reforms, do seem to influence the probability of reducing the level of independence. Having experienced a financial crisis in the previous two years increases the probability of implementing a reversal in the level of CBI. This is in line with the findings in Masciandaro and Romelli (2018), who show that crises increase the likelihood of assigning the responsibility of financial sector supervision to central banks, which, in the ECBI index, would correspond to a reduction in independence. Along the same lines, external inducements and growth level do not seem to matter when looking at negative reforms.

Finally, in Columns (5) and (6), I look at the magnitude of reforms and consider only large reforms, i.e. those that increase the level of the ECBI by more than 0.10 points. The determinants of these type of reforms are in line with the results obtained thus far and confirm that the findings are not driven by smaller reforms, which may be more frequent. The index of democracy also enters now significantly, in line with the results obtained in Table 3 for the sample of developing economies. This suggests that larger reforms are most likely undertaken by less developed economies with higher levels of democracy.

Overall, these results stress the richer implications derived when looking at the size and sign of reforms as opposed to a simple dummy variable that captures the timing of reforms. The next section takes the analysis further by looking at amendments adduced to specific sections of the central bank charter.

## 5.2 Types of reforms

The construction of a dynamic index of central bank independence has highlighted the large number of changes to the design of these institutions over the past four decades . However, one might wonder whether reforms shape all aspects of the institutional framework of central banks or are mainly focused on a particular function. I explore this possibility by looking at the drivers of reforms along the six categories of the ECBI index: 1) Governor and central bank board, 2) Monetary policy and conflicts resolution, 3) Objectives, 4) Limitations on lending to the government, 5) Financial independence and 6) Reporting and accountability. Similar to the baseline analysis, the dependent variable is the change in the level of central bank independence in year $t$ in country $i$ for each dimension $d$ of the ECBI index. I first compute the average score for each of the six subcategories and normalize it between 0 and 1. Then, I measure the change in the independence score between year $t$ and year $t-1$ for each dimension.

Figure 4: Legislative reforms by subcategories (1972-2017)



Source: Authors' calculations
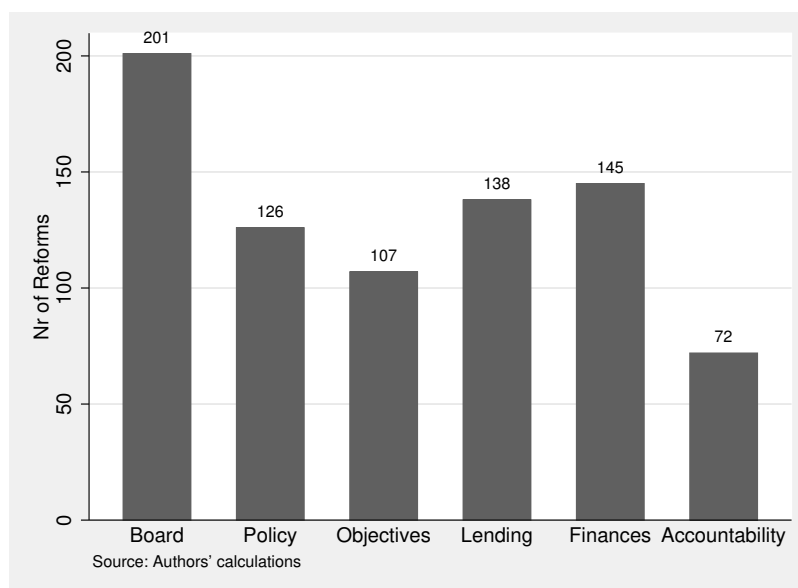
Each bar indicates the number of reforms undertaken for the different dimensions of the ECBI index. *Board* relates to governor and central bank board; *Policy*: monetary policy and conflicts resolution. *Objectives*: monetary policy objectives. *Lending*: limitations on lending to the government. *Finances*: financial independence. *Accountability*: reporting and accountability.

Figure 4 displays the distribution of reforms across the dimensions of central bank independence over the period 1972-2017. Reforms related to central bank governance (Governor and central bank board) are the most common, while those related to reporting and accountability are the least common. Moreover, if I look at each of the 42 questions codified in the construction of the ECBI index, the one that has been modified the most was, interestingly, the one related to the objective of monetary policy. This suggests that the reforms captured modify significant aspects of the functioning of central banks and confirms the increasing focus on the goal of price stability over the past four decades.

The results pertaining to the ordered logit model in Equation (1) for each dimension of the ECBI index are presented in Table 7. To obtain consistent econometric tests, I also recompute the two proxies of domestic and regional learning for each dimension. The proxy for regional learning is still strongly significant across all specifications, while previous reforms matter less for changes in the degree of central bank governance (Columns (1) and (2)). Regarding the other determinants of reforms, the results are similar to the ones obtained for the aggregated ECBI index (presented in Table 3), with a few notable differences. First, in the previous sections, I found no support for the hypothesis that crises drive reforms. However, when looking at the different dimensions of central bank design, I find that financial crises are likely to be followed by reductions in monetary policy (Column

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Table 7: Ordered Logit estimates: sub-categories

| | ΔBoard | | ΔMon. Policy | | ΔObjectives | | ΔLending | | ΔFinancial Ind. | | ΔReport & Acc. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| $\text{CBI}_{t-1}*(1\text{-CBI}_{t-1})$ | 1.107 | -0.370 | 5.467** | 6.258** | 2.283* | 4.762*** | 3.427*** | 5.318*** | 3.138* | 3.530 | 3.252*** | 7.647*** |
| | (0.947) | (1.192) | (2.516) | (2.513) | (1.198) | (1.305) | (0.942) | (1.324) | (1.857) | (3.323) | (0.936) | (2.664) |
| $\text{REG}_{t-1}\text{-CBI}_{t-1}$ | 3.010*** | 2.614*** | 4.115*** | 4.276*** | 3.208*** | 3.615*** | 1.413*** | 2.136*** | 1.140* | 0.547 | 1.803*** | 2.028** |
| | (0.475) | (0.572) | (0.606) | (0.548) | (0.740) | (0.392) | (0.356) | (0.445) | (0.639) | (0.932) | (0.381) | (0.935) |
| Financial crisis | | 0.412 | | -0.999*** | | -0.133 | | 0.115 | | -0.807* | | 1.038*** |
| | | (0.270) | | (0.387) | | (0.329) | | (0.302) | | (0.453) | | (0.396) |
| Inflation crisis | | 0.013 | | -0.212 | | 0.254 | | 0.101 | | 0.306 | | -0.851 |
| | | (0.389) | | (0.343) | | (0.363) | | (0.455) | | (0.671) | | (0.742) |
| Recession | | -0.167 | | -0.001 | | 0.231 | | -0.058 | | 0.147 | | 0.519 |
| | | (0.197) | | (0.190) | | (0.249) | | (0.222) | | (0.285) | | (0.366) |
| IMF programs | | 0.438* | | 0.946*** | | 1.025*** | | 1.114*** | | 0.267 | | 0.217 |
| | | (0.244) | | (0.210) | | (0.298) | | (0.280) | | (0.329) | | (0.349) |
| Currency union | | 2.476*** | | 2.246*** | | 3.010*** | | 2.447*** | | 1.764*** | | 1.452* |
| | | (0.229) | | (0.319) | | (0.275) | | (0.301) | | (0.592) | | (0.831) |
| Additional controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,752 | 4,264 | 5,752 | 4,264 | 5,752 | 4,264 | 5,752 | 4,264 | 5,752 | 4,264 | 5,752 | 4,264 |
| Number of countries | 153 | 135 | 153 | 135 | 153 | 135 | 153 | 135 | 153 | 135 | 153 | 135 |

