



HAL
open science

Three essays on Central Banking

Daide Romelli

► **To cite this version:**

Daide Romelli. Three essays on Central Banking. Economics and Finance. Université de Cergy Pontoise, 2015. English. NNT : 2015CERG0778 . tel-01536073

HAL Id: tel-01536073

<https://theses.hal.science/tel-01536073>

Submitted on 10 Jun 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Three essays on Central Banking

Davide ROMELLI

UNIVERSITÉ DE CERGY-PONTOISE

ANNÉE 2015

N° attribué par la bibliothèque

--	--	--	--	--	--	--	--	--	--

THESE

pour l'obtention du grade de
DOCTEUR DE L'UNIVERSITÉ DE CERGY-PONTOISE

Discipline : Sciences économiques

Presenté publiquement

par

Davide ROMELLI

le 10 décembre 2015

Titre :

Three essays on Central Banking

Codirecteurs de recherche :

Mme Frédérique BEC

Prof. à l'Université de Cergy-Pontoise

Mme Cristina TERRA

Prof. à l'ESSEC Business School

JURY

M Christophe HURLIN,

M Laurent FERRARA,

M Donato MASCIANDARO,

Mme Mélika BEN SALEM,

M André FOURÇANS,

Mme Frédérique BEC,

Mme Cristina TERRA,

Professeur à l'Université d'Orléans, *Examineur*

Chef du service des Études Macroéconomiques et Synthèses Internationales à Banque de France, *Rapporteur*

Professeur à l'Université Bocconi, *Rapporteur*

Professeur à l'Université Paris-Est Marne-La-Vallée, *Examineur*

Professeur à l'ESSEC Business School, *Examineur*

Professeur à l'Université de Cergy-Pontoise, *Codirecteur*

Professeur à l'ESSEC Business School, *Codirecteur*



ESSEC
BUSINESS SCHOOL

Three essays on Central Banking

A dissertation submitted in partial fulfillment of the requirements for the degree of

**PHD IN BUSINESS ADMINISTRATION
FROM ESSEC BUSINESS SCHOOL**

Publicly defended the 10th of December 2015 by

Davide ROMELLI

JURY

Ms Frédérique BEC,	Professor, University of Cergy-Pontoise, <i>Co-director</i>
M André FOURÇANS,	Distinguished Professor, ESSEC Business School, <i>Co-director</i>
Ms Mélika BEN SALEM,	Professor, University of Marne-la-Vallée, <i>Examiner</i>
M Laurent FERRARA,	Head of International Macroeconomics Division at Banque de France, <i>Referee</i>
M Christophe HURLIN,	Professor, University of Orléans, <i>Examiner</i>
M Donato MASCIANDARO,	Professor, Bocconi University, <i>Referee</i>
Ms Cristina TERRA,	Professor, ESSEC Business School, <i>Examiner</i>

Abstract

This thesis consists of three empirical papers on central bank institutional design.

Chapter 1 contributes to the debate on the importance of central bank independence (CBI) in lowering inflation rates. It stresses the relevance of employing indices of central bank independence computed dynamically in two ways. First, it recomputes the evolution of the [Grilli et al. \(1991\)](#) index of CBI and shows that the timing of large legislative reforms is closely related to inflation rate dynamics. Using unit root tests with endogenous structural breaks, I find that reforms that modify the degree of CBI represent structural breaks in the inflation rate dynamics. Second, employing the dynamic [Grilli et al. \(1991\)](#) index of independence confirms the negative relationship between CBI and inflation in a sample of 10 advanced economies.

Chapter 2 presents a new and comprehensive database of central bank institutional design for 65 countries over the period 1972–2014. This chapter describes in detail the sources of information and the coding rules used to create a new index of central bank independence. It also compares this new index with the classical measures of CBI and highlights the new aspects of central bank institutional design included in this database such as financial independence and accountability. An important innovation of this new index is its dynamic nature. This enables an investigation of the endogenous determination of the level of independence of central banks and suggests several instruments for the CBI index. Using an instrumental variable approach, this chapter provides strong support for a causal, negative CBI-inflation nexus.

Chapter 3 uses a political economy framework to investigate the drivers of reforms in central bank institutional design. Using the new CBI index developed in Chapter 2,

this Chapter investigates the determinants of central bank reforms in a sample of 65 countries over the period 1972–2014. The results obtained suggest that the incentives generated by initial reforms which increased the level of independence, as well as a regional convergence, represent important drivers of reforms in central bank design. At the same time, an external pressure to reform, such as obtaining an IMF loan or joining a monetary union, also increases the likelihood of reforms, while government changes have little impact.

Acknowledgements

I would like to first of all thank Professors Frédérique Bec, Cristina Terra and André Fourçans, for all their help and guidance. Professor Bec has been my advisor since the Master in Economic Analysis at the University of Cergy-Pontoise and her pragmatism, rigor and constant encouragement have been fundamental to improving my work and the way I look at research. Professor Terra introduced me to the topics of international trade and finance and, while co-authoring a paper together, she has been inspirational and always constructive. Professor Fourçans's critical approach has been stimulating and improved my ability to tackle issues from many perspectives.

I am particularly grateful to Professor Laurent Ferrara and Professor Donato Masciandaro for having accepted to be the referees of my thesis. I would also like to thank the members of the jury: Professor Christophe Hurlin and Professor Mélika Ben Salem for the honor of agreeing to be part of this commission.

All my gratitude also goes to Marco Arnone, who first introduced me to this topic and co-authored the first chapter of this thesis. Thanks to this work, in 2012, I had the honor of being accepted to probably the most important conference on central bank independence at the time, FinLawmetrics. This gave me the opportunity to meet some of the most prominent researchers in this topic, including Donato Masciandaro, who has been an inspiration in pursuing this line of research.

I would like to thank all my colleagues at ESSEC Business School and University of Cergy-Pontoise for the open and friendly work environment. Special thanks go to my colleagues Nima, Vlad and Mohammad for all the “constructive” coffee breaks during the long years of PhD.

My parents and my brothers have always been wondering what I have been doing in the last five years and now I can show them this thesis! Zia Giovanna and Nadia

have always been alongside me and their courage and determination gave me strength to never give up.

Oana, for the last four years you have been always next to me and without your love, help and support, this PhD would not have been possible. This thesis is for you!

Contents

Introduction	1
1 Dynamic central bank independence indices and inflation rate: a new empirical exploration	5
1.1 Introduction	6
1.2 Measuring central bank independence	8
1.3 Central Bank Independence indices dynamics and data	10
1.3.1 Central Bank Independence indices dynamics	11
1.3.2 Data	15
1.4 Central Bank law reforms and Inflation rate dynamics	16
1.4.1 CBI indices ranking and inflation	16
1.4.2 Unit root tests with structural breaks	18
1.5 Panel data analysis	24
1.5.1 Panel unit root tests	24
1.5.2 Political and Economic independence and Inflation	25
1.5.3 The importance of dynamic CBI indices	29
1.6 Conclusions	31
Appendices	33
1.A Reforms and clustering evidences	34
1.B Alternative methods for structural breaks	36
1.C Robustness checks	38
2 Central Bank Design: A New Database	41
2.1 Introduction	41

2.2	Construction of the database	44
2.2.1	Classical measures of Central Bank Independence	49
2.2.2	The Extended Central Bank Independence (ECBI) Index	52
2.3	Characteristics of the ECBI index	56
2.4	The CBI-inflation nexus: a re-investigation	59
2.4.1	Baseline estimations	60
2.4.2	CBI-inflation nexus with endogeneity	63
2.5	Conclusions	64
	Appendices	66
2.A	Full list of questions	67
2.B	Coding rules for the ECBI index of <i>de jure</i> central bank independence and accountability	72
3	The political economy of reforms in central bank design: evidence from a new dataset	81
3.1	Introduction	82
3.2	Literature on Central Bank independence	84
3.3	Central Bank Legislative reforms	87
3.4	The political economy of reforms	91
3.4.1	Other data	94
3.5	Determinants of reforms: multivariate analysis	96
3.5.1	Alternative specifications	101
3.5.2	Types of reforms	105
3.5.3	Other robustness checks	108
3.6	Concluding remarks	110
	Appendices	112
3.A	Countries, data sources and summary statistics	113
	Conclusions	121

List of Figures

1.B.1 Inflation rate dynamics and structural breaks (1972-2010)	36
1.B.2 Inflation rate dynamics and structural breaks (1972-2010)	37
2.1 Degree of independence by dimension	57
2.2 Average degree of ECBI across regions	58
2.B.1 Weights assigned by the CBI indices to the different dimensions	76
3.1 CB Legislative reforms (1972-2014)	89
3.2 Evolution of Central Bank Independence (1972-2014)	90
3.3 Legislative reforms by subcategories (1972-2014)	105

List of Tables

1.1	GMT Political Independence (1972-2010)	12
1.2	GMT Economic Independence (1972-2010)	14
1.3	Correlation between CBI indices and inflation	16
1.4	Inflation and CBI ranking evolution	17
1.5	Unit Root tests	21
1.6	Breitung and Das panel unit root test	25
1.7	OLS Fixed Effects regression for inflation and CBI (1972-2010)	26
1.8	PCSE regression for inflation and CBI (1972-2010)	28
1.9	PCSE regression for inflation and CBI dummy (1972-2010)	30
1.A.1	Central bank reforms with influence on CBI	34
1.A.2	CBI and Inflation (clustering evidences)	35
1.C.3	PCSE regression for inflation and overall GMT CBI (1972-2010)	38
1.C.4	PCSE regression for inflation and CWN CBI (1972-2010)	39
1.C.5	PCSE regression for inflation and Overall CBI dummy (1972-2010)	40
2.1	Institutional characteristics of CBI indices	54
2.2	Cross-correlation between measures of CBI	59
2.3	Panel regressions of inflation on CBI (FGLS)	61
2.4	Panel regressions of inflation on CBI (IV)	64
2.A.1	Criteria and weights of the CWN (LVAU and LVAW) indices of CBI	71
2.B.2	Analyzed countries	77
2.B.3	Information on the criteria of the ECBI index (as of 2014)	78
2.B.4	Panel regressions of inflation on CBI (IV with LIML)	79
3.1	Measures of Central Bank Independence and Reforms	88

3.2	Evolution of central bank independence indices	90
3.3	Ordered logit estimates: benchmark specification	98
3.4	Ordered Logit estimates: alternative specifications	100
3.5	Complementary logarithmic estimates	102
3.6	Cloglog estimates: sign and magnitude of reforms	104
3.7	Ordered Logit estimates: sub-categories	107
3.8	Ordered Logit estimates: other regressions	109
3.A.1	Analyzed countries	113
3.A.2	Data sources	114
3.A.3	Summary Statistics	117
3.A.4	Ordered logit estimates: alternative CBI indices	118
3.A.5	Ordered Logit estimates: alternative specifications and CBI indices	119
3.A.6	Complementary logarithmic estimates	120

Introduction

Starting from the New Classical Revolution, theories on central banking have been concerned with the optimal institutional design of monetary policy authorities and how this impacts real economic outcomes such as inflation. In this context, [Rogoff \(1985\)](#) argues that only an independent policymaker is able to implement credible monetary policies that will favor lower inflation rates and thus eliminate the time inconsistency problem of government policies ([Kydland and Prescott, 1977](#)). [Rogoff's](#) seminal paper had a twofold effect: it created avenues for the design of indices suitable to capture the degree of independence on the research side, and it stimulated the implementation of central bank reforms on the policy side.

[Bade and Parkin \(1982\)](#), [Grilli et al. \(1991\)](#) and [Cukierman et al. \(1992\)](#) were the first to develop indices aimed at capturing the degree of central bank independence (hereafter, CBI). These indices focused on the statutes of central banks to capture, in the most objective way, the degree of independence of the central bank. Following the development of these measures, an extensive empirical literature began examining the relationship between CBI and inflation, economic growth and other macroeconomic variables (see [Arnone et al., 2006](#); [Crowe and Meade, 2008](#); [Cukierman, 2008](#), for recent reviews of the literature).

This empirical literature tends to support a negative correlation between the level of CBI and inflation rates. For example, in a meta-analysis of 57 empirical studies, [Klomp and de Haan \(2010\)](#) find that this negative relationship is particularly strong during the 1970s and for OECD countries. Other studies looking at different time frames, samples of countries or measures of CBI suggest that the CBI-inflation nexus is not consistent across countries and periods ([Posen, 1995](#); [Campillo and Miron, 1997](#)). Two main empirical challenges are generally emphasized. First, various measures of CBI proposed in the

literature use different methodologies to measure the level of independence of the central bank from the executive power. This implies that the results obtained might not be robust when alternative indices are employed. Second, and most importantly, CBI indices are generally static. Most studies that have attempted to assess the changes in central bank independence usually compute a measure of CBI at two different, often distant, points in time ([Acemoglu et al., 2008](#); [Crowe and Meade, 2008](#)). This may mask important dynamics regarding the evolution of independence across time and its relationship to economic outcomes.

This thesis aims to contribute to the central banking literature along three directions which are reflected in its three chapters. The first chapter studies the effectiveness of central bank legislative reforms in guaranteeing lower levels of inflation. Its main contribution is to highlight a new methodology to assess this classical nexus which promotes the use of time-varying indices of central bank independence. The second chapter builds on this analysis by constructing a new dynamic index of central bank independence which extends other commonly used measures in several ways. This new index also allows a re-examination of the negative relationship between CBI and inflation in a panel setting for a large set of countries. Finally, given the crucial role of central bank institutional design in guaranteeing price stability highlighted in the first two chapters, the last chapter of this thesis goes a step further and asks what are the main drivers behind the reforms in central banking. This analysis can thus explain why we still see quite different degrees of independence across the world despite its stated benefits, and, more importantly, why and how central banks reform their legislation in times of low and stable inflation.

Chapter 1 investigates the effectiveness of central bank reforms. Starting from a review of different measures of CBI proposed in the literature, this Chapter discusses why *de jure* measures of independence might be more appropriate for analyzing the impact of independence on inflation. It then recomputes the evolution of one of the most commonly used measure of *de jure* independence proposed by [Grilli et al. \(1991\)](#) for 10 OECD countries during the period 1972-2010. The importance of analyzing the dynamics of central bank independence indices and the magnitude of their changes is highlighted through two econometric strategies. First, the impact of reforms in CBI on inflation is investigated using unit root tests with endogenous structural breaks. The

endogenous identification of the years in which structural breaks in the inflation rate dynamics happen provides a good tool to assess the correspondence between central bank institutional reforms and inflation rates. These first results show that it is possible to identify a structural break in the inflation rate dynamics, which corresponds to the exact moment of legislative changes that significantly improved the level of CBI. Finally, in the second part of the analysis the dynamic index of CBI computed is employed in a panel data setting to re-investigate the CBI-inflation nexus. This empirical estimation also stresses the advantage of employing dynamic indices of CBI as compared to other approaches that use static variables or dummies to capture legislative changes (Polillo and Guillén, 2005; Acemoglu et al., 2008).

Conflicting views on the importance of the optimal central bank institutional design have often been pointed to the fact that the validity of the negative CBI-inflation link can be questioned by three main factors: a) the measure of central bank independence employed, b) the set of countries analyzed, and c) the time horizon of the study. Chapter 2 aims to overcome these important drawbacks of previous research. This Chapter presents a new database on central bank institutional design that surveys a larger than previously attempted set of central bank characteristics. This new dataset is then used to build a new index of central bank independence that extends previous ones by (i) capturing the changes in central bank legislative reforms over time and (ii) including a larger set of characteristics that may influence the degree of central bank independence. This new index is computed for a sample of 65 countries over the period 1972-2014. Chapter 2 thus presents a detailed description of the construction of this new measure of CBI, as well as a rich set of descriptive statistics that highlight new insights into the evolution of central bank independence over the past four decades. Importantly, the information collected for the construction of this index enables the re-computation of other common measures of CBI in a dynamic setting, therefore allowing the implementation of robustness checks using these alternative indices. The dynamic indices computed in this Chapter are then used to re-examine the CBI-inflation nexus in a large panel of countries. This analysis considers a possible endogenous determination of the level of central bank independence and, taking advantage of the dynamic nature of the new index of CBI, proposes a set of instruments of central bank independence. The new results obtained using this instrumental variable approach confirm the strong negative

and causal link between CBI and inflation.

While the first two chapters stress the importance of central bank independence in guaranteeing price stability in the long run, the last one focuses on the political economy of reforms. This issue has received less attention in the literature mainly due to the lack of an extensive dataset on reforms in central bank design. This Chapter aims to understand what accounts for the worldwide changes in central bank design over the past four decades. Using the dynamic central bank independence indices developed in Chapter 2, it employs a political economy perspective to explain the timing, pace and extent of reforms in central banking. The dynamic nature of this new index, together with the large set of countries and the extended period of the analysis allows for the identification of the largest number of central bank reforms investigated in the literature.

The political economy framework suggests a set of factors that can explain the timing of reforms as a function of politico-economic characteristics of countries. The relevance of these elements is assessed using an array of econometric techniques. The results obtained show that incentives generated by initial reforms which increased the level of independence, as well as a regional convergence, represent important drivers of reforms in central bank design. At the same time, an external pressure to reform, such as obtaining an IMF loan or joining a monetary union, also increases the likelihood of reforms, while government changes have little impact. These results are robust to the inclusion of different controls for the size and magnitude of reforms, as well as alternative indices of central bank independence.

The new dataset proposed as well as the empirical results presented in this thesis should encourage future research to use dynamic indices of central bank independence, leaving space for further empirical investigations on the impact of reforms of central bank institutional design on other economic outcomes.

Chapter 1

Dynamic central bank independence indices and inflation rate: a new empirical exploration*

Abstract

It has been argued that economies with more independent central banks experience lower inflation over time. In this chapter we show that this relationship is sensitive to the methodology through which central bank independence indices are constructed. We stress the importance of employing dynamic central bank independence indices in two ways. First, we perform unit root tests with structural breaks to verify if the implementation of central bank reforms represents a structural break for the inflation rate dynamics. Second, we implement a panel data analysis.

We find evidence that legislative reforms that modify the degree of independence of a central bank have a strong impact on the inflation rate dynamics. Moreover, underlying the importance of employing dynamic central bank independence indices, we confirm the negative relationship between the latter and inflation for a sample of 10 OECD

*This Chapter, co-authored with Marco Arnone, has been published in the *Journal of Financial Stability* (Volume 9, Issue 3, September 2013, Pages 385-398). Sadly, Marco Arnone passed away, he was a great scholar and dear friend.

countries.

1.1 Introduction

Rogoff (1985) emphasizes the importance of delegating the monetary policy to a central banker that places a larger weight on inflation rate stabilization relative to employment stabilization. Indeed, an independent policy maker might be able to implement credible monetary policies that will favor a lower inflation rate, thus eliminating the time inconsistency problem of government policies (Kydland and Prescott, 1977). Rogoff's seminal paper had a twofold effect, stimulating the implementation of central bank reforms on the policy side, and creating avenues for the design of indices suitable to capture the degree of independence of these institutions, on the research side.

Starting with Bade and Parkin (1982), various studies have developed indices that proxy central bank independence, hereafter referred to as CBI (e.g., Alesina, 1988; Grilli et al., 1991; Cukierman, 1992; Cukierman et al., 1992; Alesina and Summers, 1993). Following the introduction of these indicators, a burgeoning empirical literature began examining the relationship between CBI and inflation, economic growth and other macroeconomic variables.¹

This chapter has three main purposes. The first is to analyze the effectiveness of central bank reforms in guaranteeing a structurally lower level of inflation in each of the countries analyzed. The second is to re-examine if the negative relationship between CBI and inflation derived from previous cross-country studies still holds when employing dynamic CBI indices. Third, we update the central bank independence indices for the sample of selected countries until 2010.

The empirical literature has examined the relationship between CBI and inflation employing indices based on the central bank legislation (*de jure*), or on the turnover rate of the central bank governor (*de facto*). Klomp and de Haan (2010)'s meta-regression analysis of 57 empirical studies shows that legal CBI indices have a negative relationship with inflation in OECD countries, especially during the 1970s. Moreover, studies based on *de facto* CBI remark a positive relationship between this indicator and inflation, even if the causality among these two variable is difficult to evaluate.

¹For an extensive overview of the literature, see Arnone et al. (2006), Crowe and Meade (2008) and Cukierman (2008).

Even if we disregard the sign of the relationship of these indices and inflation, it is important to notice how almost all of this literature is based on cross-country analyses. These approaches do not allow for an explicit evaluation of the impact of central bank law reforms on the inflation rate dynamics of each country. Furthermore, studies implemented considering the current level of CBI, might not be able to capture the effect of the evolution of this indicator. Consider, for example, the Deutsche Bundesbank which has been known, more than any other central bank, for its historical commitment to fight inflation ([Clarida and Gertler, 1997](#)), and is now characterized by almost the same degree of independence of the other euro area countries.

More recent studies implement panel estimations considering time varying indicators. [Cukierman et al. \(2002\)](#), focusing on a group of newly created central banks of former socialist economies and controlling for cumulative liberalization and other variables, find no relationship between inflation and CBI during the '90s. [Jacome and Vazquez \(2008\)](#) explore the effects of CBI on inflation for a sample of 24 Latin American and Caribbean countries during the period 1985-2002. Their results confirm the negative relationship between CBI and inflation. [Arnone et al. \(2009\)](#) and [Laurens et al. \(2009\)](#), using the [Grilli et al. \(1991\)](#) CBI indices for a group of developing countries and emerging markets, show the important role played by a more independent central bank in keeping a lower inflation rate. [Acemoglu et al. \(2008\)](#) analyze changes in the central bank legislation of 52 countries, during the period 1989-2003 and confirm that CBI is associated with a significant decline in inflation in countries with a medium level of political constraints. However, these studies do not specifically analyze the effect of structural reforms, such as the Maastricht Treaty and the euro or the Reserve Bank of New Zealand Act 1989, which have been implemented in more advanced economies during the last two decades and might impact inflation rate dynamics.

In an effort to fill this gap, we reconstruct the evolution of CBI indices for 10 OECD countries, during the period 1972-2010. Our analysis relies on the CBI indices implemented by [Grilli et al. \(1991\)](#) (hereafter GMT). This methodology allows for the construction of indices able to capture the degree of political and economic independence of a central bank through the investigation of a wide number of characteristics concerning the organization and the activity of a central bank.

We stress the importance of dynamic CBI indices and the magnitude of their changes

on inflation in two ways. First, we verify the real impact of central bank law reforms on the inflation rate dynamics. We identify endogenous structural breaks in the inflation rate through unit root tests and compare the obtained break dates with the years of the central bank law reforms.

Second, instead of measuring *de jure* CBI by a dummy variable that takes a value of one in every year after a major reform leading to increased independence (see Polillo and Guillén, 2005; Acemoglu et al., 2008), we employ dynamic CBI indices in our panel data analysis. Indeed, even if the dummy variable approach partially mitigates the weakness of constant CBI indices, the introduction of dynamic ones might overcome this problem even further. This is due to the fact that the inflation rate dynamics might not only be affected by the current degree of CBI, but also by the magnitude of a reform and the length of time it has been in effect.

The outline of the chapter is as follows. Section 1.2 discusses the characteristics of the methodology adopted to compute CBI indices. The evolution of these indicators and the data are presented in Section 1.3, while Section 1.4 is dedicated to the study of the relationship between central bank law reforms and inflation rate dynamics. Our panel data analysis is presented and discussed in Section 1.5. Section 1.6 concludes.

1.2 Measuring central bank independence

This chapter examines the relationship between legal CBI and inflation. We believe that *de jure* CBI indices are appropriate indicators of CBI for three main reasons. First, economists argue that the mere adoption of a legal statute guaranteeing central bank independence dampens inflationary expectations in the economy (Polillo and Guillén, 2005).

Second, these indices are preferred because they focus on specific claims contained in central bank statutes and, for this reason, they are not biased by the presence of possible subjective judgments.

The third reason in favor of the adoption of legal CBI indices is that the alternative *de facto* index, the turnover rate of the central bank governor (TOR), associates the independence of this institution to the autonomy of its governor. Thus, by not taking into consideration the independence of the other members of the board of directors, such

an index might over or underestimate the degree of CBI. Moreover, it is important to notice that, to obtain a more accurate TOR index, it might be necessary to analyze the reasons of the departure, before the end of his/her term, of the central bank governor.

The CBI index used in this chapter is the GMT index, which allows for the identification of a political and an economic independence index. The political index is based on a binary code assigned to 8 different characteristics that sum up the ability of monetary authorities to independently achieve the final *goals* of their policy. This index captures three main aspects of monetary regimes: the procedure for appointing the members of the central bank governing bodies, the relationship between these bodies and the government, and the formal responsibilities of the central bank. Starting from these three aspects, one point is assigned for each of the following criteria, if satisfied: the governor is appointed without government involvement, he/she is appointed for more than five years, the other members of the board of directors are appointed without government involvement, they are appointed for more than five years, there is no mandatory participation of government representatives in the board, there is no government approval of monetary policy formulation, there are statutory requirements that the central bank pursues monetary stability amongst its goals, and there are legal provisions that strengthen the central bank's position in the event of a conflict with the government.

The economic index summarizes the degree of independence of central banks in choosing their monetary policy *instruments*. Its two main aspects concern the influence of the government in determining how much to borrow from the central bank and the nature of the monetary instruments under the control of the central bank. Again, one point is assigned for each of the following satisfied criteria: there is no automatic procedure for the government to obtain direct credit facilities from the central bank, these facilities are extended at market interest rates, the credit supplied to the government is extended on a temporary basis, and for a limited amount, the central bank does not participate in the primary market for public debt, the central bank is responsible for setting the discount rate, and the central bank has no responsibility for overseeing the banking sector (two points), or shares this function with other institutional entities (one point).

Given these guidelines, a central bank will be considered more independent the higher

the value of these indices will be.

Despite the fact that the most widely employed legal index of CBI is from [Cukierman et al. \(1992\)](#) (CWN), our decision to adopt GMT methodology to assess the degree of CBI is not casual. The main motivations are remarked below.

First, the GMT index is also able to capture information concerning the tenure and the degree of government involvement in the appointment of the members of the board of directors apart from the governor. The importance of this information has grown over the last two decades, since the movement toward making monetary policy decisions by a committee represents a *quiet revolution* in central bank practices ([Blinder, 2004](#)). Indeed, nowadays only few central bank governors, such as the one of the Reserve Bank of New Zealand, are solely responsible for setting the monetary policy. Thus, being able to partially capture the independence of the other members of the board of directors, might improve the accuracy of CBI indices.

Second, the involvement of the central bank in the supervision of the banking sector might subtract important resources from the monetary policy function and make central bankers more prone to being “captured by bankers” ([Boyer and Ponce, 2012](#)). Thus, capturing information regarding the involvement of the central bank in banking supervision might be relevant, since this mandate, together with the financial stability one, is acquiring more and more importance around the world ([de Haan et al., 2008](#)).

As a further confirmation of our choice, it is interesting to notice that [Jacome and Vazquez \(2008\)](#) extended the CWN index to incorporate some aspects of central banks’ autonomy already present in GMT indices. Indeed, their index expands the assessment of the rules for the appointment and the dismissal of the entire central bank’s board of directors. Furthermore, it features a couple of innovations regarding the legal provisions for policy formulation and it relates to the central bank’s capacity to lend to the public sector. The GMT index, however, is not excessively focused on statutory aspects of the relationship between the government and the central bank ([Siklos, 2008](#)).

1.3 Central Bank Independence indices dynamics and data

Our analysis covers the period 1972-2010 (post Bretton Woods). Indeed, before 1972, the countries participating to the Bretton Woods system were required to maintain the

parity of their national currencies with their currency reserves and to operate in foreign exchange markets to avoid oscillations of their exchange rate larger than $\pm 1\%$. These constraints limited the set of actions available to policymakers. The collapse of this international monetary system led to the return to floating exchange rates, reintroducing room for the conduct of domestic monetary policies. Thus, since 1972, we might be able to identify the presence of a stronger relationship between the degree of independence of a central bank and the inflation rate dynamics.

1.3.1 Central Bank Independence indices dynamics

Despite the fact that the current legislation of most central banks is accessible online, only few of them provide their previous statutes. Given this constraint, we restrict our sample to countries for which: (i) the current and previous central bank statutes, together with every amendments introduced since 1972, are available on the central bank website; or these documents are accessible through a public library; (ii) are member of the Organization for Economic Co-operation and Development (OECD). The latter requirement assures that the analyzed economies are characterized, even if with different magnitude, by the same international shocks during the analyzed period. Moreover it guaranties that these countries present similar stages in economic development.²

Following these requirements, we analyze a sample of ten countries: Australia, Canada, France, Germany, Italy, Japan, New Zealand, Switzerland, United Kingdom, and United States.

In line with the main findings of [Arnone et al. \(2009\)](#), a sharp increase in CBI indices can be noticed for the 10 analyzed countries, during the period 1972-2010.³ Comparing the political independence index in 1972 with its values in 2010 (Table 1.1), it is possible to verify a remarkable change for France, Italy and New Zealand. The increase in the degree of political independence of the first two central banks can be attributed to the ratification of the treaty of the European Union (signed in Maastricht

²The importance that economic background might have in the CBI-inflation nexus is stressed by [Cukierman et al. \(2002\)](#), who analyze former socialist economies during the nineties and find no relation between inflation and legal independence during the initial stages of liberalization. However, once the shift to a market economy has become sufficiently large, the negative relation between inflation and legal independence does emerge.

³We computed the GMT political and economic independence index in 1972 and we recomputed them after every legislative reform, so to be able to compute their evolution until 2010. The indices presented in Table 1.1 and Table 1.2 correspond to political and economic independence indices in 1972 and 2010, while yearly data for these indices are available on the corresponding author website.

Table 1.1: GMT Political Independence (1972-2010)

Countries	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Pol. Indep.
1972									
Australia		*					*		2
Canada	*	*					*		3
France		*			*				2
Germany		*		*	*	*	*	*	6
Italy	*	*	*		*				4
Japan							*		1
New Zealand									0
Switzerland		*			*	*	*	*	5
United Kingdom					*				1
United States				*	*	*	*	*	5
2010									
Australia		*					*		2
Canada	*	*					*		3
France	*	*	*	*	*	*	*	*	8
Germany	*	*	*	*	*	*	*	*	8
Italy	*	*	*	*	*	*	*	*	8
Japan							*		1
New Zealand					*		*		2
Switzerland		*		*	*	*	*	*	6
United Kingdom					*		*	*	3
United States				*	*	*	*	*	5

Note: (1) governor appointed without government involvement; (2) governor appointed for more than five years; (3) CB board (CBB) appointed without government involvement; (4) CBB appointed for more than five years; (5) no mandatory participation of government representatives in the CBB; (6) no government approval is required for formulation of monetary policy; (7) CB legally obliged to pursue monetary stability as one of its primary objectives; and (8) legal protections that strengthen the CB's position in the event of a conflict with government.

Source: National legislation.

on 7 February 1992, entered into force on 1 November 1993) and subsequent reforms required for the adoption of the euro. As common in the literature (e.g. [Crowe and Meade, 2008](#); [Laurens et al., 2009](#)), after the introduction of the euro, the CBI score is identical (with the exception of the banking supervision activity one, since every state has his own supervision system) for all euro area countries and is based on the statute of the European Central Bank (ECB).⁴ Indeed, since 1 January 1999 the ECB has been responsible for conducting monetary policy for the euro area. Focusing on the third country characterized by a sharp increase in political independence, New Zealand,

⁴It is important to notice that the ECB has been designed according to the best standard in central banking legislation in 1998. For this reason the statutory political and economic independence of the ECB is very similar to the one of the Deutsche Bundesbank at the time.

we remark that in 1972 the Reserve Bank of New Zealand had no de jure political independence. After a period of high and volatile inflation rate, its government decided to redesign the structure of its central bank, implementing the Reserve Bank of New Zealand Act of 1989 which recognized the political and economic independence of its central bank.

It is interesting to notice that in 1972 only 60% of the analyzed central banks presented, as one of their main goals, a legislative requirement to pursue monetary stability, criteria satisfied by all of them in 2010. A simple analysis of the changes in central bank objectives might appear sufficient to be able to proceed with a study on the relationship between inflation and CBI. However, the importance given to monetary stability differs among central banks.⁵ It is for this reason that we do not have to overlook the importance of the degree of economic independence of a central bank, because it is through its instruments that policymakers can really pursue its goals.

The economic independence indices presented in Table 1.2 reveal a higher average value than the political independence ones. In this case, as well, France and Italy represent the central banks that were influenced the most by central bank legislation reforms.⁶ These economies are followed by the United Kingdom, where the variation in economic independence was mainly determined by the reform that gave the power to the Financial Security Authority to supervise its banking system.

Appendix Table 1.A.1 highlights, for every country, the years of major legislative reforms and their impact on political and economic independence. It also underlines one of the most important information uncovered through our data collection: despite the large number of modifications brought to the central bank legislation, only few changes had a real impact on the de jure CBI indexes. Extreme cases are represented by the Bank of Canada and the Federal Reserve Bank, whose reforms did not adduce changes to their degree of independence.

⁵For example the primary objective of the ECB is to maintain *price stability* (art. 105, Consolidated Version of the Treaty Establishing the European Community), while the US Federal Reserve Bank aims to promote effectively the goals of *maximum employment, stable prices and moderate long-term interest rates* (section 2A, Federal Reserve Act).