The dependent variable is the change in dimension $d$ of the ECBI index, $\Delta\text{ECBI}_{d,i,t}$. *Financial crisis* is a dummy equal to one in the two years following a systemic banking crisis. *Inflation crisis* is a dummy equal to one if annual inflation rates higher than 40% are registered in the two years prior to a reform in year $t$. *Recession* is a dummy that takes the value of one in the two years following the start of an economic recession. IMF programs takes value one in the two years following an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. Additional controls include: *Left government*, *Openness*, *Common law* and *Globalization index*. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denote significance at 1, 5 and 10-percent levels, respectively.

(4)) and financial independence (Column (10)), and increases in central bank accountability (Column (12)). These reforms mainly concern the involvement of central banks in banking sector supervision and the distribution of profits to the Government, both of which are more likely to increase following financial crises. While much anecdotal evidence discusses these trends in central bank design following financial crises, this is the first paper to document these empirical patterns in a large cross-section of countries.

Second, the coefficient of the IMF loan dummy is significant for the first four dimensions only. This might be related to the set of guidelines used by the IMF to provide technical assistance to countries, where marginal importance is assigned to central bank financial independence and accountability (Lybek, 1999).

## 5.3 Democratization and reforms

Previous studies have documented how structural reforms and democratization sometimes come in waves (see Giavazzi and Tabellini, 2005; Giuliano et al., 2013; Acemoglu et al., 2018, among others). The results presented do not show a strong effect of democracy, as captured by the Polity2 index. However, the ordinal nature of this index does not reflect a clear distinction between authoritarian regimes and democracies. To overcome this issue, I follow Giavazzi and Tabellini (2005) and create a democracy variable dummy that takes the value of one for strictly positive values of the Polity2 score.

The results using this alternative definition of democracy are presented in Table 8. Columns (1) to (3) present the estimates for the ordered logit, cloglog and OLS estimations, respectively. While the effect of the other covariates remain robust to the inclusion of this alternative measure, the democracy dummy variable is still not statistically significant.

An alternative approach is to analyze whether episodes of democratization are followed by changes in the institutional design of central banks. To do so, I create a dummy variable that takes the value of one in the first year in which a country moves from an autocracy (democracy$_{t-1}$=0, i.e. polity2 values lower of equal 0) to a democracy (democracy$_t$=1, i.e. strictly positive values of polity2).

The results employing this alternative proxy of democracy are presented in Columns (4) to (6), using three different econometric techniques: ordered logit, cloglog, OLS. The positive and statistically significant sign of the democratic reform dummy variable across all specifications implies that the process of democratization is accompanied by reforms in central bank institutional design. This suggests that the degree of independence of

Table 8: Central bank design and democracy

|  | (1) $\Delta$ECBI | (2) $Reform$ | (3) $\Delta$ECBI | (4) $\Delta$ECBI | (5) $Reform$ | (6) $\Delta$ECBI |
|---|---|---|---|---|---|---|
| $\text{ECBI}_{t-1}*(1-\text{ECBI}_{t-1})$ | 7.941*** | 3.633* | 0.055** | 8.056*** | 3.760* | 0.058** |
|  | (1.549) | (2.009) | (0.025) | (1.553) | (1.993) | (0.024) |
| $\text{REG}_{t-1}-\text{ECBI}_{t-1}$ | 3.153*** | 1.969*** | 0.083*** | 3.096*** | 1.914*** | 0.082*** |
|  | (0.478) | (0.525) | (0.011) | (0.463) | (0.521) | (0.011) |
| $\text{Democracy}_t$ | 0.240 | 0.120 | 0.002 |  |  |  |
|  | (0.205) | (0.207) | (0.003) |  |  |  |
| $\text{Democratic Reform}_t$ |  |  |  | 1.508*** | 1.403*** | 0.024** |
|  |  |  |  | (0.519) | (0.373) | (0.011) |
| IMF programs | 0.829*** | 0.632*** | 0.004** | 0.845*** | 0.634*** | 0.005** |
|  | (0.195) | (0.189) | (0.002) | (0.194) | (0.188) | (0.002) |
| Currency union | 2.841*** | 2.077*** | 0.043*** | 2.871*** | 2.089*** | 0.043*** |
|  | (0.223) | (0.235) | (0.006) | (0.221) | (0.234) | (0.006) |
| $\text{GDP growth}_{t-1}$ | 0.026*** | 0.017* | 0.001 | 0.026*** | 0.018* | 0.001 |
|  | (0.009) | (0.010) | (0.001) | (0.008) | (0.010) | (0.001) |
| Additional controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Country FE |  |  | Yes |  |  | Yes |
| Year FE |  |  | Yes |  |  | Yes |
| Observations | 4,263 | 4,263 | 4,263 | 4,260 | 4,260 | 4,260 |
| R-squared |  |  | 0.104 |  |  | 0.109 |
| Number of countries | 135 | 135 | 135 | 135 | 135 | 135 |

The dependent variable is $\Delta ECBI$ in Columns (1), (3), (4) and (6) and $Reform$, a dummy that takes value one in years in which a reform that modified the degree of Central Bank Independence index takes place, in Columns (2) and (5). *Democracy* is a dummy variable that assumes the value of one for positive values of the Polity2 score. *Democratic reforms* is a dummy variable that takes the value one whether the country moved from an autocracy (democracy$_{t-1}$=0) to a democracy (democracy$_t$=1) in the current year. *IMF Programs* is a dummy that takes the value one if an IMF loan program has been in place in the two previous years. *Currency union* is a dummy variable that assumes value one in the five years prior to joining a currency union. Additional controls include: *Financial crisis*, *Inflation crisis*, *Recession*, *Left government*, *Openness*, *Common law* and *Globalization index*. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denote significance at 1, 5 and 10-percent levels, respectively.

monetary policy institutions is an important aspect of the process towards a full democracy.