⁶Our economic independence index for France has been prudentially computed as if Banque de France (BdF) shares banking supervision responsibility with other institutions, since the Banking Commission that is in charge of banking supervision in France is chaired by the Governor of the BdF and can receive resources from BdF. Empirical estimations presented in Section 1.5.2 have been implemented considering BdF partially involved in banking supervision. Knowing that this consideration differs from Grilli et al. (1991) and Masciandaro (2009), who consider BdF not involved in banking supervision, we also replicated our analysis using their assumptions. The overall results appear unchanged.

Table 1.2: GMT Economic Independence (1972-2010)

Countries	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Econ. Indep.
1972								
Australia	*	*	*	*		*		5
Canada	*	*	*	*		*	**	7
France				*	*	*	*	4
Germany	*	*	*	*	*	*	*	7
Italy				*				1
Japan	*		*			*	*	4
New Zealand			*	*		*		3
Switzerland		*	*	*	*	*	**	7
United Kingdom	*	*	*	*		*		5
United States	*	*	*	*	*	*	*	7
2010								
Australia	*	*	*	*		*	**	7
Canada	*	*	*	*		*	**	7
France	*	*	*	*	*		*	6
Germany	*	*	*	*	*		*	6
Italy	*	*	*	*	*			5
Japan	*		*			*	**	5
New Zealand		*	*	*	*	*		5
Switzerland	*	*	*	*	*	*	**	8
United Kingdom	*	*	*	*	*	*	**	8
United States	*	*	*	*	*	*	*	7

Note: (1) no automatic procedure for government to obtain direct credit from CB; (2) when available, credit is extended to government at market interest rates; (3) credit is temporary; (4) and for limited amount; (5) CB does not participate in primary market for public debt; (6) CB responsible for setting policy rate; and (7) CB has no responsibility to oversee banking sector (two points) or shares responsibility with other institutions (one point).

Source: National legislation.

Focusing our attention on the evolution of the central bank legislation in the aftermath of the recent financial crisis, it is important to notice that none of the amendments introduced had an impact on the degree of CBI. Indeed, since September 2008 most of the analyzed central banks intervened supplying huge amounts of short-term liquidity to the economy, in a context of stable inflation rates. Despite the broad consensus that financial regulation should have been reinforced and supervision tightened (Cukierman, 2011), only the Dodd-Frank Wall Street Reform and Consumer Protection Act, which leaves the independence of the Federal Reserve intact, has been introduced in the period 2007-2010.

We can summarize the analyzed data with two main insights: i) the creation of the European Central Bank and the European System of Central Banks led France and Italy

to a large improvement of their political and economic independence; ii) only a limited number of amendments modified the overall level of CBI and, thanks to their nature, these might generate shocks in the conduct of the monetary policy of a central bank.

1.3.2 Data

Our main dependent variable, the inflation rate, is based on quarterly data of the consumer price index (CPI), obtained from the IMF's International Financial Statistics (series 64...ZF), for the period 1972-2010. Inflation rate has been computed as:

$$\pi_{c,q} = 100 * [\ln(CPI_{c,q}) - \ln(CPI_{c,q-4})], \quad (1.1)$$

where $\pi_{c,q}$ denotes the annual inflation rate for country c in quarter q , with respect to the price level at the same quarter of the previous year.

In other studies, the inflation rate is computed as the yearly change in the level of CPI, then rescaled using the formula: $\pi_{c,q}/(1 + \pi_{c,q})$. This transformation is more useful for studies on emerging markets and developing countries, which are characterized by hyper-inflationary episodes. Knowing that this standardization might smooth our inflation rate dynamics, this chapter analyzes the relationship between inflation and CBI using the results obtained from equation (1.1). Whereas, the standardized inflation rate has been employed for robustness checks.

The other variables considered in our panel data analysis are: inflation targeting, openness to trade, output gap and real interest rate. Inflation targeting regimes data are obtained from [Roger \(2009\)](#) and central banks' websites; we construct a dummy variable that takes a value of 1 for every year after the adoption of an inflation targeting regime, and zero otherwise. Openness to trade, calculated as the sum of imports and exports divided by real GDP, is obtained from the Penn World Table 7.0 (series OPENK). The level of output gap is available in the IMF's World Economic Outlook (series NGAP-NPGDP). The real interest rate is computed applying the Fisher equation to the money market rate, obtained from the IMF's International Financial Statistics (series 60B..ZF).

1.4 Central Bank law reforms and Inflation rate dynamics

This section presents evidences concerning the relationship between central bank law reforms and inflation. First, we depict the correlation between the degree of political and economic independence of the different central banks and the inflation rate. Afterwards, we verify, with the use of unit root tests with structural breaks, if the dates of the different *endogenous* structural breaks in inflation rate dynamics correspond to the years of the changes in the central bank legislation that modified the level of CBI.

1.4.1 CBI indices ranking and inflation

The stylized negative correlation between inflation and central bank independence is confirmed using our CBI indices. A basic evidence of the negative relationship between CBI and inflation presented in early empirical studies is drawn on the negative correlation between the two, which is clear also here, as presented in Table 1.3.⁷

Table 1.3: Correlation between CBI indices and inflation

	Political Indep.	Economic Indep.
All countries	-0.3179***	-0.4731***
Australia	n.a.	-0.543***
Canada	n.a.	n.a.
France	-0.692***	-0.728***
Germany	-0.530***	0.530***
Italy	-0.754***	-0.748***
Japan	n.a.	-0.437***
New Zealand	-0.876***	-0.876***
Switzerland	-0.380**	-0.380**
United Kingdom	-0.540***	-0.540***
United States	n.a.	n.a.

Note: ***/** Significant at 1%/5%.

Table 1.4 presents, for each country, summary statistics concerning the 10 years average inflation rate, its standard deviation and the average ranking of political (P) and economic (E) independence. A clear evidence that economies with more independent

⁷We also checked the reliability of our dynamic CBI indices by examining the correlation between our indices and CWN de jure and de facto CBI indices. As expected, our indices are positively correlated (significant at 1%) with CWN legislative CBI index and negatively correlated with CWN turnover rate of central bank governor (de facto index).

Table 1.4: Inflation and CBI ranking evolution

Country	1970s		1980s		1990s		2000s	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ
Australia	10.433 (6 ; 5)	3.114	8.061 (6 ; 5)	1.965	2.451 (7 ; 6)	2.029	3.087 (8 ; 3)	0.890
Canada	8.100 (5 ; 1)	1.833	6.266 (5 ; 1)	3.054	2.164 (6 ; 1)	1.627	2.060 (6 ; 3)	0.662
France	9.260 (6 ; 7)	2.158	7.047 (6 ; 7)	4.128	1.865 (5 ; 6)	0.942	1.695 (1 ; 6)	0.648
Germany	4.891 (1 ; 1)	1.497	2.843 (1 ; 1)	2.132	2.474 (1 ; 4)	1.452	1.538 (1 ; 6)	0.615
Italy	13.139 (4 ; 10)	4.092	10.488 (4 ; 10)	5.323	4.030 (2 ; 10)	1.690	2.175 (1 ; 8)	0.683
Japan	9.032 (8 ; 7)	5.619	2.480 (8 ; 7)	2.207	1.196 (10 ; 9)	1.235	-0.301 (10 ; 8)	0.729
New Zealand	11.490 (10 ; 9)	3.043	11.126 (10 ; 9)	4.326	2.103 (7 ; 8)	1.646	2.677 (8 ; 8)	0.619
Switzerland	4.782 (2 ; 1)	3.304	3.206 (2 ; 1)	1.718	2.294 (3 ; 1)	2.082	0.923 (4 ; 2)	0.697
United Kingdom	12.812 (8 ; 5)	4.893	6.746 (8 ; 5)	3.825	3.080 (9 ; 5)	2.221	1.951 (6 ; 1)	0.857
United States	7.300 (2 ; 1)	2.549	5.351 (2 ; 1)	3.350	2.954 (3 ; 1)	1.052	2.448 (5 ; 3)	1.160

Note: Political and Economic independence average ranking into parentheses (P;E).

central banks are characterized by a lower inflation rate can be seen here. Japan is an exception, being characterized by a low level of economic and political independence, but having, at the same time, one of the lowest average inflation rate during the period 1972-2010. This evidence might be influenced by the fact that since 1996 the money market interest rate in the country has been lower than 0.50%. Such an exceptional situation limited the set of policy instruments available to policymakers and, consequently, the possible implementation of inflationary policies.

In Appendix Table 3.1, we provide a further comparison between clusters of countries with more independent central banks versus less independent central banks. Column 1 presents the evidence obtained by clustering central banks according to their ranking of economic independence, while column 2 presents information obtained by clustering the analyzed countries on the basis of their political independence index. Columns 3 and 4 present the same information excluding Japan from the sample, since this country was characterized by an uncommon (negative) level of inflation and, at the same time, by a low degree of CBI.

1.4.2 Unit root tests with structural breaks

In the context of dynamic CBI stressed in this chapter, it is possible to identify whether central bank law reforms can be associated with structural breaks in the inflation rate dynamics. This hypothesis is tested here through unit root tests with structural changes.

Theoretical background

A popular methodology used to test for the presence of unit roots in a series is the Augmented Dickey-Fuller (ADF) test developed by [Dickey and Fuller \(1979\)](#). For a series characterized by the presence of a constant and a trend, as our inflation rate, the tested equation is the following:

$$\Delta\pi_t = u + \beta t + \alpha\pi_{t-1} + \sum_{i=1}^k c_i \Delta\pi_{t-i} + \epsilon_t, \quad (1.2)$$

where we want to test the null hypothesis of $\alpha = 0$, i.e. non-stationarity, against the alternative hypothesis of $\alpha \leq 0$; and Δ denotes the first difference, π_t is the inflation rate being tested, t is the time trend variable and k is the number of lags which are added to the model to ensure that the residuals ϵ_t are white noise.

However, in order to identify if changes in the level of CBI can be considered as structural breaks in the dynamic of the inflation rate, we focus on more recent developments in the literature on unit root tests. [Perron \(1989\)](#) introduced the concept of structural breaks, showing that the ADF test is biased toward the non-rejection of the null hypothesis in the presence of a structural break. He proposes a modified Dickey-Fuller unit root test including dummy variables to account for one known or *exogenous* structural break.

This methodology, however, assumes the selection of *a priori* structural breaks based on an ex post estimation or knowledge of the data which could lead to an over rejection of the unit root hypothesis. To overcome these drawbacks, many studies (e.g. [Banerjee et al., 1992](#); [Zivot and Andrews, 1992](#); [Perron and Vogelsang, 1992](#)) show that biases in the usual unit root test could be reduced by considering an *endogenous* structural break. Among these alternative tests, the most used in empirical analysis are the [Zivot and Andrews \(1992\)](#) and the [Perron and Vogelsang \(1992\)](#) test.

The [Zivot and Andrews \(1992\)](#) test analyzes the null hypothesis of a unit root in a

series with no break against the alternative of a trend stationary process which combines one-time changes in the level and in the slope of the trend function of the series. In this test the break date is selected in the point where the t-statistic testing the null of unit root is at a minimum. [Zivot and Andrews](#)'s specification is the following:

$$\begin{aligned} \Delta\pi_t = & u + \beta t + \alpha\pi_{t-1} + \theta DU_t + \gamma DT_t \\ & + \sum_{i=1}^k c_i \Delta\pi_{t-i} + \epsilon_t, \end{aligned} \quad (1.3)$$

with DU_t a dummy variable for a mean shift occurring at each possible time break-date; and DT_t a trend shift variable.

[Perron and Vogelsang \(1992\)](#) propose a unit root test with a break for two different situations, so to be able to consider the presence of an Additive Outlier (AO) or an Innovational Outlier (IO). The AO model allows for a sudden change in mean (shock), while the IO model allows for more gradual changes. Both tests are based on the minimal value of the t-statistics on the sum of the autoregressive coefficients over all possible breakpoints in the appropriate autoregression. Since a variation in the level of CBI might generate a sudden change in the inflation rate mean, we will present the results relative to the additive outliers (AO) model. This model is characterized by a two-step procedure, where the first step removes the deterministic part of the series, through the estimation of the following regression:

$$\pi_t = \mu + \delta DU_t + \epsilon_t, \quad (1.4)$$

where the dummy variable $DU_t = 1$ if $t > T_B$ (time break), and zero otherwise, with $t = 1, \dots, T$.

The residuals obtained from the previous regression are then tested for the presence of a unit root estimating:

$$\begin{aligned}\Delta\epsilon_t &= \sum_{i=0}^k \omega_i DTB_{t-1} + \alpha\epsilon_{t-1} \\ &+ \sum_{i=1}^k c_i \Delta\epsilon_{t-i} + e_t,\end{aligned}\tag{1.5}$$

where the dummy variable $DTB_t = 1$ if $t > T_B + 1$, and zero otherwise, with $t = k + 2, \dots, T$. In this case the dummy variable DTB_{t-1} is included to ensure that the t-statistic on α is invariant to the lag truncation parameter k .

Going further, more recent studies (Clemente et al., 1998) find evidence that many economic time series might contain more than one structural break. This situation could correctly characterize our inflation rate series, because during the last 4 decades, international structural breaks could be identified, for example, during (i) the two oil prices crises; (ii) the dot-com bubble burst; or (iii) the financial crisis started in 2007.

Given the possibility of many structural breaks in our series, we extended our analysis considering the Clemente et al. (1998) test which allows the identification of two structural breaks. Considering the case where the shifts are better represented as additive outliers (AO model), they test the unit root null hypothesis through the following two-step procedure. First, they remove the deterministic part of the variable by estimating the following model:

$$y_t = \mu + d_1 DU_{1t} + d_2 DU_{2t} + \tilde{y}_t.\tag{1.6}$$

Subsequently, they carry out the test by searching for the minimal t-ratio for the $\rho = 1$ hypothesis in the following model:

$$\begin{aligned}\tilde{y}_t &= \sum_{i=0}^k \omega_{1i} DTB_{1t-1} + \sum_{i=0}^k \omega_{2i} DTB_{2t-1} \\ &+ \rho\tilde{y}_{t-1} + \sum_{i=1}^k c_i \Delta\tilde{y}_{t-i} + e_t,\end{aligned}\tag{1.7}$$

Empirical results

Table 1.5 presents the unit root properties of quarterly data inflation rate for the period 1972-2010.

The results of the ADF tests for the inflation rate, reported in Table 1.5, reveal that the unit root hypothesis is rejected at a 5% level for three of the ten analyzed countries, Germany, Japan and Switzerland; and at 10% for Australia. However, as already mentioned, the ADF test has low power when the analyzed time series are characterized by the presence of one or more structural breaks. Indeed, [Zivot and Andrews](#) tests provide evidence of no unit root with a structural break (at a 5% level) for six of our ten countries: Australia, Italy, Japan, New Zealand and United States; and also for Canada at a 10%.

Table 1.5: Unit Root tests

	ADF	k	ZA	k	PV	k	CMR	k
Australia	-3.341*	5	-7.538**	3	-3.913**	4	-4.413	4
			(1996:4)		(1989:3)**		(1977:1)** ; (1990:2)**	
Canada	-2.275	10	-4.676*	1	-3.058	4	-5.559**	6
			(1994:2)		(1983:3)**		(1983:3)** ; (1992:2)**	
France	-1.543	9	-4.404	1	-4.824**	6	-5.943**	6
			(1993:3)		(1986:3)**		(1984:4)** ; (1993:1)**	
Germany	-3.472**	7	-3.907	3	-3.378	1	-4.555	5
			(1986:1)		(1984:4)**		(1984:4)** ; (1991:3)	
Italy	-1.962	10	-5.228**	1	-2.585	9	-4.717	5
			(1997:1)		(1985:2)**		(1985:1)** ; (1996:4)**	
Japan	-3.722**	9	-9.647**	3	-3.519	12	-0.435	4
			(1983:1)		(1978:3)**		(1974:1)** ; (1998:1)**	
New Zealand	-2.713	10	-4.555**	1	-2.983	12	-3.468	12
			(1999:1)		(1989:1)**		(1986:4)** ; (1989:3)**	
Switzerland	-5.274**	7	-4.379	3	-2.334	9	-3.505	6
			(1978:3)		(1976:3)**		(1974:1)** ; (1995:1)**	
United Kingdom	-3.006	10	-4.369	3	-2.482	12	-3.593	10
			(1986:3)		(1983:3)**		(1976:4)** ; (1983:1)**	
United States	-2.750	10	-5.175**	3	-1.879	12	-2.099	12
			(1986:4)		(1983:2)**		(1979:2)** ; (1982:2)**	

Note: ZA = [Zivot and Andrews](#); PV = [Perron and Vogelsang](#); CMR = [Clemente et al.](#); k = number of lags; Structural Break date between parentheses.

**/* Significant at 5%/10%.

The main goal of testing for the presence of a unit root with one or two structural breaks in the inflation rate is the possibility to identify the exact date of *endogenous* structural breaks in our series. The *endogenous* break dates obtained from the [Perron and Vogelsang](#) test are closely associated, for six countries, with the oil price fall of the early eighties, phenomenon generated by the oil glut of the time, that forced, during

the period 1980-1986, the OPEC cartel to decrease oil production several times to keep oil prices high, even if their attempt failed and oil prices fell. Moreover, during these years many countries started to concentrate their efforts in maintaining a stable and low inflation rate (beginning of the Great Moderation period).

When we allow for two structural breaks in the mean of our series (Clemente et al. test), we obtain almost the same break dates for Canada, France, Germany, Italy, New Zealand, United Kingdom and United States. If for the vast majority of our advanced economies the first date of “endogenous” breaks obtained can be associated to the oil prices shocks and the subsequent decline of inflation in the early 1980s, looking at the second structural break an interesting evidence is found. From the analysis presented in Section 1.3.1, four countries have been characterized by big improvements in the degree of political and/or economic independence of their central banks: France, Italy, New Zealand and United Kingdom. Indeed, for France and New Zealand we have a clear evidence that the break years correspond to the ones of the implementation of the new central bank legislation; while for Italy the date of the second structural break appears between the two years for which we observed central bank reforms in the country (1993 and 1998). Indeed, after the adoption of the Maastricht Treaty, Italy was influenced by drastic changes in the implementation of its monetary policy. For the United Kingdom the two structural breaks correspond to the period of big reforms brought by Thatcher’s government, so, for this country, we can say that the central bank legislation changes that improved the CBI indices do not represent one of the two main structural breaks during the period 1972-2010. Similar evidences, not reported here, have been found by applying the same unit root tests on the standardized inflation rate.

These first results confirm that, for countries characterized by both improvements in the level of CBI and drastic changes in the monetary policies of the central bank, it is possible to identify a structural break in the inflation rate dynamics, which corresponds to the exact moment of those changes. Indeed, with the adoption of the Reserve Bank Act of 1989 and the accompanying Policy Targets Agreement, the Reserve Bank of New Zealand moved from a purely discretionary monetary policy system to one where its legislative mandate was to preserve price stability. Similar considerations can be drawn for France and Italy, countries for which: a) legislative reforms have been implemented in 1993 and 1998, and b) central bank practices drastically changed during the period

1993-1998, in order to prepare their national central banks for the adoption of the euro and the delegation of their monetary policy power to the European Central Bank. Based on this evidence, we can safely conclude that reforms that highly modify the degree of independence of a central bank are generally associated with changes in the monetary policies which ultimately have a real impact on inflation.

Alternative methods for identifying structural breaks

We verify the robustness of the break dates identified through the unit root tests with structural breaks using the testing strategy proposed by [Zeileis et al. \(2003\)](#). They implement a dynamic programming algorithm for dating breakpoints in data, following the model proposed by [Bai and Perron \(2003\)](#).

Considering the standard linear regression model:

$$y_i = x_i^T \beta_i + u_i \quad (i = 1, \dots, n), \quad (1.8)$$

where x_i is a $k \times 1$ vector of regressors and β_i is the $k \times 1$ vector of regression coefficients, which may vary over time, we test the hypothesis that the regression coefficient remains constant:

$$H_0 : \beta_i = \beta_0 \quad (i = 1, \dots, n), \quad (1.9)$$

against the alternative that at least one coefficient varies over time.

Critical values for the F-statistic are tabulated by [Hansen \(1997\)](#). After identifying the number of structural breaks, the coefficients of β_i are estimated for each partition. The procedure to identify the date of the structural breaks implies finding the breakpoints that minimize the residual sum of squares over each section.

This methodology allows us to identify up to 5 abrupt structural changes in our inflation rate series. These results are presented in Appendix Section [1.B](#). In line with the breakpoints identified using the [Clemente et al. \(1998\)](#) test, one of the structural breaks was identified in the year of the implementation of central bank law reform for France and New Zealand, and during the period 1993-1998 for Italy. Thus, we have a confirmation of the robustness of the previously identified structural changes.

1.5 Panel data analysis

In the first part of this section we present the results obtained from panel unit root tests used to verify the presence of a unit root in our panel of inflation series, since the rest of our estimation relies on the stationarity of the variables employed. In the second part, we present the main evidence obtained from panel data regressions implemented to identify the relationship between political and economic independence indices and inflation.

1.5.1 Panel unit root tests

We first verify if our panel of inflation rate is stationary using a second generation panel unit root test, proposed by [Breitung and Das \(2008\)](#).⁸ A second generation panel unit root test is characterized by the assumption that the observed panels present a cross-sectional dependence.

The first requirement for the selection of a correct panel unit root test is to look at the dimension of the analyzed series. In our case we test annual inflation rate data from 1972 to 2010 ($T=39$) for 10 countries ($N=10$) (390 observations), with the particularity that our panel presents a number of units (N) lower than the number of individual observations (T). Since the most common panel unit root tests of second generation (see [Gengenbach et al., 2008](#), for a summary), require the presence of a large number of units (N), we look at alternative panel unit root tests like the [Breitung and Das \(2008\)](#) and the [Sul \(2009\)](#) ones. These tests have been implemented for panel characterized by a number of units (N) smaller than the number of individual observations (T). Among them we test the [Breitung and Das \(2008\)](#) one.

For data characterized by a different constant (starting point) and a similar general trend (in our case an overall reduction of the inflation rate for all the observed units), [Breitung and Das \(2008\)](#) suggest to compute the panel unit root test on the following “reduced form” regression:

$$\Delta\pi_{\mathbf{t}} = \phi(\pi_{\mathbf{t}-1} + \pi_0) + \mathbf{e}_{\mathbf{t}}, \quad (1.10)$$

⁸We exclude from our analysis the first generation of panel unit root tests (see [Baltagi, 2005](#), for a complete overview), because their main limitation is that these are all constructed under the assumption that the different time series of the panel are cross-sectionally independently distributed.

where $\Delta\pi_{\mathbf{t}} = (\Delta\pi_{1,t}, \dots, \Delta\pi_{N,t})'$, $\pi_{\mathbf{t}-1} = (\Delta\pi_{1,t-1}, \dots, \Delta\pi_{N,t-1})'$, and $\mathbf{e}_{\mathbf{t}} = (e_{1,t}, \dots, e_{N,t})'$.

It is important to notice that, aiming to eliminate the possible distortion generated by each individual specific constant, the test has been calculated removing from each individual observation the initial level of the inflation rate (π_0). Using this approach, [Breitung and Das \(2008\)](#) calculate two test statistics: t_{rob} (the adjusted OLS statistic) and t_{GLS} (Generalized Least Square statistic).

Table 1.6: [Breitung and Das](#) panel unit root test

Variables	Full sample	Restricted sample
$(\pi_{c,t} - \pi_{c,0})$		
t_{rob}	-1.381*	-1.328*
t_{GLS}	-2.063**	-1.646**
$(RIR_{c,t} - RIR_{c,0})$		
t_{rob}	-1.718**	-1.950**
t_{GLS}	-2.429**	-2.441**

Note: RIR = Real interest rate.

**/* Significant at 5%/10%.

Table 1.6 summarizes the results obtained applying the [Breitung and Das \(2008\)](#) panel unit root tests on our modified inflation assuming the presence of a general time trend. The same procedure has been applied to the real interest rate (RIR). In addition to the panel unit root tests performed considering all the analyzed countries (full sample), we verify if our panel inflation rate and the real interest rate are still stationary after the omission of the two countries (restricted sample) whose political and economic independence indices did not change over time: Canada and United States. Both the robust t-statistic and the GLS t-statistic obtained for all the implemented tests strongly indicate rejection of the unit root null hypothesis.

1.5.2 Political and Economic independence and Inflation

Once the stationarity of inflation rate is confirmed, we proceed with a panel data analysis.

We first identify the relationship between inflation and political and economic independence indices by estimating:

$$\pi_{c,t} = \alpha\pi_{c,t-1} + \gamma E_{c,t} + \delta P_{c,t} + \rho_c + \varphi_t + \epsilon_{c,t}, \quad (1.11)$$

where $\pi_{c,t-1}$ represents the lagged inflation rate, $E_{c,t}$ is the dynamic economic independence index, $P_{c,t}$ is the dynamic political independence index, ρ_c is a dummy variable of each country, φ_t represents the year dummies and $\epsilon_{c,t}$ is the error term.

Table 1.7: OLS Fixed Effects regression for inflation and CBI (1972-2010)

	Full sample		Restricted sample	
	(1)	(2)	(3)	(4)
Inflation _{t-1}	0.6488*** (0.04)	0.7916*** (0.02)	0.6584*** (0.04)	0.7786*** (0.02)
Political indep.	-0.2858 (0.51)	-0.9934 (0.69)	-0.3875 (0.56)	-1.0585 (0.74)
Economic indep.	-2.9917*** (0.72)	-2.9520** (0.95)	-3.0198*** (0.70)	-3.1442** (1.03)
Constant	7.0706*** (0.73)	3.4750*** (0.76)	7.1116*** (0.88)	3.7027*** (0.83)
Country Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes		Yes	
R^2	0.89	0.78	0.89	0.79
No. of Obs.	380	380	304	304

Note: Robust standard errors, adjusted for clustering by country, in parentheses.
 ***/** Significant at 1%/5%.

Columns 1-2 of Table 1.7 examine the whole sample, while columns 3-4 repeat the same regression for the group of countries whose political and/or economic independence changed during the period 1972-2010.⁹ In all the estimations there is evidence of a negative effect of the economic independence index on inflation, statistically significant at 1%. The coefficients across columns are quite similar, ranging from -2.992 to -3.144. These estimates imply that an economic independence index is associated with a lower annual inflation rate of 3.0/3.1%. Consistent with Grilli et al. (1991), the political independence index is not statistically significant.

Even if the results presented in Table 1.7 are consistent with the literature, two main concerns have been raised with this type of estimations.

The first criticism has been pointed out by Campillo and Miron (1997), who consider

⁹Following Arnone et al. (2009) we standardize both political and economic independence indices, so to obtain scores ranging between zero and one.

that these estimations might lose significance with the inclusion of a number of key variables, such as openness to trade, an index of political stability, the level of GDP and debt to GDP, that might influence the inflation rate.

The second problem is related to the inclusion, in the estimated equation, of both fixed effects and lagged dependent variables. In the presence of lagged dependent variables, our key regressor $\pi_{c,t}$ and its lagged value will be mechanically correlated with $\epsilon_{c,s}$ for $s < t$, so that the fixed effects estimator is inconsistent (see Wooldridge, 2001, Ch. 11).

We implement next a more rigorous test through the inclusion of several control variables. However, to obtain a consistent estimation we have to identify the right econometric model to apply to our panel. To be more precise we have to analyze time-series-cross-section (TSCS) data, because in our sample the number of individual observations is bigger than the cross-sectional dimension ($T > N$). The best estimation model to use in this case is represented by the ordinary least squares (OLS) regressions with “panel corrected standard errors” (PCSEs) (Beck and Katz, 1995), that is characterized by the following pooled model:¹⁰

$$\pi_{c,t} = \beta \mathbf{x}_{c,t} + \epsilon_{c,t}, \quad (1.12)$$

where $\pi_{c,t}$ is the observation for our dependent variable in country c , at time t , with $c=1, \dots, N$ and $t=1, \dots, T$; and $\mathbf{x}_{c,t}$ represents a vector of independent variables.

Even though theoretical analyses suggest that the best estimation model to use with time-series-cross-section-data is represented by the panel corrected standard errors, we proceeded with a double check, testing the Breusch-Pagan Lagrangian multiplier for random effects. This test checks if an analysis with random effects should be preferred to an analysis with a pooled model. The test confirms the better fit of the pooled model.

We extended our analysis to include other key determinant variables of the inflation rate: (i) an index of openness to trade, as suggested by Campillo and Miron (1997);¹¹

¹⁰In their influential paper on time-series-cross-section (TSCS) data analysis, Beck and Katz (1995) demonstrated that Feasible Generalized Least Squares (FGLS) produces coefficient standard errors that are severely underestimated. Through a Monte Carlo simulation they showed that Panel Corrected Standard Errors (PCSE) estimator produces accurate standard error estimates with no or little loss in efficiency compared to FGLS.

¹¹From the determinants of inflation rate considered by Campillo and Miron (1997), we do not include the political stability index for two main reasons: (i) almost all the data concerning political stability index are only available since 1990s; and (ii) we assume that our group of advanced economies

(ii) an index of the output gap, as elaborated by the IMF; (iii) an inflation targeting (IT) dummy capturing the year of the adoption of IT policies; (iv) the real interest rate; and (v) year dummy variables, to incorporate the year effects in our model.

Results are presented in Table 1.8, where, same as before, columns 1 and 2 examine the whole sample, while columns 3 and 4 the restricted sample, including only countries whose political and/or economic independence changed during the analyzed period. In every regression we consider the presence of a first-order autocorrelation AR(1), within panels.

Table 1.8: PCSE regression for inflation and CBI (1972-2010)

	Full sample		Restricted sample	
	(1)	(2)	(3)	(4)
Political indep.	-0.5119 (1.00)	-0.4801 (0.95)	-1.0809 (1.26)	-0.8044 (1.08)
Economic indep.	-3.9744*** (1.32)	-4.0627*** (0.98)	-4.2867*** (1.47)	-4.7132*** (1.06)
Openness to trade	0.0056 (0.02)	-0.0009 (0.01)	0.0254 (0.03)	0.0114 (0.01)
Output Gap	0.1069* (0.06)	0.0100 (0.04)	0.1028 (0.06)	0.0322 (0.05)
Inflation Targeting	0.3849 (0.78)	0.3306 (0.53)	0.1853 (0.94)	0.1747 (0.65)
Real Interest Rate		-0.4648*** (0.04)		-0.4694*** (0.04)
Constant	7.3394*** (1.18)	9.0634*** (0.69)	7.5880*** (1.27)	9.3528*** (0.75)
Year Dummy	Yes	Yes	Yes	Yes
AR(1)	Yes	Yes	Yes	Yes
R^2	0.56	0.72	0.55	0.72
No. of Obs.	380	354	304	283

Note: Panel corrected standard error (PCSE), in parentheses.

***/**/* Significant at 1%/5%/10%.

The evidence presented in Table 1.8 confirms the significance of the economic independence index in explaining inflation rate dynamics. The economic independence index is statistically significant at 1%, and its coefficient estimates range from -3.97 to

is characterized by similar levels of political stability. The main results reported here relate only to the openness to trade index. We re-estimate, however, the model to include the other suggested variables: a) log GDP per capita; b) log GDP; and c) public debt / GDP. Our results are robust also under these specifications and are available upon request.

-4.71. Real interest rate is also highly significant and its negative sign underlines how an increase in the real cost of borrowings contributes to lowering the inflation rate.

As in our previous regressions, and in line with the main findings of [Grilli et al. \(1991\)](#), the political independence index is not statistically significant. Despite this evidence, Appendix Table [1.C.3](#) and Appendix Table [1.C.4](#) confirm the negative relationship between inflation and the overall GMT CBI index (Table [1.C.3](#)), computed by summing-up political and economic independence indices, and the CWN CBI index (Table [1.C.4](#)).

Moreover, our results point to no relationship between inflation and openness to trade. This result is in line with previous evidence that remarks how this relationship is confined to severely indebted countries and is only evident during the '80s ([Terra, 1998](#)). Furthermore, we do not find any evidence of a link between inflation targeting and inflation. Similar results have been obtained in previous works by [Ball and Sheridan \(2003\)](#) and [Lin and Ye \(2007\)](#) that show how inflation targeting has no significant impact on inflation in developed countries.

To test the robustness of our results, we implement the same analysis using as dependent variable the standardized inflation rate, as well as, inflation rate volatility computed as a three years moving standard deviation of the inflation rate. Furthermore, it has been argued that the negative relationship between CBI and inflation may be influenced by the dynamics of these two variables over time, i.e. progressive increase for the former one, and decrease of the latter one. We explicitly test for this by restricting our analysis to the period 1995-2010, which saw a more stable inflation rate. The results obtained in Table [1.8](#) are confirmed using all these alternative specifications.¹²

1.5.3 The importance of dynamic CBI indices

In order to underline the importance of adopting dynamic CBI indices, we re-estimate our model by replacing our economic and political independence indices by two dummy variables which value one for all the years after a central bank reform that modified the level of economic and/or political independence of the central bank, following the approach of [Polillo and Guillén \(2005\)](#) and [Acemoglu et al. \(2008\)](#).