## 5.4   Crises, IMF programs and reforms

The results shown so far cast doubts on the conventional wisdom that "it takes a crisis to reform". To show the robustness of these findings, I follow Gokmen et al. (2017) and combined the three measures of crises, i.e. financial crisis, recession and inflation crisis, into a single crisis measure. This new dummy variable takes the value of one in the two years following any type of crisis episode.

The results using this alternative definition of crises are presented in Table 9. In Column (1), I estimate the baseline model in Equation (1), over the full sample, while in Columns (2) and (3), the sample is split between advanced and developing countries. The sign and statistical significance of all control variables remain unchanged, however the aggregated crisis variable is still statistically insignificant. A potential concern related to the lack of a

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Table 9: Other robustness tests

| | Full sample (1) | Advanced (2) | Developing (3) | Full sample (4) | Advanced (5) | Developing (6) |
|---|---|---|---|---|---|---|
| $\text{ECBI}_{t-1}*(1-\text{ECBI}_{t-1})$ | 8.041*** | 8.424*** | 9.756*** | 7.252*** | 8.574*** | 8.603*** |
| | (1.562) | (2.480) | (2.345) | (1.509) | (2.459) | (2.205) |
| $\text{REG}_{t-1}-\text{ECBI}_{t-1}$ | 3.168*** | 2.448*** | 3.835*** | 3.065*** | 2.340*** | 3.749*** |
| | (0.473) | (0.863) | (0.498) | (0.494) | (0.869) | (0.515) |
| Crisis | 0.045 | 0.115 | 0.019 | 0.116 | 0.193 | 0.102 |
| | (0.154) | (0.304) | (0.176) | (0.152) | (0.282) | (0.177) |
| IMF programs | 0.798*** | 1.155** | 0.704*** | | | |
| | (0.192) | (0.539) | (0.199) | | | |
| IMF programs (random) | | | | 0.067 | 0.065 | 0.048 |
| | | | | (0.160) | (0.304) | (0.185) |
| Currency Union | 2.811*** | 2.831*** | 2.970*** | 2.668*** | 2.706*** | 2.761*** |
| | (0.226) | (0.347) | (0.325) | (0.219) | (0.351) | (0.268) |
| Left government$_t$ | 0.160 | 0.560* | -0.047 | 0.107 | 0.560* | -0.115 |
| | (0.169) | (0.302) | (0.221) | (0.174) | (0.314) | (0.226) |
| Polity$_{t-1}$ | 0.025 | -0.130 | 0.033** | 0.033** | -0.139* | 0.042*** |
| | (0.016) | (0.097) | (0.017) | (0.015) | (0.082) | (0.016) |
| Common law | -0.470*** | -0.853*** | -0.346* | -0.519*** | -0.896*** | -0.409* |
| | (0.174) | (0.310) | (0.203) | (0.184) | (0.314) | (0.216) |
| GDP growth$_{t-1}$ | 0.026*** | 0.086 | 0.023*** | 0.021** | 0.081 | 0.019** |
| | (0.008) | (0.056) | (0.008) | (0.009) | (0.057) | (0.008) |
| Openness$_{t-1}$ | -0.001 | -0.003 | -0.001 | 0.001 | -0.002 | -0.001 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.003) | (0.002) |
| Globalization index$_{t-1}$ | 0.011 | 0.017 | 0.015 | -0.002 | 0.007 | 0.007 |
| | (0.007) | (0.024) | (0.010) | (0.006) | (0.022) | (0.009) |
| Observations | 4,264 | 1,034 | 3,230 | 4,264 | 1,034 | 3,230 |
| Number of countries | 135 | 32 | 111 | 135 | 32 | 111 |

The dependent variable is $\Delta ECBI_t$. *Crisis* is a dummy equal to one in the two years following any of the following crises: systemic banking crisis, inflation crisis or recessions. *IMF programs* is a dummy equal to one in the two years following an IMF loan program. *IMF programs (random)* is a randomly assigned date of an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. *Left government* is a dummy that takes the value of one if a left-wing party is in power in year $t$. *Polity* is the Polity2 index of democracy. *Common law* is a dummy that takes value one for countries adopting common law system. *Openness* is the ratio of the sum of exports and imports to GDP. *Globalization index* is the value of the KOF index in the previous year. In Columns (2) and (5) the sample is restricted to advanced economies, while in Columns (3) and (6) it focuses exclusively on developing countries. Robust standard errors in parentheses, adjusted for clustering by country. \*\*\*/\*\*/\* denote significance at 1, 5 and 10 percent levels, respectively.

crisis-reform hypothesis is that the IMF program dummy variables may partially capture the effect of a crisis, as these interventions are likely to follow crisis episodes. One way to test the importance of the IMF programs over the crisis effect is to assign a random date for IMF programs. Columns (4) to (6) in Table 9 present the results obtained from the randomization of IMF programs for the full sample (Column (4)), the subsample of advanced (Column (5)) and developing (Column (6)) countries. The lack of significance of the randomized IMF loan variable confirms the importance of the external inducement played by the IMF. Moreover, this placebo test also confirms the lack of a robust relationship between the occurrence of crises and reforms in central bank institutional design.[15]

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[15]Further robustness tests have been run by excluding the IMF programs control variable from the different estimations. Also in these cases, I find no evidence of the crisis-reform hypothesis.

# 6 Concluding remarks

This paper uses a political economy framework to investigate the drivers of reforms in central bank design in a set of 154 countries over the period 1972-2017. Employing a comprehensive survey of central bank design, it documents 2490 legislative changes over this time frame. Yet, to gauge whether these reforms had a significant impact on the design of central banks, I restrict the analysis to reforms that modify the degree of central bank independence, which has long been considered the optimal institutional setting of monetary policy authorities. I propose a new index of central bank independence that incorporates and extends previous indices by including new information on central bank financial independence and accountability.

Employing this dynamic index, I document several new stylized facts about the evolution of central bank design, including an increase in the level of independence across time, several waves of reforms such as the ones that followed the 2008-09 global financial crisis, as well as a still significant cross-country variation in the level of central bank independence.

Looking at the determinants behind the many reforms central banks have implemented over the past four decades, I find a strong a learning effect. This is captured by a dynamic inverse U-shaped relationship between the level of independence and subsequent reforms. The likelihood of reforms is also influenced by regional converge and international pressures to reform such as receiving an IMF loan or joining a monetary union. However, the political orientation of the government or other institutional factors such as openness or the level of democracy matter less. Finally, the results also show that crises only drive reforms which decrease the level of CBI, while periods of growth are more conducive to increases in CBI.