From the results presented in Table [1.9](#), these new political and the economic in-

¹²Results are not reported here, but are available upon request.

Table 1.9: PCSE regression for inflation and CBI dummy (1972-2010)

	Full sample		Restricted sample	
	(1)	(2)	(3)	(4)
Political indep. (Dummy)	0.4034 (1.16)	0.9354 (0.60)	0.4651 (1.17)	1.0744* (0.65)
Economic indep. (Dummy)	-0.5220 (1.10)	-0.4625 (0.57)	-0.5459 (1.20)	-0.5134 (0.67)
Openness to trade	-0.0102 (0.02)	-0.0205* (0.01)	-0.0110 (0.03)	-0.0291** (0.01)
Output Gap	0.1134* (0.06)	0.0330 (0.04)	0.1247* (0.07)	0.0635 (0.04)
Inflation Targeting	0.4424 (0.73)	0.4568 (0.56)	0.3394 (0.85)	0.3352 (0.65)
Real Interest Rate		-0.4605*** (0.04)		-0.4667*** (0.04)
Constant	5.0012*** (0.81)	6.5632*** (0.55)	5.5720*** (1.04)	7.0779*** (0.67)
Year Dummy	Yes	Yes	Yes	Yes
AR(1)	Yes	Yes	Yes	Yes
R^2	0.53	0.70	0.53	0.70
No. of Obs.	380	354	304	283

Note: Panel corrected standard error (PCSE), in parentheses.
 ***/**/* Significant at 1%/5%/10%.

dependence indices do not appear significant, since the inclusion of dummy variables for CBI indices might generate possible distortion of the estimators. This robustness check provides clear evidence of the importance of adopting dynamic CBI indices. If the regressions presented in Table 1.8 reveal a negative and statistically significant economic independence index, substituting its real value with a dummy variable implies the loss of its significance in all the analyzed regressions. Similar results, presented in Appendix Table 1.C.5, have been obtained replacing our overall CBI index with a dummy variable able to capture the implementation of central bank law reforms.

Our evidence underlines the fact that a better way to analyze the relationship between inflation and CBI might require the use dynamic CBI indices, such as the ones proposed in our study.

1.6 Conclusions

Several conclusions can be drawn from our study. Our results confirm the effectiveness of central bank reforms that highly modify the level of CBI, since these changes represent structural breaks for the inflation rate dynamics. This evidence confirms the belief that credible changes in the degree of independence of a central bank can affect the inflation rate dynamics by influencing the inflationary expectations of economic agents.

Based on a panel data analysis for the period 1972-2010, this chapter confirms the negative relationship between inflation and an index of economic independence, computed following the procedure set up by [Grilli et al. \(1991\)](#). In line with their results, we do not find a significant relationship between inflation and an index of political independence. Moreover, the negative relationship is confirmed analyzing both the [Grilli et al. \(1991\)](#) and the [Cukierman et al. \(1992\)](#) overall CBI indices.

We provide evidence concerning the importance of computing dynamic CBI indices. Throughout our analysis we underline how the level of CBI changed drastically for some of the analyzed countries. Thus, by computing dynamic CBI indices, we are better able to capture the link between the degree of central bank independence and inflation. This is confirmed by comparing the estimates obtained by using dynamic CBI indices and the ones implemented with a dummy variable that captures changes in CBI indices, but not their magnitude.

We focus here on a sample of advanced economies, however future research might investigate whether changes in central bank legislation represent structural breaks in inflation rate dynamics also for emerging markets and developing countries. For these economies, the results may differ, considering the previous evidence obtained by [Cukierman et al. \(1992\)](#) and [Crowe and Meade \(2008\)](#), due to the different economic and fiscal structure of these economies.

The Global Financial Crisis brought new light to the concept of central bank independence and the need to reconsider the central bank's role for banking supervision ([Masciandaro, 2012](#)) and financial stability. However, new time inconsistency problems may arise in the presence of conflicting central bank objectives, i.e. price and financial stability ([Ueda and Valencia, 2014](#)). For this reason, future research might be directed to extending central bank independence indices to include not only indicators of central

bank financial strength ([Perera et al., 2013](#)), but also the presence of possible conflicting objectives in the mandate of the central bank.

Appendices

1.A Reforms and clustering evidences

Table 1.A.1: Central bank reforms with influence on CBI

Country	Reformed central banks legislation	Year of reform	Δ Pol. Indep.	Δ Econ. Indep.
Australia	Banking Act 1959, as amended by Act No. 54 of 1998	1998		+2
Canada	Bank of Canada Act 1985	1985		
France	Loi sur la Banque de France, as amended by Act No. 93-980 of 1993	1993	+3	+2
	Statute of the European System of Central Banks and of the European Central Bank, 1998	1998	+3	
Germany	Statute of the European System of Central Banks and of the European Central Bank, 1998	1998	+2	-1
Italy	Consolidated Version of the Treaty on European Union and of the Treaty Establishing the European Community	1993	+3	+4
	Statute of the European System of Central Banks and of the European Central Bank, 1998	1998	+1	
Japan	Banking Act	2000		+1
New Zealand	Reserve Bank of New Zealand Act 1989	1989	+2	+2
Switzerland	Federal Act on the Swiss National Bank, as amended in 2003	2003	+1	+1
United Kingdom	Bank of England Act 1998	1998	+2	+3
United States	Dodd-Frank Wall Street Reform and Consumer Protection Act	2010		

Source: National legislation.

Table 1.A.2: CBI and Inflation (clustering evidences)

	All countries		Excluding Japan	
	Economic Ind.	Political Ind.	Economic Ind.	Political Ind.
1970s				
More independent CBs	8.05 (2.27)	7.64 (1.94)	8.05 (2.27)	7.64 (1.94)
Less independent CBs	10.73 (2.95)	10.61 (3.15)	11.30 (2.31)	11.00 (2.72)
1980s				
More independent CBs	5.41 (1.53)	5.87 (1.51)	5.41 (1.53)	5.87 (1.51)
Less independent CBs	7.79 (2.00)	7.10 (2.03)	9.55 (2.23)	8.64 (2.27)
1990s				
More independent CBs	2.35 (0.74)	2.72 (0.71)	2.35 (0.74)	2.72 (0.71)
Less independent CBs	2.57 (1.13)	2.20 (1.17)	2.92 (1.21)	2.45 (1.26)
2000s				
More independent CBs	1.88 (0.53)	1.76 (0.50)	1.88 (0.53)	1.76 (0.50)
Less independent CBs	1.75 (0.58)	1.89 (0.60)	2.43 (0.61)	2.44 (0.62)

Note: Standard deviation between parentheses.

1.B Alternative methods for structural breaks

Figure 1.B.1: Inflation rate dynamics and structural breaks (1972-2010)

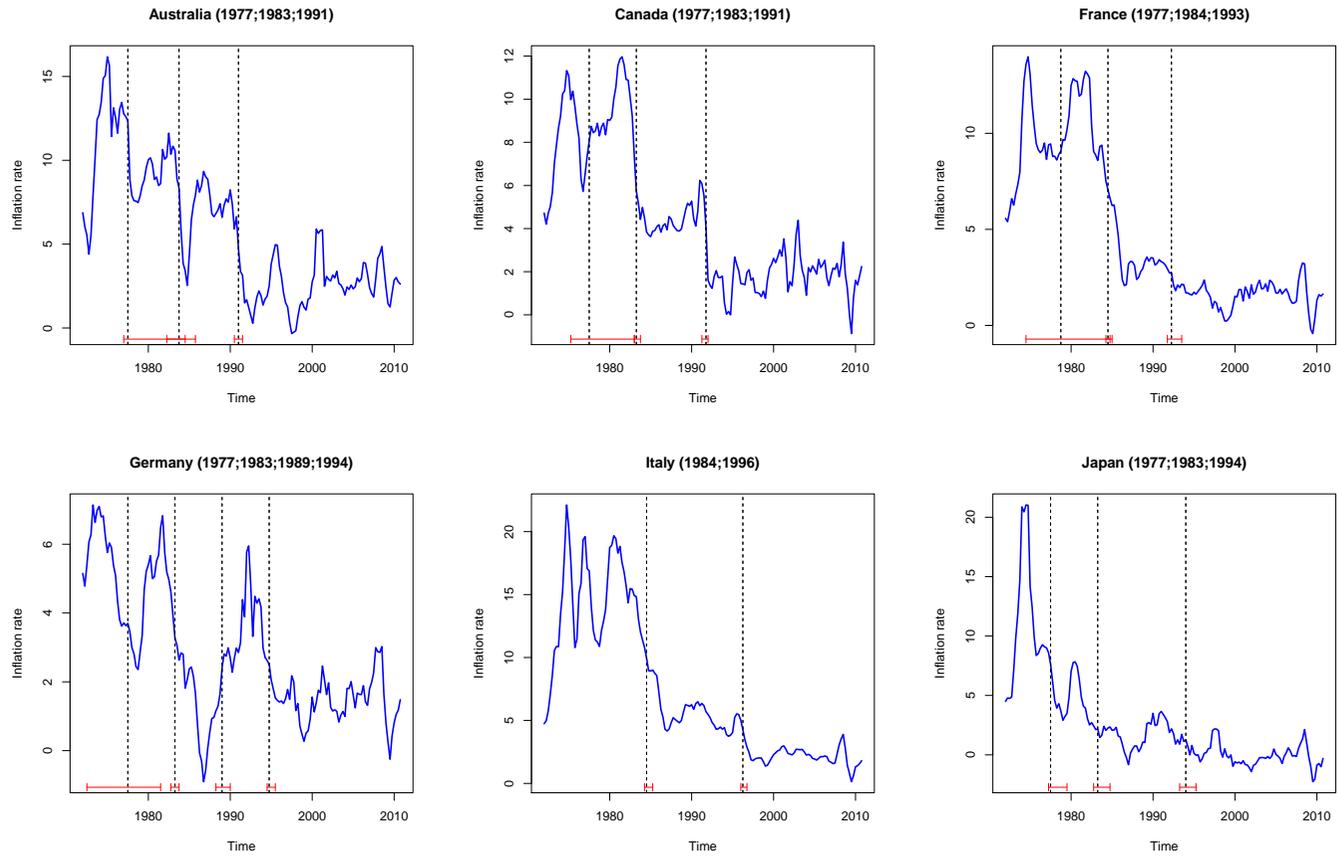
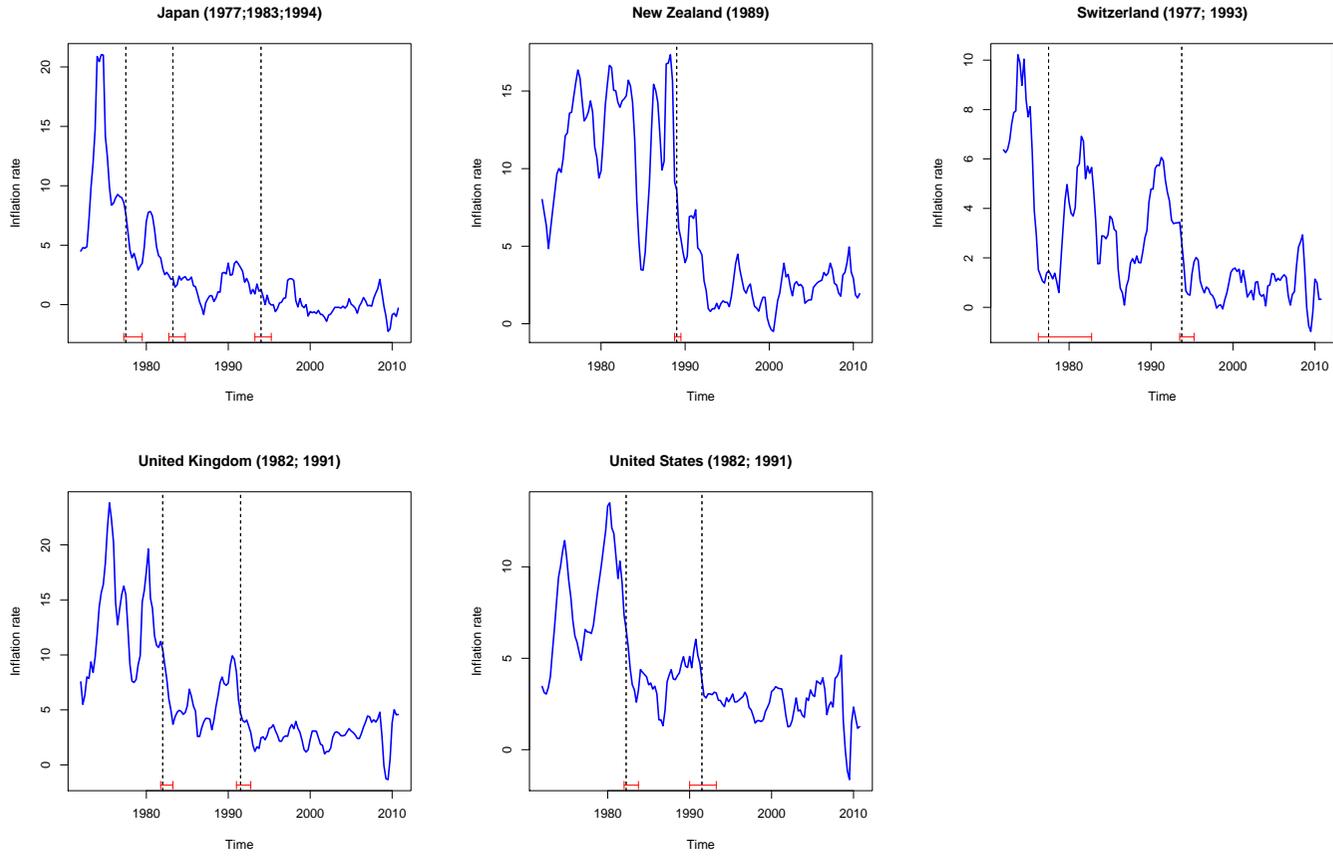


Figure 1.B.2: Inflation rate dynamics and structural breaks (1972-2010)



1.C Robustness checks

Table 1.C.3: PCSE regression for inflation and overall GMT CBI (1972-2010)

	Full sample		Restricted sample	
	(1)	(2)	(3)	(4)
GMT CBI	-4.1829*** (1.52)	-4.5437*** (0.91)	-5.0243*** (1.88)	-5.5850*** (1.16)
Openness to trade	0.0127 (0.02)	0.0089 (0.01)	0.0342 (0.03)	0.0272** (0.01)
Output Gap	0.1055* (0.06)	0.0268 (0.04)	0.1027 (0.07)	0.0479 (0.05)
Inflation Targeting	-0.0580 (0.71)	-0.0949 (0.51)	-0.2321 (0.86)	-0.3309 (0.61)
Real Interest Rate		-0.4510*** (0.04)		-0.4582*** (0.04)
Constant	7.0003*** (1.15)	8.8062*** (0.65)	7.2497*** (1.26)	9.0457*** (0.72)
Year Dummy	Yes	Yes	Yes	Yes
AR(1)	Yes	Yes	Yes	Yes
R^2	0.56	0.71	0.55	0.71
No. of Obs.	380	354	304	283

Note: Panel corrected standard error (PCSE), in parentheses.
 ***/**/* Significant at 1%/5%/10%.

Table 1.C.4: PCSE regression for inflation and CWN CBI (1972-2010)

	Full sample		Restricted sample	
	(1)	(2)	(3)	(4)
CWN CBI	-2.9181** (1.49)	-3.0993*** (0.94)	-2.9863* (1.65)	-3.1925*** (1.01)
Openness to trade	0.0094 (0.02)	0.0047 (0.01)	0.0155 (0.03)	0.0048 (0.01)
Output Gap	0.1126* (0.06)	0.0351 (0.04)	0.1184* (0.07)	0.0630 (0.05)
Inflation Targeting	-0.1640 (0.75)	-0.1672 (0.52)	-0.3089 (0.91)	-0.3450 (0.62)
Real Interest Rate		-0.4433*** (0.04)		-0.4510*** (0.04)
Constant	6.2160*** (1.04)	7.8285*** (0.61)	6.6164*** (1.23)	8.1291*** (0.71)
Year Dummy	Yes	Yes	Yes	Yes
AR(1)	Yes	Yes	Yes	Yes
R^2	0.55	0.70	0.54	0.70
No. of Obs.	380	354	304	283

Note: Panel corrected standard error (PCSE), in parentheses.
 ***/**/* Significant at 1%/5%/10%.

Table 1.C.5: PCSE regression for inflation and Overall CBI dummy (1972-2010)

	Full sample		Restricted sample	
	(1)	(2)	(3)	(4)
CBI (Dummy)	-0.2089 (0.60)	0.2688 (0.37)	-0.1725 (0.72)	0.3567 (0.44)
Openness to trade	-0.0076 (0.02)	-0.0144 (0.01)	-0.0069 (0.03)	-0.0193 (0.01)
Output Gap	0.1133* (0.06)	0.0345 (0.04)	0.1252* (0.07)	0.0668 (0.05)
Inflation Targeting	0.4215 (0.72)	0.4160 (0.56)	0.3238 (0.84)	0.3159 (0.64)
Real Interest Rate		-0.4567*** (0.04)		-0.4612*** (0.04)
Constant	4.9558*** (0.82)	6.4594*** (0.54)	5.4790*** (1.05)	6.8500*** (0.64)
Year Dummy	Yes	Yes	Yes	Yes
AR(1)	Yes	Yes	Yes	Yes
R^2	0.53	0.70	0.53	0.70
No. of Obs.	380	354	304	283

Note: Panel corrected standard error (PCSE), in parentheses.

***/**/* Significant at 1%/5%/10%.

Chapter 2

Central Bank Design: A New Database

Abstract

This chapter presents a new and comprehensive database of central bank institutional design for 65 countries over the period 1972-2014. Building on the most commonly used measures of central bank independence, this database includes more than 130 institutional characteristics of central banks. This chapter describes in detail the sources of information and the coding rules used to create a new index of central bank independence. It also compares this new index with others and presents several descriptive statistics regarding the evolution of central bank independence over the past four decades. Finally, a new empirical investigation of the inflation-central bank independence nexus is proposed by taking into account the endogenous evolution of the level of independence over time.

2.1 Introduction

Over the past four decades, central banks around the world have progressively narrowed their mandate to the goal of price stability. This convergence was prompted by the chronic inflation that characterized advanced economies in the 1970-80s, to which most countries responded by creating independent central banks anchored to an inflation target. In an extensive survey of worldwide developments in monetary institutions since the

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

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

To contribute to a better understanding of central bank institutional design and how this can affect the functioning of central banks, this chapter presents and discusses a new and comprehensive database mainly based on a methodical analysis of central banks’ legislative mandates. Covering 65 countries during the period 1972-2014, this database collects information on more than 130 central bank institutional characteristics that can provide a valuable support to answer some of the questions previously mentioned. This dataset is then employed to construct a new index of central bank independence as well as to update previous indices such as the ones proposed by [Grilli et al. \(1991\)](#)

(GMT), [Cukierman \(1992\)](#) and [Cukierman et al. \(1992\)](#) (CWN), and later expanded by [Jacome and Vazquez \(2008\)](#) and [Dincer and Eichengreen \(2014\)](#). In particular, the new index of CBI proposed in this chapter enhances previous ones along several dimensions. First, it combines and extends the different functional and operational characteristics of the GMT and CWN indices. The information collected from the codification of central bank legislations is aggregated along seven dimensions: 1) Governor and central bank board, 2) Monetary policy and conflict resolution, 3) Objectives, 4) Limitations on lending to the government, 5) Central bank finances, 6) Reporting and accountability and 7) Additional information. This allows for a more detailed analysis of central bank institutional design, as well as the construction of aggregate measures focused on specific dimensions.

The second important distinction from previous efforts of capturing the design of monetary policy institutions rests in the dynamic aspect of the index built in this chapter. Previous research generally evaluates the degree of CBI of a country at a particular point in time (see [Acemoglu et al., 2008](#)), or by focusing on a specific index (see [Bodea and Hicks, 2015](#)). This limits our understanding of how central bank design has evolved over time and how it may have impacted the dynamics of certain macroeconomic variables. As a result, this database presents a dynamic index of central bank independence that is evaluated in every year in which the central bank legislation has been amended and recomputed whenever a legislative reform induced a change along the first six dimensions considered, which are related to central bank independence. This provides a better measure of the timing and magnitude of central bank institutional reforms than was previously possible. The database's wide range of countries and coverage can also provide a base for analyzing policy reforms and defining best practices in worldwide central bank institutional design.

The construction of this new index of central bank design relies on a thorough examination of the legislation available on central banks' websites and, especially for older statutes, on the documents sent to me directly by these institutions or collected from different libraries around the world. Given the difficulty of analyzing and codifying central bank legislations and reducing the subjectivity of their interpretation, this database remains a work in progress, and would benefit from feedback on both its construction and on the coding of specific countries.

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

The chapter is organized as follows. Section 2.2 discusses the construction of the database and the characteristics of the new index of CBI. Section 2.3 presents some descriptive statistics. Section 2.4 proposes a reinvestigation of the CBI-inflation link, while Section 2.5 concludes.

2.2 Construction of the database

In this section I describe the database and discuss the methods taken to translate the central bank charters into a panel dataset. The design and implementation of this survey on central bank institutional design is rooted in my goal to extend the central banking literature by investigating the evolution of central bank independence, finances and accountability. The completion of the survey entailed several steps. The first step required the collection of the current and previous central bank statutes. In very few cases, central banks' websites contained all these documents and, as a result, most of the legislation was obtained by directly contacting the institution. The second step entailed the elaboration of a comprehensive set of questions that could capture central

bank institutional design . The literature on central bank independence provides a good starting point, by defining a set of variables that are relevant for the design of a central bank not only in terms of monetary policy and objectives, but also in terms of governance and its interaction with the government (see [Grilli et al., 1991](#); [Cukierman et al., 1992](#); [Lybek, 1999](#), among others). Additional elements were inspired by various [Bank for International Settlements \(2009\)](#) discussions on central bank governance, and [Amtenbrink \(2010\)](#) on central bank finances.

The full database answers to more than 130 questions on central bank institutional design.¹ Even if individual responses in the survey may be of interest in their own, a certain degree of grouping and aggregation of these variables is required for policy analysis and research. Yet, as with previous research, it is important to clarify that there is not a unique way to grouping or aggregating these information (see also [Beck et al., 2001](#)). As a result, some variables that are currently grouped under one heading could be grouped under another, alternatively.

In the database, the different questions are grouped into 7 dimensions of central bank institutional design: I) Governor and central bank board; II) Monetary policy and conflicts resolution; III) Objectives; IV) Limitations on lending to the government; V) Central bank finances; VI) Reporting and accountability; and VII) Additional information. I summarize below the guidelines for the codification of these dimensions, with their two-letters abbreviation used hereafter:

- **Governor and Central Bank Board (go)**. 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 credibil-

¹The full list of questions is presented in Appendix [2.A](#).

ity 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 the executive branch has little or no legal authority in appointing the governor and other board members, the term of office exceeds the electoral cycle, reappointment is limited, dismissal is based on objective grounds and parallel activities of management bodies are limited can be considered to be more independent from the government.

- **Monetary Policy and Conflicts Resolution (mp).** 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 to 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 (ob).** 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 one. [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 (ll).** Whenever the government can influence the quantity and the 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 might 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 (fi).** Even if central banks are not generally concerned with liquidity, central bank financial strength appears to be positively associated with good policy performance.² 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 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 by a state owned auditing agency. Finally, the legal arrangements surrounding the distribution of central bank's profits and losses plays a relevant role in guaranteeing long-term financial independence. Only realized net profits, after prudent provisioning by the central bank and appropriate allocation to general reserves, should be returned to the government. It follows that the central bank legislation should specify: a) how the *allocation of the 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.

²Milton and Sinclair (2010) provide a comprehensive and historical analysis of the issues on central banks' capital and financial strength.

- **Central Bank Reporting and Accountability (ra).** 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.
- **Additional information.** This last dimension of the database includes a set of questions on central bank design that are not explicitly considered in the construction of the new index of CBI proposed in this chapter. The information grouped into this section captures either a different way of coding data already captured in the previous dimensions or additional characteristics of central banks which cannot be explicitly codified, such as, for example, the number of board members, the list of objectives of monetary policy, the identification of financial sector supervisory authorities, etc. Although this information is not used in the most straightforward application of this database which is the constructions of the new index of central bank independence, I consider it can nevertheless provide a useful documentation for future research on central bank design.

2.2.1 Classical measures of Central Bank Independence

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

The Grilli, Masciandaro, and Tabellini Index

Grilli et al. (1991) construct the first composite index of CBI (hereafter, GMT) through a comprehensive codification of central bank legislations for a group of 18 advanced economies as of 1989.³ The GMT index is calculated as the sum of central banks' fulfillment of 15 criteria and ranges from zero (least independent) to 16 (most independent). Importantly, this index allows the identification of a political and an economic independence index.

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

The economic independence index summarizes the degree of independence of central banks in choosing their monetary policy instruments. Its three main aspects concern: the influence of the government in determining how much it can borrow from the central bank, the nature of the monetary instruments under the control of the central bank and the degree of central bank involvement in banking supervision. Again, one point is assigned for each of the following satisfied criteria: (1) there is no automatic procedure for the government to obtain direct credit from the central bank; (2) when available,

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

direct credit facilities are extended to the government at market interest rates; (3) direct credit facilities are temporary; (4) direct credit facilities are for a limited amount; (5) the central bank does not participate in the primary market for public debt; (6) the central bank is responsible for setting the policy rate; and (7) the central bank has no responsibility for overseeing the banking sector (two points) or shares its responsibility with another institution (one point).

The Cukierman and Cukierman, Webb, and Neyapti Index

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

While the GMT index is based on a binary code assigned to each one of its criteria and its overall value is given by the sum of every single criteria, the CWN index requires a series of further steps for its computation. First of all, every question analyzed

for the construction of the index is coded from 0 to 1, with lower values indicating a lower independence level and higher values signaling an higher degree of independence. Then the sixteen criteria are aggregated into eight different groups and the obtained values are summed up to obtain a single index that ranges from zero (no independence) to one (maximal independence). Starting from these eight aggregated variables, the authors develop two indices of CBI. In particular, [Cukierman \(1992\)](#) introduces the LVAU measure, obtained as an unweighted average of the eight aggregated variables, while [Cukierman et al. \(1992\)](#) develop the LVAW measure, suggesting different weights for the various aggregations.⁴

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

2.2.2 The Extended Central Bank Independence (ECBI) Index

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

The extended index incorporates the characteristics of *both* the GMT and CWN indices. This aggregation aims to overcome the main criticism of these classical measures of CBI, i.e. the fact that only nine characteristics are common to both indices, out of a respective total of 15 in GMT and 16 in CWN (see [Mangano, 1998](#)). Apart from integrating these two well-know indices, the ECBI index also includes new criteria able

⁴The eight aggregated variables and the weights assigned to each criteria are presented in Appendix Table 2.A.1.

to capture good practices in central bank financial independence and accountability. Table 2.1 presents the summary of the characteristics collected in the GMT and CWN indices, as well as, in the ECBI index.

One important innovation of the ECBI index is represented by the introduction of several criteria on financial independence and accountability (see Table 2.1). The financial independence criterion concerns the conditions for capitalization and recapitalization of the central bank capital, the identification of the authority that determines and approves the central bank's budget, as well as the requirements for profits allocation. These last two features are of particular interest during crises periods, when, as it happened following the global financial crisis of 2008-09, the total amount of central banks' assets increased exponentially. In this context, the presence of limits on the determination of the central banks' budget and on the distribution of their net profits, may limit their capacity to implement their monetary policy. Regarding profits allocation, in particular, Reis (2013) discusses the fact that, under fiscal stress, governments will always be tempted to demand the central bank to generate more profits and transfer them to the Treasury.

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

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

Table 2.1: Institutional characteristics of CBI indices

Criteria	GMT	CWN	ECBI
<i>Governor and Central Bank Board</i>			
Who appoints the governor	*	*	*
Term of office of governor	*	*	*
Reappointment option for 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	*		*
<i>Monetary Policy and Conflicts Resolution</i>			
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	*	*	*
<i>Objectives</i>			
Central bank's statutory goals	*	*	*
<i>Lending to the Government</i>			
Direct credit: not automatic	*	*	*
Direct credit: market of 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	*	*	*
<i>Financial Independence</i>			
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 the net profits			*
Allocation of profits to the general reserve fund			*
Partial payments of dividends before the end of the fiscal year			*
Unrealized profits included in the calculation of distributable profits			*
<i>Central Bank Reporting and Accountability</i>			
Central bank reporting			*
Central bank financial statements			*

Note: GMT = Grilli et al. (1991), CWN = Cukierman et al. (1992) and ECBI = Extended CBI Index.

codification strategy for each one of its 16 criteria.

While for most of the 42 criteria analyzed in the ECBI index the codification strategy

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

The information collected is used to build a new index of central bank independence which ranges from 0 (no independence) to 1 (full independence).⁵ The structure and the different scores assigned in the ECBI index are summarized in Appendix 2.B. There are, of course, different ways to aggregate the collected data in order to obtain a unique index of central bank independence. For example, [Grilli et al. \(1991\)](#) compute their index by summing up the values obtained from the 15 criteria proposed for the construction of their index. In this case the importance assigned to every dimension of the index is driven by the number of questions. An alternative approach, proposed by [Cukierman \(1992\)](#) and [Cukierman et al. \(1992\)](#) and followed by [Jacome and Vazquez \(2008\)](#) and [Dincer and Eichengreen \(2014\)](#), consists in assigning a set of a priori weights to each dimension and its criteria. However, in this case as well, we might have situations in which a too high (low) weight is assigned to a certain subcategory of the index. In the case of the LVAU index, for example, 62.5% of the weight is assigned to the dimension on the limitations on lending to the government.

Recognizing the importance of the various elements that might influence the degree of central bank independence, the overall ECBI index is constructed assigning an equal weight to its six dimensions. To do so, I first assign an equal weight to each question in a dimension and compute its average score. Then, the overall index is computed as the average scores across these six dimensions. This guarantees that all dimensions are

⁵When 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 of 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, we might have 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 are 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.

given the same weight in determining the level of independence.

This results in an index that varies over the interval $[0;1]$, with each dimension having an equal share in the overall index:⁶

$$ECBI_{i,t} = \frac{1}{6} \sum_{d=1}^6 Dim_{i,t,d}, \quad (2.1)$$

where $Dim_{i,t,d}$ represents the average degree of independence of dimension d for country i in year t .

2.3 Characteristics of the ECBI index

This section presents some characteristics and descriptive statistics of the ECBI index. It includes a breakdown of the average CBI score in its six dimensions and discusses how this new index relates to the classical measures of central bank independence.

This database covers a set of 65 countries over the period 1972-2014. The list of countries and information on data availability are presented in Appendix Table 2.B.2. This table also classifies countries according to their geo-political areas. The sample includes 23 OECD countries, 18 Eastern European countries, 10 African and Middle-Eastern countries and 6 Latin-American countries.

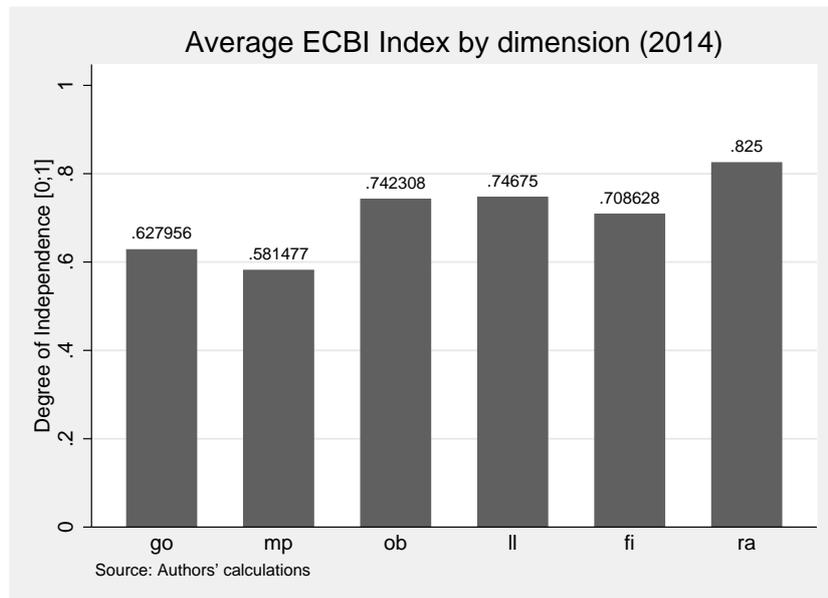
Given the large set of questions included in the design of the ECBI index, looking at each particular aspect collected may not be very intuitive. Yet, focusing on each of its six dimensions can give us an indication of which aspects of CBI countries are most likely to improve.⁷ Looking at the differences between these dimensions of the index is particularly useful for policy makers to assess which aspects of central bank institutional design can be improved in order to assign monetary polity institutions a higher degree of independence.

Figure 2.1 shows the average degree of independence assigned to the different dimensions on the ECBI index in 2014 for the whole sample of countries. This figure indicates

⁶Appendix Figure 2.B.1 presents a bar chart which summarizes the different weights assigned to the six dimensions of the ECBI index, as compared to previous indices of CBI. This figure shows a certain degree of subjectivity in computing the overall level of central bank independence and motivates our approach to construct the ECBI index by assigning equal weights to the six dimensions.