The empirical investigation proposed in this paper, although focused on central bank reforms, contributes to a broader political economy literature on the endogenous evolution of political institutions. The results obtained reinforce some widely held conclusions, such as the importance of external inducements in reforming central banks, but also shed light on some ambiguities in the literature such as the role of crises or of the status quo level of independence. The analysis not only sheds light on the endogenous evolution of central banks, but also provides a useful time-varying instrument of institutional design. Future empirical analysis should therefore allow for a dynamic specification of the reform process and employ dynamic indices of central bank independence.

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Table A1: Analyzed countries

| Countries, year of first analyzed legislation and region (geo-political area) | | | | | |
|---|---|---|---|---|---|
| Afghanistan | 2003 | Middle East & the North of Africa | Dominica | 1983 | Latin America & the Caribbean |
| Albania | 1992 | Europe & Central Asia | Dominican Republic | 1959 | Latin America & the Caribbean |
| Algeria | 1962 | Middle East & the North of Africa | Ecuador | 1957 | Latin America & the Caribbean |
| Angola | 1997 | Africa | Egypt | 1957 | Middle East & the North of Africa |
| Anguilla | 1987 | Latin America & the Caribbean | Equatorial Guinea | 1972 | Africa |
| Antigua and Barbuda | 1983 | Latin America & the Caribbean | Estonia | 1993 | Europe & Central Asia |
| Argentina | 1935 | Latin America & the Caribbean | Ethiopia | 1994 | Africa |
| Australia | 1959 | Western Europe & other developed countries | Finland | 1966 | Western Europe & other developed countries |
| Austria | 1955 | Western Europe & other developed countries | France | 1936 | Western Europe & other developed countries |
| Azerbaijan | 1996 | Europe & Central Asia | Gabon | 1972 | Africa |
| Bahrain | 1973 | Middle East & the North of Africa | Gambia | 1971 | Africa |
| Bangladesh | 2003 | South Asia | Georgia | 1995 | Europe & Central Asia |
| Belarus | 1990 | Europe & Central Asia | Germany | 1957 | Western Europe & other developed countries |
| Belgium | 1948 | Western Europe & other developed countries | Ghana | 1975 | Africa |
| Benin | 1956 | Africa | Greece | 1959 | Western Europe & other developed countries |
| Bolivia | 1945 | Latin America & the Caribbean | Grenada | 1983 | Latin America & the Caribbean |
| Bosnia and Herzegovina | 1997 | Europe & Central Asia | Guatemala | 1959 | Latin America & the Caribbean |
| Botswana | 1975 | Africa | Guinea | 1994 | Africa |
| Brazil | 1964 | Latin America & the Caribbean | Haiti | 1979 | Latin America & the Caribbean |
| Brunei | 1984 | East Asia & the Pacific | Hungary | 1991 | Europe & Central Asia |
| Bulgaria | 1991 | Europe & Central Asia | Iceland | 1966 | Western Europe & other developed countries |
| Burkina Faso | 1956 | Africa | India | 1934 | South Asia |
| Burundi | 1965 | Africa | Indonesia | 1953 | East Asia & the Pacific |
| Cambodia | 1954 | East Asia & the Pacific | Iran | 1972 | Middle East & the North of Africa |
| Cameroon | 1972 | Africa | Iraq | 1964 | Middle East & the North of Africa |
| Canada | 1954 | Western Europe & other developed countries | Ireland | 1942 | Western Europe & other developed countries |
| Central African Republic | 1972 | Africa | Italy | 1948 | Western Europe & other developed countries |
| Chad | 1972 | Africa | Ivory Coast | 1956 | Africa |
| Chile | 1953 | Latin America & the Caribbean | Jamaica | 1992 | Latin America & the Caribbean |
| China | 1995 | East Asia & the Pacific | Japan | 1957 | Western Europe & other developed countries |
| Colombia | 1923 | Latin America & the Caribbean | Jordan | 1971 | Middle East & the North of Africa |
| Comoros | 1987 | Africa | Kazakhstan | 1993 | Europe & Central Asia |
| Costa Rica | 1953 | Latin America & the Caribbean | Kenya | 1984 | Africa |
| Croatia | 1991 | Europe & Central Asia | Kuwait | 1968 | Middle East & the North of Africa |
| Cuba | 1959 | Latin America & the Caribbean | Kyrgyzstan | 1992 | Europe & Central Asia |
| Cyprus | 1963 | Western Europe & other developed countries | Laos | 1995 | East Asia & the Pacific |
| Czech Republic | 1991 | Europe & Central Asia | Latvia | 1992 | Europe & Central Asia |
| Democratic Republic of the Congo | 1993 | Africa | Lebanon | 1969 | Middle East & the North of Africa |
| Denmark | 1942 | Western Europe & other developed countries | Liberia | 1974 | Africa |

Table A1 Continued: Analyzed countries

| Countries, year of first analyzed legislation and region (geo-political area) | | | | | |
|---|---|---|---|---|---|
| Libya | 1996 | Middle East & the North of Africa | Saint Kitts and Nevis | 1983 | Latin America & the Caribbean |
| Lithuania | 1994 | Europe & Central Asia | Saint Lucia | 1983 | Latin America & the Caribbean |
| Luxembourg | 1983 | Western Europe & other developed countries | Saint Vincent and the Grenadines | 1983 | Latin America & the Caribbean |
| Macao S.A.R | 2000 | East Asia & the Pacific | Saudi Arabia | 1957 | Middle East & the North of Africa |
| Macedonia | 1992 | Europe & Central Asia | Senegal | 1956 | Africa |
| Malawi | 1989 | Africa | Seychelles | 1986 | Africa |
| Malaysia | 1982 | East Asia & the Pacific | Sierra Leone | 1963 | Africa |
| Maldives | 1982 | South Asia | Singapore | 1991 | East Asia & the Pacific |
| Mali | 1984 | Africa | Slovakia | 1992 | Europe & Central Asia |
| Malta | 1994 | Western Europe & other developed countries | Slovenia | 1991 | Europe & Central Asia |
| Mauritania | 1956 | Africa | Somalia | 1960 | Africa |
| Mauritius | 1966 | Africa | South Africa | 1956 | Africa |
| Mexico | 1960 | Latin America & the Caribbean | South Korea | 1950 | East Asia & the Pacific |
| Moldova | 1992 | Europe & Central Asia | Spain | 1962 | Western Europe & other developed countries |
| Mongolia | 1996 | East Asia & the Pacific | Sri Lanka | 1953 | South Asia |
| Montenegro | 2005 | Europe & Central Asia | Sweden | 1966 | Western Europe & other developed countries |
| Morocco | 1959 | Middle East & the North of Africa | Switzerland | 1953 | Western Europe & other developed countries |
| Myanmar | 1952 | East Asia & the Pacific | Taiwan | 1979 | East Asia & the Pacific |
| Namibia | 1990 | Africa | Thailand | 1942 | East Asia & the Pacific |
| Nepal | 1955 | South Asia | The Bahamas | 1974 | Latin America & the Caribbean |
| Netherlands | 1948 | Western Europe & other developed countries | Togo | 1956 | Africa |
| New Zealand | 1933 | Western Europe & other developed countries | Trinidad and Tobago | 1964 | Latin America & the Caribbean |
| Niger | 1956 | Africa | Tunisia | 1958 | Middle East & the North of Africa |
| Nigeria | 1969 | Africa | Turkey | 1970 | Europe & Central Asia |
| Norway | 1966 | Western Europe & other developed countries | Turkmenistan | 1994 | Europe & Central Asia |
| Oman | 2000 | Middle East & the North of Africa | Uganda | 1966 | Africa |
| Pakistan | 1972 | South Asia | Ukraine | 1991 | Europe & Central Asia |
| Panama | 1941 | Latin America & the Caribbean | United Arab Emirates | 1980 | Middle East & the North of Africa |
| Paraguay | 1952 | Latin America & the Caribbean | United Kingdom | 1946 | Western Europe & other developed countries |
| Peru | 1962 | Latin America & the Caribbean | United Republic of Tanzania | 1966 | Africa |
| Philippines | 1948 | East Asia & the Pacific | United States of America | 1951 | Western Europe & other developed countries |
| Poland | 1997 | Europe & Central Asia | Uruguay | 1938 | Latin America & the Caribbean |
| Portugal | 1962 | Western Europe & other developed countries | Uzbekistan | 2000 | Europe & Central Asia |
| Qatar | 1993 | Middle East & the North of Africa | Venezuela | 1939 | Latin America & the Caribbean |
| Republic of Congo | 1972 | Africa | Vietnam | 1990 | East Asia & the Pacific |
| Romania | 1991 | Europe & Central Asia | Yemen | 1971 | Middle East & the North of Africa |
| Russia | 1992 | Europe & Central Asia | Zambia | 1971 | Africa |
| Rwanda | 1997 | Africa | Zimbabwe | 1956 | Africa |

# A    Main guidelines for constructing the ECBI Index

- **Governor and central bank board**. In many countries the governor and other senior officials of the central bank are appointed through a governmental process. However, in order to assure some measures of balance, the *appointment* of the governor should be done by separate bodies. In an optimal institutional settings, the *term of office* of the governor and board members should be longer than the electoral cycle, while their *reappointment* should be limited in order to avoid the favoring of politicians who decide on reappointment. In order to foster continuity and renewal, the central bank legislation might also require a *staggering of terms* for senior central bankers. This requirement should reduce the short-term political influence on the central bank. An improper behavior of the central bank's governor and other board members can potentially damage the credibility of the institution in the financial markets and harm its reputation among the public. For this reason, most central bank statutes specify the circumstances or conditions for the dismissal of the governor and other board members. However, their *dismissal* should only occur in cases of personal misconduct or whether the member loses his/her qualification requirements. Indeed, the removal of central bankers for policy reasons might open the door to unwarranted pressure from the government. Similarly, the involvement of the governor and other board members in *other offices* of the government might create a conflict of interest between the two positions and this might pose some problems for the overall credibility of the central bank. Finally, the introduction in the legislation of *qualification* requirements can help to filter out those who might otherwise be selected on the basis of their political connections or simply as notable persons, but lacking any particular qualifications for the function. Given all these elements, central banks in which: i) the executive branch has little or no legal authority in appointing the governor and other board members; ii) the term of office exceeds the electoral cycle; iii) reappointment is limited; iv) dismissal is based on objective grounds; and v) parallel activities of management bodies are limited, can be considered to be more independent from the government.

- **Monetary policy and conflicts resolution**. Central banks need the right to *determine and implement monetary policy* to achieve their objectives. To this end, in an optimal institutional design, the government should not interfere in monetary policy. Similarly, the central bank should have the authority to determine *interest rates* on its own, while *banking supervision* might be delegated to an autonomous agency to avoid that this activity conflicts with monetary policy. In line with previous studies, I also assume that the central bank's role in *approving public sector budget and/or debt* represent useful instruments to help enforce fiscal discipline and strengthen monetary policy. Finally, whether any *conflict* might emerge between the central bank and the government, the central bank legislation should specify the procedure to follow and resolve such conflicts. In particular, to avoid that the monetary policy decisions adopted by the central bank are overruled by the government, the central bank should have the final authority over issues related to its objectives.

- **Objectives**. To strengthen the credibility of the monetary policy authority, its *objectives* need to be clearly defined. Given the social costs imposed by inflation in the long-run, the objective of price stability is a natural long-run goal for any central bank. Price stability is now the primary objective of most monetary policy institutions. Yet, other goals such as aggregate output or employment might be taken into account. Moreover, especially since the onset of the 2008-09 financial crisis, there

is a continuing debate about whether monetary policy frameworks focused on price stability should be amended to include financial stability. Smets (2014), for example, suggests that in order to avoid the time-inconsistency problem and to ensure clear accountability, it is important that price stability remains the monetary authorities' primary objective. He considers that a lexicographic *ordering* with the price stability objective coming before the financial stability objective will avoid an inflationary bias that may arise from the central bank's involvement in financial stability, while ensuring that financial stability concerns are still taken into account. Similar considerations hold if the central bank pursues multiple objectives.

- **Limitations on lending to the government**. Whenever the government can influence the quantity and conditions under which it borrows money from the central bank, it can also influence the creation of monetary base and lessen the economic independence of the central bank (Grilli et al., 1991). Therefore, in an optimal institutional design, temporary advances to the government should be prohibited. However, if direct credits are allowed, these may be moderate. For example, monetary financing of the government might be allowed if: (i) loans are provided with strict *limits*; (ii) the *terms of lending* are controlled by the central bank; (iii) the *beneficiary* is only the government and not also local administrations or public enterprises; (iv) the *maximum amount of advances* is quantified; (v) their *maturity* is limited and clearly specified in the central bank legislation; and (vi) loans are at market-related *interest rates*. Finally, the central bank should be prohibited to *underwrite* government securities in the primary market. Consequently, central banks in which the legislation introduces tighter limits on its lending to the public sector are considered more independent.