⁷Appendix Table 2.B.3 contains additional information on the 42 criteria used for the creation of the ECBI index, grouping them into its different dimensions.

Figure 2.1: Degree of independence by dimension

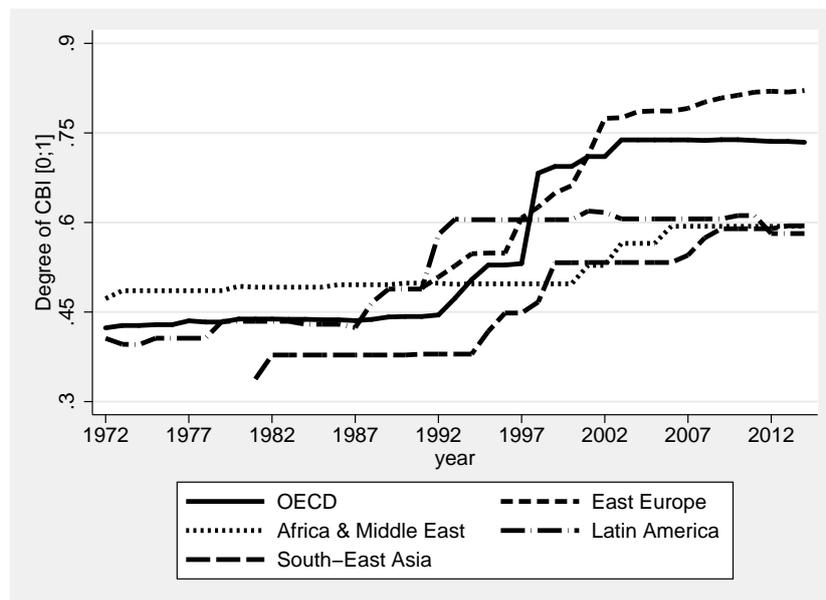


Each bar indicates the average value of independence of the different dimensions of the ECBI index in 2014. *go*: governor and central bank board. *mp*: monetary policy and conflict resolution. *ob*: monetary policy objectives. *ll*: limitations on lending to the government. *fi*: central bank finances. Finally, *ra*: reporting and accountability.

that there is quite little variation in the average value of independence across dimensions. Interestingly, the two dimensions omitted in both the GMT and CWN indices, i.e. financial independence and accountability, appear to be quite relevant in central bank statutes. In particular, the characteristics related to reporting and accountability are associated with the highest average value of independence, while the ones on financial independence are also among the highest in terms of independence from the executive branch. Looking now at the dimensions with the lowest degree of independence, we can find the ones related to the central bank governance and monetary policy. Given these similar levels of average independence along the different dimensions, the rest of the analysis focuses on the aggregated index of independence computed following Equation (2.1). This also allows for a comparison with previous studies, most of which investigate the link between CBI and macroeconomic outcomes by looking at the overall level of independence.

Apart from the extended set of central bank characteristics, another important innovation of the ECBI index is its dynamic nature, that allows us to track the evolution of central bank independence over time. This also improves previous approaches of

Figure 2.2: Average degree of ECBI across regions



assessing the changes in the degree of central bank independence that recompute the level of CBI at two different, usually distant moments in time (Arnone et al., 2009). By recomputing the level of independence after each central bank legislative reform, we can draw a complete picture of how central bank institutional design has evolved over time. Figure 2.2 shows the evolution of the average values of the ECBI index across different regions. In line with Arnone et al. (2009), I find that the average degree of CBI has sharply increased especially after the late 1980s. However, notable cross-country differences persist. On average, the degree of CBI across all regions moved from 0.42 during the 1970s to 0.72 today. Looking at the evolution across different sample, we find that central banks in more advanced economies (OECD geo-political area) are the ones that have improved the most their independence during the last 4 decades. However, the former socialist economies (East Europe region) are the ones characterized by the highest average degree of CBI in 2014. This is also consistent with the findings of Arnone et al. (2009), who suggest that their proximity to the European Union together with the process of establishing the euro zone have strengthened incentives for introducing autonomous central banks.

Interestingly, central banks in Africa and the Middle East, Latin America and South-East Asia are now characterized by a similar average degree of independence. However, their evolution over time was different. The African and the Middle Eastern countries

kept their central bank institutional setting unchanged between 1972 and the beginning of the 2000s and introduced marginal reforms afterwards. In the case of the Latin American countries, most of the improvements in CBI happened in the second half of the 1980s and first half of the 1990s, with the independence of the central bank in some of these countries being subsequently reduced in 2012.

The detailed nature of the new dataset on central bank design enables me to also recompute the degree of central bank independence as captured by the most common used measures of CBI, i.e. the [Grilli et al. \(1991\)](#); [Cukierman \(1992\)](#); [Cukierman et al. \(1992\)](#); [Jacome and Vazquez \(2008\)](#); [Dincer and Eichengreen \(2014\)](#) indices. Table 2.2 presents the pair-wise correlations between the ECBI index and these alternative measures. Overall there is a strong positive correlation between all measures, the ECBI index being closest to the CWNE measure, since this is also the only other measure of independence that captures information on accountability. On the other hand, the lowest correlation of the ECBI index is with the GMT index.

Table 2.2: Cross-correlation between measures of CBI

Variables	ECBI	GMT	LVAU	LVAW	CWNE	CBIU	CBIW
ECBI	1.0000						
GMT	0.8657	1.0000					
LVAU	0.9236	0.8643	1.0000				
LVAW	0.9452	0.8826	0.9909	1.0000			
CWNE	0.9643	0.8702	0.9503	0.9607	1.0000		
CBIU	0.9304	0.8818	0.9948	0.9901	0.9549	1.0000	
CBIW	0.9405	0.8945	0.9887	0.9949	0.9609	0.9945	1.0000

Note: ECBI = Extended CBI Index; GMT = [Grilli et al. \(1991\)](#); LVAU = [Cukierman \(1992\)](#); LVAW = [Cukierman et al. \(1992\)](#); CWNE = [Jacome and Vazquez \(2008\)](#); CBIU, CBIW = [Dincer and Eichengreen \(2014\)](#).

2.4 The CBI-inflation nexus: a re-investigation

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

2.4.1 Baseline estimations

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

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

Following [Jacome and Vazquez \(2008\)](#), initial estimations were performed using OLS and with fixed-effects at the country level. However, given the heteroskedasticity across panels and the autocorrelation across observations present in the data, the preferred estimations use Feasible Generalized Least Squares (FGLS) allowing for heteroskedasticity across countries and a common AR(1) error process.

Table 2.3 presents the results obtained using the FGLS estimations. In particular, Column (1) shows the estimations using the ECBI measure of independence, while Columns (2) to (7) present the estimates pertaining to the alternative measures of independence recomputed dynamically. The coefficients of the different indices of CBI are generally similar and negatively related to inflation at a 1% level. This confirms the results in the previous Chapter that countries characterized by an higher degree of

Table 2.3: Panel regressions of inflation on CBI (FGLS)

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

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

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

independence of their central bank also experience lower inflation rates.

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

While this simple test confirms the negative correlation between inflation and central bank independence it does not, however, imply a causal link. A recent literature on endogenous political institutions argues that central bank independence is not imposed “exogenously”, but evolves in response to changing political, social or economic factors. For example, Aghion et al. (2004) consider the case of the German Bundesbank whose statute was modified in 1957 as a result of a strong public aversion towards inflation after periods of hyperinflation in Germany. They argue that, often, central banks have

been made more independent, to “insulate” monetary policy in periods of high inflation. [Posen \(1995\)](#) also discusses these issues of causality between CBI and inflation by suggesting that the different levels of CBI reflect differences in countries’ financial opposition to inflation. He argues that CBI lead to a reduction of inflation in OECD countries because in these countries a large part of the population actually prefers low and stable inflation. Other cultural characteristics are discussed in [de Jong \(2002\)](#), who finds that the distribution of power in the society and the degree of uncertainty avoidance might also explain differences in CBI. Political systems can be an equally important factor influencing a country’s degree of central bank independence. For example, [Moser \(1999\)](#) finds that legal independence is significantly higher in OECD countries with legislative processes characterized by extensive checks and balances. [Keefer and Stasavage \(2003\)](#) look at the *de facto* CBI and show that the monetary policy credibility (lower governor turnover) is enhanced by the presence of multiple veto players in the government. In [Alesina and Stella \(2010\)](#) the fractionalization of the party system might make the delegation of monetary policy to independent experts more cumbersome given the conflicts among groups. Finally, [Cukierman and Webb \(1995\)](#) also find a certain level of endogeneity of the *de facto* index of CBI, by showing that the probability of a change of the central bank governor is more than two times higher in periods within six months after a political transition.

These empirical findings on the endogeneity of CBI are, nonetheless, limited to small samples and sensitive to the choice of CBI indices (see [de Haan and van’t Hag, 1995](#), for a critical assessment). Yet, the need to study the determinants of central bank independence is greater in periods in which the design of central banks is put into question ([Masciandaro and Romelli, 2015b](#)). The 2008-09 financial crisis has brought into question many of the established facts about monetary policy and its institutions ([Alesina and Stella, 2010](#)). For example, [Masciandaro and Passarelli \(2013\)](#) explain the recent developments in central banking by focusing on a political economy model of bailouts. They argue that the distribution of financial wealth among individuals might represent one of the drivers of the decision of a country to maintain or reform its central bank regime.

All these arguments suggest that the level of central bank independence evolves endogenously as a response to a set of social, economic and political factors. The dy-

dynamic nature of the new index of CBI proposed in this chapter can overcome many of the challenges of previous research and provide a reliable instrument of central bank independence.

2.4.2 CBI-inflation nexus with endogeneity

To account for the possible endogeneity of the degree of central bank independence, I re-estimate the results presented in Table 2.3 using an instrumental variable approach. In particular, the degree of central bank independence is instrumented by: i) its lagged value, to account for a time dependence of CBI; ii) the lagged level of the unemployment rate, to control for the short-run trade-off between inflation and unemployment⁸; iii) an indicator of government stability, since we can expect that more stable governments are more likely to adopt reforms, including granting more independence to the monetary policy authority; iv) the level of GDP per capita; and v) a dummy variable for currency unions, which in this sample assumes the value one for the Euro zone countries characterized by a similar degree of central bank independence. The results of the first stage estimation are not reported, but suggest that all the instruments except the government stability one are appropriate, with coefficients significant at the 1% level.

Table 2.4 presents the results obtained by implementing an instrumental variable estimation for fixed-effects panel data.⁹ Importantly, the Hausman test statistic suggests the rejection of the null hypothesis that the endogenous regressor can be treated as exogenous, confirming that the degree of central bank independence is indeed an endogenous variable in this analysis.

Column (1) shows the estimations using the instrumented ECBI index, while Columns (2) to (7) look at the instrumented alternative measures of independence. These results confirm the negative and statistically significant (at 1% level) relationship between inflation and the different indices of CBI. More importantly, the point estimates of the instrumented level of CBI are almost twice as big as the estimated coefficients of CBI in Table 2.3, suggesting an even stronger effect of central bank independence on

⁸Looking at the link between unemployment and CBI, for example, [Eijffinger and Schaling \(1995\)](#) show that a higher natural rate of unemployment is associated with a higher degree of central bank independence.

⁹The Hausman specification test always rejected the null hypothesis of equality between the coefficients of the random and the fixed-effects models in all specification, suggesting therefore that the fixed effect model is more reasonable.

inflation rates. Furthermore, the results in Table 2.4 also suggest an important effect of periods of financial distress and inflationary trends around the world. Moreover, now, also the level of openness to trade and the type exchange rate regime of the country are more precisely estimated.

Table 2.4: Panel regressions of inflation on CBI (IV)

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

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

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

The robustness of these results is tested using the Limited Information Maximum Likelihood (LIML) estimation technique. This estimation is more robust in the presence of weak instruments. The results obtained using this alternative technique are presented in Appendix Table 2.B.4 and are qualitatively similar.

2.5 Conclusions

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

This chapter contributes to this debate by providing a new database on central bank institutional design and developing a new and comprehensive dynamic index of central bank independence which will enable more precise empirical estimations on the topic. A special attention is dedicated to the description of the characteristics of this index. Furthermore, the information collected for the construction of this database also allows the re-construction of the classical measures of central bank independence in a dynamic setting.

Employing this new database, this chapter provides a detailed description of the evolution of central bank independence for a set of 65 countries during the period 1972-2014. It thus sheds some light on important trends in central bank design over the past four decades, given the dynamic structure of the calculated indices. The second contribution of the chapter rests in the reinvestigation of the CBI-inflation nexus. I go beyond the simple negative correlation between CBI and inflation by employing an instrumental variable approach where the level of CBI is instrumented by a set of politico-economic factors. Results confirm the endogeneity of the CBI index and support a negative causal link between central bank independence and inflation.

Appendices

2.A Full list of questions

I. Governor and Central Bank Board

- I.1) Who appoints the governor?
- I.2) Term of office of governor
- I.3) Is there any reappointment option for the governor?
- I.4) Provisions for dismissal of governor
- I.5) May the governor hold other offices in government?
- I.6) Is there any qualification requirement for the governor?
- I.7) Who appoints the rest of the board?
- I.8) Term of office of the rest of the board
- I.9) Is there any reappointment option for the rest of the board?
- I.10) Provisions for dismissal of the rest of the board
- I.11) May the rest of the board hold other offices in government?
- I.12) Is there any qualification requirement for the rest of the board?
- I.13) Does the legislation require a staggering term of office for the appointment of board members?
- I.14) No mandatory participation of government representatives in the board

II. Monetary Policy and Conflicts Resolution

- II.1) Who formulates monetary policy?
- II.2) Is the central bank responsible for setting the policy rates?
- II.3) Is there no responsibility of the central bank for overseeing the banking sector?
- II.4) Central bank given active role in formulation of government's budget and/or debt
- II.5) Who has final word in resolution of conflicts?

III. Objectives

- III.1) Price stability objective

IV. Limitations on Lending to the Government

- IV.1) Limitations on advances
- IV.2) Lending to government
- IV.3) Who decides financing conditions to government (maturity, interest, amount)?
- IV.4) Potential borrowers from the central bank
- IV.5) Limits on central bank lending defined
- IV.6) Maturity of advances
- IV.7) Interest rates on advances
- IV.8) Central bank prohibited from buying or selling government securities in the primary market

V. Financial Independence

- V.1) Does the statute describe precisely the provisions relating to the payment of the initial capital?
- V.2) The statute quantify precisely the authorized capital of the central bank
- V.3) Financial autonomy
- V.4) Are there legal arrangements allowing for an automatic capital contribution upon the request by the central bank (automatic recapitalization)?
- V.5) How are managed, from a legislative point of view, transfers of money from the treasury to the central bank?
- V.6) The central bank has the exclusive right to determine and approve its annual budget
- V.7) The adoption of the annual balance sheet of the central bank belongs exclusively to its decision-making bodies
- V.8) The accounts of the central bank are subject to the control of a state agency of auditing
- V.9) Allocation of the net profits of the central bank

- V.10) How is the allocation of profits to the general reserve fund handled by the central bank?
- 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?
- V.12) Are unrealized profits included in the calculation of distributable profits?