- **Financial Independence**. Even if central banks are not generally concerned with liquidity, central bank financial strength appears to be positively associated with good policy performance.[16] In extreme situations, financially weak central banks can generate losses that undermine macroeconomic stability and can put into question the credibility of the institution (Stella, 2010). Consequently, the central bank legislation should clearly address the elements directly related to the financial position of the central bank, such as the conditions for capitalization and recapitalization, the determination of the central bank budget and the arrangements for profits distribution and loss coverage. In order to ensure financial independence, the central bank statute should describe precisely the provisions relating to the *payment* and *level* of the initial authorized capital, as well as information on the obligation of the *government to re-capitalize the bank* and provide details on whereby recapitalizations are *subject to approval* by the executive power or the parliament. Moreover, financial independence should not depend on the government's budget. To strengthen this point, the central bank's legislation should require to *uncouple the approval of the central bank budget* from the government's one. Similarly, the *adoption of the central bank balance sheet* should belong to its decision-making bodies and *financial accountability* might be ensured by requiring that the internal and external review of the bank's account is not conducted by the government or a state owned auditing agency. Finally, the legal arrangements surrounding the distribution of central bank's profits and losses play a relevant role in guaranteeing long-term financial independence. Only realized net profits, after prudent provisioning by the central bank and appropriate allocation to

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[16]Milton and Sinclair (2010) provide a comprehensive and historical analysis of the issues on central banks' capital and financial strength.

general reserves, should be returned to the government. It follows that the central bank legislation should specify: a) how the *allocation of net profits* is conducted, b) how the appropriate allocation to the *general reserve* fund of a percentage the profits is handled by the central bank, c) that the government or the central bank's shareholders are prohibited from receiving *partial payments* before the end of the fiscal year, and d) that *unrealized profits* cannot be included in the calculation of distributable profits.

- **Reporting and Accountability**. Policy and financial accountability should be clearly established and, for this reason, the central bank should prepare formal statements on monetary policy performance at fixed time intervals, without prior approval of the government (Lybek, 1999). Jacome and Vazquez (2008) recognize financial accountability as an integral component of central bank independence. Indeed, holding central banks accountable strengthens institutional credibility and hence underpins monetary policy effectiveness. Following these guidelines, in an optimal institutional design, the central bank legislation might require that central banks report on a regular basis their *policy targets and achievements*, and publish *financial statements* that follow international accounting standards and are certified by an independent auditor.

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# B  Coding rules for the index

This index provides an indicator of central bank *de jure* independence and accountability.[17]

I. **Governor and central bank board**

I.1)  Who appoints the governor?
Central bank board / shareholders (if different from the government)     1.00
A council of the central bank board, executive branch, 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?
Central bank board / shareholders (if different from the government)     1.00
A council of the central bank board, executive branch, 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

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[17]When setting the rules for interpreting the information presented in the central bank legislation, a clear strategy had to be established in order to codify missing data. For example, Cukierman et al. (1992) assumes that, "when an entry is not available for one or more variables within a subgroup, only the variables with meaningful entries are aggregated". This strategy might, however, overestimate the degree of central bank independence for countries in which the legislation is partially incomplete and the executive power could have complete power in deliberating on all the points not mentioned in the central bank charter. On the other hand, there might be cases in which the statute formally requires the approval of the central bank's monetary policy by the government even if this rarely results in the approval being denied (see Grilli et al., 1991, for the case of Italy before the 1990s). In order to guarantee a consistent interpretation of the central bank legislation, in all the cases in which certain information is not mentioned in the legislation or certain requirements are a mere formality, I assume the minimum level of independence, i.e. a value equal to 0 for the criteria of interest.

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 | 1.00 |
| 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 |
| Government, on policy issues not clearly defined as the central bank's goals | 0.80 |
| A council of the central bank, executive branch, 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 plus others goals including financial stability of financial system that may conflict with the former, without priority | 0.50 |
| Price stability together with 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 the secondary market with restricted limits | 0.75 |
| In the secondary market with lax or without limits | 0.50 |
| In the primary market with limits or approved by central bank board with a qualified majority | 0.25 |
| In the 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 statute / central bank charter | 1.00 |
| Left to the discretion of the central bank | 0.67 |
| A kind of negotiation between the government and the central bank | 0.33 |
| Left to 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?

| | |
|---|---|
| The decision is just on objective criteria established precisely by the statute | 1.00 |
| The decision is left to the discretion of the central bank | 0.67 |
| The decision is made by the central bank in consultation with the government | 0.33 |
| Left to 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.   Reporting and accountability

VI.1)   Central Bank reporting

| | |
|---|---|
| Reports to executive branch and informs at least annually to Congress. | 1.00 |
| Reports to the executive once a year and submits an annual report to 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 report 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 authority | 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 |

Figure B.1: Weights assigned by the CBI indices to the different dimensions
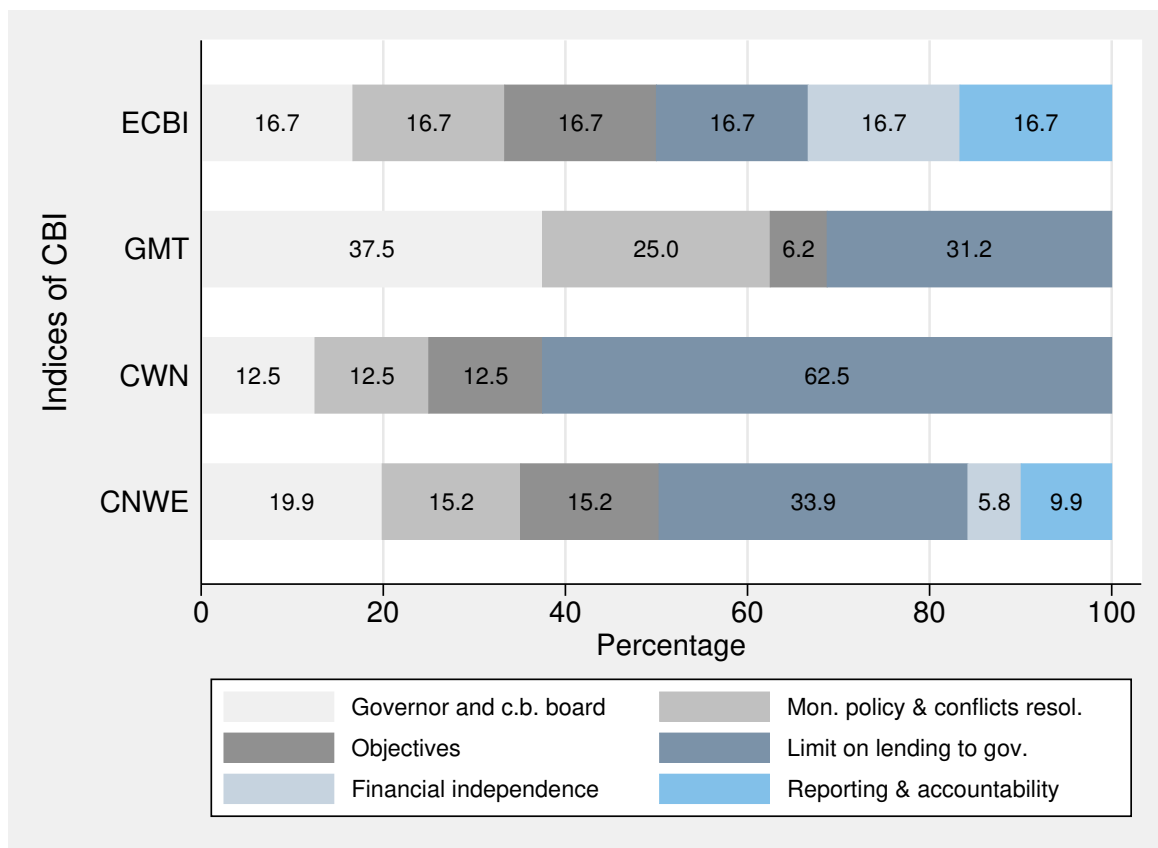
Note: Each horizontal bar indicates the weight assigned by the CBI indices to the different dimensions. ECBI: Extended CBI Index; GMT: Grilli et al. (1991); CWN: Cukierman (1992) and CWNE: Jacome and Vazquez (2008).

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| Variable | Definition | Data sources |
|---|---|---|
| **Dependent variables** | | |
| $\Delta$**ECBI** | Change in the ECBI index between year $t$ and $t-1$: $\Delta ECBI = ECBI_{i,t} - ECBI_{i,t-1}$. | Authors |
| **Reform** | Dummy variable that takes the value of one if country $i$ is experiencing a reform in the degree of central bank independence in year $t$ | Authors |
| **Reform** | Dummy variable that takes the value of one if country $i$ is experiencing a reform in the degree of central bank independence in year $t$. | Authors |
| **Reform>0** | Dummy variable that takes the value of one if country $i$ is experiencing a reform that increases the degree of central bank independence. | Authors |
| **Reform<0** | Dummy variable that takes the value of one if country $i$ is experiencing a reform that reduces the degree of central bank independence. | Authors |
| **Large Reform>0.10** | Dummy variable that takes the value of one in years in which a large change to the level of the ECBI index (variation of the index greater than 10 basis points) takes place. | Authors |
| $\Delta$**ECBI**$_d$ | Variable that captures the change in one of the six dimensions ($d$) of the ECBI index. | Authors |
| $\Delta$**GMT/** $\Delta$**CWN/** $\Delta$**CWNE** | Variable that captures the change in the degree of central bank independence as defined in Grilli et al. (1991), Cukierman et al. (1992) and Jacome and Vazquez (2008), respectively. | Authors |
| **Explanatory variables** | | |
| **ECBI** | Extended Central Bank Independence index that provides information on central bank institutional design across six dimensions: 1) Governor and central bank board, 2) Monetary policy and conflicts resolution, 3) Objectives, 4) Limitations on lending to the government, 5) Financial independence and 6) Reporting and accountability. See the description provided in Section 3, for further details. | Authors |
| **Financial crisis** | Dummy variable that takes the value of one in the two years following a systemic banking crisis. | Authors following Laeven and Valencia (2013) |
| **Inflation Crisis** | Dummy variable that takes the value of one in the two years an inflation crisis (inflation rate higher than 40%). | Authors following Reinhart and Rogoff (2004) |
| **Recession** | Dummy variable that takes the value of one in the two year following a recession. Recession years are those years between the peak and the trough of the cyclical component of real GDP, computed following the methodology proposed by Braun and Larrain (2005). | Authors following Braun and Larrain (2005) |
| **Crisis** | Dummy variable that takes the value of one in the two years following either a systemic banking crisis, an inflation crisis or a recession. | Authors |
| **IMF programs** | Dummy variable that takes the value of one in the two years following an IMF loan program. | Authors following Dreher (2006b) |
| **IMF programs** | Dummy variable that takes the value of one in the two years following a randomly assigned date of an IMF loan program. | Authors |
| **Currency Union** | Dummy variable that takes the value of one in the five years prior to joining a currency union. | Authors |
| **Left government** | Dummy that takes the value of one if left-wing party (communist, socialist, social democratic, or left-wing) is in power. | Beck et al. (2001); Keefer and Stasavage (2003) |
| **Polity** | Index that measures the difference between the democratic and the autocratic score of a country. The resulting unified polity scale ranges from +10 (strongly democratic) to -10 (strongly autocratic). | PolityIV (2018) |
| **Democracy** | Dummy that signals whether country $i$ is a democracy or not (democracy=1 if Polity has positive values, =0 otherwise). | Authors following Giavazzi and Tabellini (2005) |
| **Democratic Reform** | Dummy that signals whether country $i$ became a democracy in the current year (where democracy$_t$=1 and democracy$_{t-1}$=0). | Authors |
| **Common law** | Dummy for Common Law legal roots: 1= Anglo-Saxon Law; 0 = non-Anglo-Saxon Law. | Authors following La Porta et al. (1999) |
| **GDP growth** | Annual percentage growth rate of per capita GDP based on constant local currency. | World Bank (2018) |
| **Openness** | Ratio of the sum of exports and imports to GDP. | World Bank (2018) |
| **Globalization index** | Index of globalization covering three main dimensions: 1) Economic integration: (i) data on actual flows, and (ii) data on trade and capital restrictions. 2) Social globalization: (i) data on personal contact, and (ii) data on information flows. 3) Political integration. | Dreher (2006a) |

| Variable | Mean | Std. Dev. | Min | Max | Nr of obs |
|---|---|---|---|---|---|
| ECBI | 0.5473 | 0.174 | 0.1 | 0.95 | 5877 |
| $\Delta$ECBI | 0.0045 | 0.0375 | -0.3 | 0.55 | 5801 |
| Reform | 0.0359 | 0.1861 | 0 | 1 | 5877 |
| Reform>0 | 0.0288 | 0.1672 | 0 | 1 | 5801 |
| Reform<0 | 0.0076 | 0.0868 | 0 | 1 | 5801 |
| Large Reform>0.10 | 0.016 | 0.1255 | 0 | 1 | 5877 |
| $\Delta$Board | 0.0037 | 0.0411 | -0.6 | 0.8 | 5801 |
| $\Delta$Mon. Policy | 0.0034 | 0.0402 | -0.35 | 0.7 | 5801 |
| $\Delta$Objectives | 0.0082 | 0.0747 | -0.75 | 0.9 | 5801 |
| $\Delta$Lending | 0.0065 | 0.0643 | -0.6 | 0.9 | 5801 |
| $\Delta$Financial ind. | 0.0013 | 0.0273 | -0.45 | 0.5 | 5801 |
| $\Delta$Report & Acc. | 0.0036 | 0.0387 | -0.5 | 0.85 | 5801 |
| $\Delta$GMT | 0.0045 | 0.0411 | -0.4375 | 0.625 | 5801 |
| $\Delta$CWN | 0.0058 | 0.0502 | -0.435 | 0.7603 | 5801 |
| $\Delta$CWNE | 0.0055 | 0.0444 | -0.3965 | 0.6781 | 5801 |
| Financial crisis | 0.116 | 0.3203 | 0 | 1 | 5877 |
| Inflation crisis | 0.0686 | 0.2527 | 0 | 1 | 5877 |
| Recession | 0.2741 | 0.4461 | 0 | 1 | 5877 |
| Crisis | 0.4059 | 0.4911 | 0 | 1 | 5701 |
| IMF programs | 0.3724 | 0.4835 | 0 | 1 | 5459 |
| IMF programs (random) | 0.3206 | 0.4667 | 0 | 1 | 5459 |
| Currency union | 0.0226 | 0.1487 | 0 | 1 | 5877 |
| Left Government | 0.2756 | 0.4469 | 0 | 1 | 5366 |
| Polity | 2.3917 | 7.21 | -10 | 10 | 5034 |
| Democracy | 0.5898 | 0.4919 | 0 | 1 | 5034 |
| Democratic reform | 0.0159 | 0.1253 | 0 | 1 | 5017 |
| GDP growth | 2.0341 | 6.0413 | -65 | 140.5 | 5406 |
| Openness | 78.44 | 49.18 | 0.021 | 531.74 | 5322 |
| Globalization index | 53.97 | 16.38 | 16.15 | 90.67 | 5398 |

Table D1: Ordered logit estimates: alternative CBI indices

| | $\Delta$GMT | | $\Delta$CWN | | $\Delta$CWNE | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $CBI_{t-1}*(1-CBI_{i,t-1})$ | 2.172 | | 4.019*** | | 2.780 | |
| | (1.487) | | (1.353) | | (1.759) | |
| $CBI_{t-1}$ | | 1.783 | | 5.961*** | | 3.040 |
| | | (2.334) | | (2.254) | | (2.439) |
| $CBI^2_{t-1}$ | | -2.020 | | -4.871*** | | -2.888 |
| | | (1.734) | | (1.655) | | (1.947) |
| $REG_{t-1}$-$CBI_{i,t-1}$ | 2.142*** | 1.928** | 1.885*** | 2.905*** | 3.317*** | 3.453*** |
| | (0.588) | (0.960) | (0.495) | (0.980) | (0.506) | (0.949) |
| Financial crisis | -0.134 | -0.129 | 0.189 | 0.179 | 0.291 | 0.289 |
| | (0.364) | (0.368) | (0.315) | (0.316) | (0.316) | (0.318) |
| Inflation crisis | 0.025 | 0.040 | -0.094 | -0.137 | -0.478 | -0.484 |
| | (0.377) | (0.378) | (0.468) | (0.471) | (0.404) | (0.406) |
| Recession | 0.145 | 0.142 | 0.258 | 0.280 | 0.188 | 0.191 |
| | (0.186) | (0.189) | (0.215) | (0.217) | (0.222) | (0.224) |
| IMF programs | 0.676*** | 0.679*** | 0.970*** | 0.958*** | 0.946*** | 0.942*** |
| | (0.238) | (0.238) | (0.262) | (0.261) | (0.249) | (0.247) |
| Currency union | 2.814*** | 2.803*** | 2.677*** | 2.742*** | 2.726*** | 2.736*** |
| | (0.284) | (0.282) | (0.315) | (0.315) | (0.290) | (0.280) |
| Left government$_t$ | 0.402** | 0.400** | 0.279 | 0.284 | 0.315 | 0.316 |
| | (0.190) | (0.189) | (0.216) | (0.213) | (0.242) | (0.242) |
| Polity$_{t-1}$ | 0.001 | 0.001 | -0.015 | -0.014 | 0.006 | 0.006 |
| | (0.016) | (0.016) | (0.019) | (0.019) | (0.021) | (0.021) |
| Common law | -0.633*** | -0.643*** | -0.588** | -0.573** | -0.422** | -0.420** |
| | (0.238) | (0.237) | (0.239) | (0.236) | (0.209) | (0.208) |
| GDP/capita growth$_{t-1}$ | 0.030 | 0.030 | 0.011 | 0.011 | 0.021 | 0.021 |
| | (0.018) | (0.018) | (0.020) | (0.021) | (0.020) | (0.020) |
| Openness$_{t-1}$ | 0.001 | | 0.001 | | 0.002 | |
| | (0.002) | | (0.002) | | (0.002) | |
| Globalization index$_{t-1}$ | 0.004 | 0.005 | 0.017* | 0.014 | 0.013 | 0.013 |
| | (0.008) | (0.008) | (0.010) | (0.010) | (0.009) | (0.009) |
| Observations | 2,906 | 2,906 | 2,906 | 2,906 | 2,906 | 2,906 |
| Number of countries | 132 | 132 | 132 | 132 | 132 | 132 |

The dependent variable is the change in the indices of Central Bank Independence, $\Delta CBI_{i,t}$. These alternative measure are the GMT (Grilli et al., 1991), CWN (Cukierman, 1992) and CWNE (Jacome and Vazquez, 2008) indices of CBI. $CBI_{i,t-1}(1-CBI_{i,t-1})$ and $(REG_{i,t-1}-CBI_{i,t-1})$ are the proxies of domestic and regional learning, respectively. *Financial crisis* is a dummy equal to one in the two years following a systemic banking crisis. *Inflation crisis* is a dummy equal to one if annual inflation rates higher than 40% are registered in the two years prior to a reform in year $t$. *Recession* is a dummy that takes the value of one in the two years following the start of a recession. *IMF programs* is a dummy equal to one in the two years following an IMF loan program. *Currency union* is a dummy variable that takes value one in the five years prior to joining a currency union. *Left government* is a dummy that takes the value of one if a left-wing party is in power in year $t$. *Polity* is the Polity2 index of democracy. *Common law* is a dummy that takes value one for countries adopting common law system. *Openness* is the ratio of the sum of exports and imports to GDP. *Globalization index* is the value of the KOF index in the previous year. Robust standard errors in parentheses, adjusted for clustering by country. ***/**/* denotes significance at the 1, 5 and 10-percent levels, respectively.

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