VI. Central Bank Reporting and Accountability

- VI.1) Central bank reporting
- VI.2) Central bank financial statements

VII. Additional Information

- VII.1. Year of establishment of the central bank
- VII.2. Is there any mention of the central bank in the constitution
- VII.3. *Governance*
 - VII.3.1) Duration of term of office of the governor
 - VII.3.2) Is double-veto arrangement required for the election of the governor?
 - VII.3.3) Is there any professional requirement for the governor?
 - VII.3.4) Is there any education requirement for the governor?
 - VII.3.5) Is individual character of integrity a mandatory requirement for the governor?
 - VII.3.6) Is there any citizenship requirement for the governor?
 - VII.3.7) Is there any retirement age for the governor?
 - VII.3.8) How many vice governor are required by the legislation?
 - VII.3.9) Which is the name of the main board of the central bank?
 - VII.3.10) Appointment and term of office rest of the rest of the board
 - VII.3.11) Are more than half of the board members appointments made independently from the government?
 - VII.3.12) Is double-veto arrangement required for the election of board members?
 - VII.3.13) Dismissal of board members
 - VII.3.14) Is there any professional requirement for the rest of the board?
 - VII.3.15) Is there any education requirement for the rest of the board?
 - VII.3.16) Is individual character of integrity a mandatory requirement for the rest of the board?
 - VII.3.17) Is there any citizenship requirement for the rest of the board?
 - VII.3.18) Is there any retirement age for the rest of the board?
 - VII.3.19) Is the governor the presiding officer of the board?
 - VII.3.20) Can external members be appointed as board members?
 - VII.3.21) Have (if present) government representative voting rights in the board?
 - VII.3.22) How many government representatives are present in the board?
 - VII.3.23) If not a member of the board, can the ministry of finance or its representative attend the meeting of the board?
 - VII.3.24) If the ministry of finance, or its representative, can attend the meeting of the board, can he/she also give opinions?
 - VII.3.25) Are there any ex-officio members in the board? (different from government's representatives)
 - VII.3.26) How many ex-officio members are present in the board?
 - VII.3.27) Does the central bank legislation require the presence of certain sectorial representatives?
 - VII.3.28) Does the central bank legislation require the presence of certain regional/nationality representatives?
 - VII.3.29) Have (if present) ex-officio members voting rights in the board?
 - VII.3.30) Number of members of the board (governor and vice-governor included)
 - VII.3.31) How many internal member are present in the board?
 - VII.3.32) Number of voting members of the board (governor and vice-governor included)
 - VII.3.33) Are the majority of the members internal or external to the central bank?
 - VII.3.34) Does the central bank legislation specify a quorum for adopting decisions?
 - VII.3.35) Is there a majority principle for adopting board decisions?
 - VII.3.36) Does the governor have special voting rights?
 - VII.3.37) Is the management of the central bank attributed to a sole person?
 - VII.3.38) Who is the person or the board in charge of the management of the central bank?
 - VII.3.39) Does the board or a specific committee fix the salary of the governor?
 - VII.3.40) Who fixes the salary of the governor?

- VII.3.41) Does the board or a specific committee fix the salary of the other board members?
 - VII.3.42) Who fixes the salary of the other board members?
 - VII.3.43) Name of special board(s)/committee(s) of the central bank
 - VII.3.44) Number of special board(s)/committee(s) of the central bank
 - VII.3.45) Functions of special board(s)/committee(s) of the central bank
 - VII.3.46) Number of members of special board(s)/committee(s) of the central bank
 - VII.3.47) Is the governor the presiding officer of specific/all board(s)?
- VII.4. *Monetary Policy*
- VII.4.1) Is uniquely the governor responsible for formulating monetary policy?
 - VII.4.2) Has the government (or parliament) the right to give instructions to the central bank?
 - VII.4.3) Is there any authority that can give instructions to the central bank?
 - VII.4.4) Does the central bank have obligations to provide advice on economic policy to the government?
 - VII.4.5) Relation of the central bank with government (approval/consultation)
 - VII.4.6) Relation of the central bank with parliament (approval/consultation)
 - VII.4.7) Has the central bank the right for an appeal in case of instructions?
- VII.5. *Policy Objectives*
- VII.5.1) Report the list of central bank objectives
 - VII.5.2) Does the central bank legislation stipulate the objectives of monetary policy?
 - VII.5.3) Are the policy objectives clearly defined?
 - VII.5.4) Is there a clear prioritization of policy objectives?
 - VII.5.5) Is past performance a ground for dismissal of a central bank governor?
 - VII.5.6) Is the central bank adopting an inflation targeting regime?
 - VII.5.7) When did the central bank adopted the inflation targeting regime?
 - VII.5.8) Is there a formal statement of the objective(s) of monetary policy, with an explicit prioritization in case of multiple objectives?
 - VII.5.9) Is financial stability one of the goals?
 - VII.5.10) Which is/are the authority/authorities responsible for overseeing the banking sector in the country?
 - VII.5.11) Which is/are the authority/authorities responsible for overseeing the insurance sector in the country?
 - VII.5.12) Which is/are the authority/authorities responsible for overseeing the stock markets in the country?
 - VII.5.13) Is the central bank the lender of last resort in the country?
- VII.6. *Government Lending*
- VII.6.1) Securitized lending to the government
- VII.7. *Capital, Profit Allocation and Auditing*
- VII.7.1) The state has the power to impose, unilaterally, measures to reduce the capital of the central bank
 - VII.7.2) Are recapitalization on request of the central bank subject to approval by the executive government or parliament?
 - VII.7.3) Ownership of the central bank
 - VII.7.4) Percentage of public ownership
 - VII.7.5) Percentage of private ownership
 - VII.7.6) Is there any requirement for the allocation of the central bank profits?
 - VII.7.7) Does the central bank have the power to create, in a completely independent manner, financial provisions and capital reserves?
 - VII.7.8) Does the central bank legislation require a “graduated sharing approach” for the allocation of profits to the general reserve?
 - VII.7.9) Does the central bank legislation require a “fully rules based sharing approach” for the allocation of profits to the general reserve?
 - VII.7.10) Does the central bank legislation specify that a part of the profits has to be allocated to a general reserve?
 - VII.7.11) Is the percentage of profits to be allocated to the general reserve determined?
 - VII.7.12) In the allocation of profits, does the amount allocated to the general reserve has a priority?
 - VII.7.13) Does the legislation set a maximum amount for the general reserve?
 - VII.7.14) Which is the maximum amount that can be reached by the general reserve fund?

- VII.7.15) Is there a fix amount of money that have to be distributed to the state, no matter which is the amount of profits?
 - VII.7.16) Which is the minimum amount of money that have to be distributed to the state, no matter which is the amount of profits?
 - VII.7.17) Is the central bank subject to monitoring by parliament (apart from the annual reports issues)?
 - VII.7.18) Who is in charge of the auditing of the annual report or the financial statement of the central bank?
- VII.8. *Transparency*
- VII.8.1) Is there a mention concerning the minutes of meetings of the governing board of the central bank in the central bank charter?
 - VII.8.2) Does the law specify if the minutes of the meeting have to be published?

Table 2.A.1: Criteria and weights of the CWN (LVAU and LVAW) indices of CBI

		Weights	
		LVAU	LVAW
1	Central Bank Governor		
	<i>Term of office</i>	0.03125	0.05
	<i>Who appoints</i>	0.03125	0.05
	<i>Dismissal</i>	0.03125	0.05
	<i>Other offices</i>	0.03125	0.05
2	Policy Formulation		
	<i>Who formulates</i>	0.0625	0.0375
	<i>Final authority</i>	0.03125	0.075
	<i>Role in budget</i>	0.03125	0.0375
3	Objectives		
	<i>Objectives</i>	0.125	0.15
4	Advances		
	<i>Advances</i>	0.125	0.15
5	Securitized lending		
	<i>Securitized lending</i>	0.125	0.1
6	Terms of Lending		
	<i>Terms of lending</i>	0.125	0.1
7	Potential Borrowers		
	<i>Potential borrowers</i>	0.125	0.05
8	Limits on Lending		
	<i>Type of limit</i>	0.03125	0.025
	<i>Maturity of loans</i>	0.03125	0.025
	<i>Interest rates</i>	0.03125	0.025
	<i>Primary market</i>	0.03125	0.025
<i>Sum of weights</i>		1	1

2.B Coding rules for the ECBI index of *de jure* central bank independence and accountability

I. Governor and Central Bank Board

I.1)	Who appoints the governor?	
	Board of central bank / shareholders (if different from the government)	1.00
	A council of the central bank board, executive and legislative branch	0.75
	By legislative branch (congress, king)	0.50
	By executive branch collectively (e.g. council of ministers)	0.25
	By one or more members of executive branch	0.00
I.2)	Term of office of the governor	
	More than 8 years	1.00
	6 to 8 years	0.75
	Equal to 5 years	0.50
	Equal to 4 years	0.25
	Less than 4 years or at the discretion of appointer (no limits or not mentioned)	0.00
I.3)	Is there any reappointment option for the governor?	
	No	1.00
	Restricted to two consecutive terms	0.50
	Yes	0.00
I.4)	Provisions for dismissal of governor	
	No provision for dismissal	1.00
	Only for non-policy reasons (e.g., incapability, or violation of law)	0.83
	At the discretion of central bank board	0.67
	For policy reasons at legislative branch's discretion	0.50
	At legislative branch's discretion	0.33
	For policy reasons at executive branch's discretion	0.17
	At executive branch's discretion	0.00
I.5)	May the governor hold other offices in government?	
	Prohibited by law	1.00
	Not allowed unless authorized by executive branch	0.50
	No prohibition for holding another office	0.00
I.6)	Is there any qualification requirement for the governor?	
	Yes	1.00
	No	0.00
I.7)	Who appoints the rest of the board?	
	Board of central bank / shareholders (if different from the government)	1.00
	A council of the central bank board, executive and legislative branch	0.75
	By legislative branch (congress, king)	0.50
	By executive branch collectively (e.g. council of ministers)	0.25
	By one or more members of executive branch	0.00
I.8)	Term of office of the rest of the board	
	More than 8 years	1.00
	6 to 8 years	0.75
	Equal to 5 years	0.50
	Equal to 4 years	0.25
	Less than 4 years or at the discretion of appointer (no limits or not mentioned)	0.00
I.9)	Is there any reappointment option for the rest of the board?	
	No	1.00
	Restricted to two consecutive terms	0.50
	Yes	0.00
I.10)	Provisions for dismissal of the rest of the board	
	No provision for dismissal	1.00
	Only for non-policy reasons (e.g., incapability, or violation of law)	0.83
	At the discretion of central bank board	0.67
	For policy reasons at legislative branch's discretion	0.50
	At legislative branch's discretion	0.33
	For policy reasons at executive branch's discretion	0.17
	At executive branch's discretion	0.00
I.11)	May the rest of the board hold other offices in government?	
	Prohibited by law	1.00
	Not allowed unless authorized by executive branch	0.50
	No prohibition for holding another office	0.00

I.12)	Is there any qualification requirement for the rest of the board?	
	Yes	1.00
	No	0.00
I.13)	Does the legislation require a staggering term of office for the appointment of board members?	
	Yes	1.00
	No	0.00
I.14)	No mandatory participation of government representatives in the board	
	Yes	1.00
	No, but without voting rights	0.50
	No	0.00
II. Monetary Policy and Conflicts Resolution		
II.1)	Who formulates monetary policy?	
	Central bank alone	1.00
	Central bank participates, but has little influence	0.67
	Central bank only advises government	0.30
	Central bank has no say	0.00
II.2)	Is the central bank responsible for setting the policy rates?	
	Yes	1.00
	No	0.00
II.3)	Is there no responsibility of the central bank for overseeing the banking sector?	
	Banking supervision not entrusted to the central bank	1.00
	Banking supervision not entrusted to the central bank alone	0.50
	Banking supervision entrusted to the central bank alone	0.00
II.4)	Central Bank given active role in formulation of government's budget and/or debt	
	Approves government budget and/or debt	1.00
	Legally required to provide opinion on technical aspects	0.50
	No involvement at all	0.00
II.5)	Who has final word in resolution of conflicts?	
	The central bank, on issues clearly defined in the law as its objectives	1.00
	The government, on policy issues not clearly defined as the central bank's goals	0.80
	A council of the central bank, executive and legislative branch	0.60
	The legislature, on policy issues	0.40
	The executive branch on policy issues, subject to due process and possible protest by the bank	0.20
	The executive branch has unconditional priority	0.00
III. Objectives		
III.1)	Price stability objective	
	Price stability is the single or primary objective	1.00
	Price stability together with non-conflicting objectives but without priority	0.75
	Price stability and other conflicting goals (i.e. stability of financial system), without priority	0.50
	Price stability together with objective of economic growth / development with no priority	0.25
	Objectives do not include price stability	0.00
IV. Limitations on Lending to the Government		
IV.1)	Limitations on advances	
	Advances to government prohibited	1.00
	Advances permitted, but with strict limits (e.g., up to 15 percent of government revenue)	0.67
	Advances permitted, and the limits are loose (e.g., over 15 percent of government revenue)	0.33
	No legal limits on lending	0.00
IV.2)	Lending to government	
	Not allowed	1.00
	In secondary market with restricted limits	0.75
	In secondary market with lax or without limits	0.50
	In primary market with limits or approved by central bank board with a qualified majority	0.25
	In primary market without limits	0.00
IV.3)	Who decides financing conditions to government (maturity, interest, amount)?	
	Central bank defines terms and conditions	1.00
	Specified by the bank charter	0.67
	Agreed between the central bank and executive	0.33
	Decided by the executive branch alone	0.00

IV.4)	Potential borrowers from the central bank	
	Only the government	1.00
	Government plus local governments	0.67
	All of the above plus public enterprises	0.33
	All of the above and to the private sector, also if it is not mentioned otherwise	0.00
IV.5)	Limits on central bank lending defined	
	As an absolute cash amount	1.00
	As a percentage of central bank capital or other liabilities	0.67
	As a percentage of government revenues	0.33
	As a percentage of government expenditure	0.00
IV.6)	Maturity of advances	
	Within 6 months	1.00
	Within 1 year	0.67
	More than 1 year	0.33
	No mention of maturity in the law	0.00
IV.7)	Interest rates on advances	
	At market rates	1.00
	Interest rates not specified in law	0.50
	At below market rates	0.00
IV.8)	Central bank prohibited from buying or selling government securities in the primary market	
	Yes	1.00
	No	0.00

V. Financial Independence

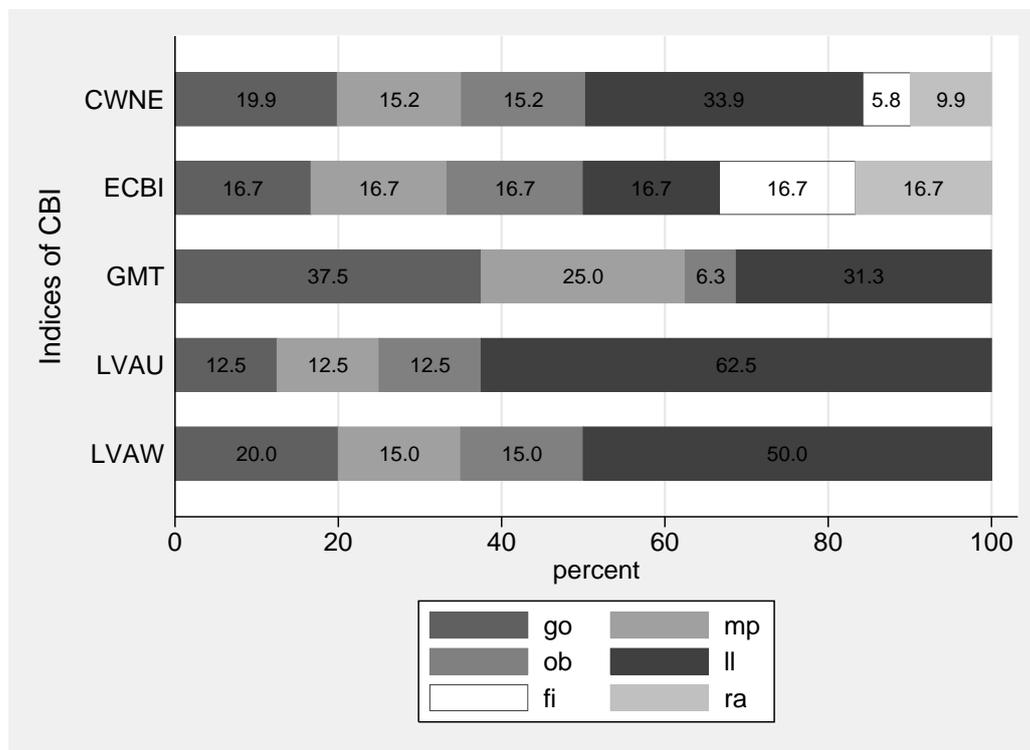
V.1)	Does the statute describe precisely the provisions relating to the payment of the initial capital?	
	Yes	1.00
	No	0.00
V.2)	The Statute quantify precisely the authorized capital of the central bank	
	Yes	1.00
	No	0.00
V.3)	Financial autonomy	
	Government should maintain central capital integrity	1.00
	Government is legally allowed to capitalize the central bank	0.67
	The law does not allow the government to capitalize the central bank	0.33
	The central bank conducts quasi-fiscal operations	0.00
V.4)	Are there legal arrangements allowing for an automatic capital contribution upon the request by the central bank (automatic recapitalization)?	
	Yes	1.00
	No	0.00
V.5)	How are managed, from a legislative point of view, transfers of money from the treasury to the central bank?	
	The decision is based on technical criteria	1.00
	The transfer requires approval by the treasury	0.50
	The transfer requires an act of the legislature	0.00
V.6)	The central bank has the exclusive right to determine and approve its annual budget	
	Yes	1.00
	Ex-post approval by the government	0.50
	No	0.00
V.7)	The adoption of the annual balance sheet of the central bank belongs exclusively to its decision-making bodies	
	Yes	1.00
	No	0.00
V.8)	The accounts of the central bank are subject to the control of a state agency of auditing	
	No	1.00
	No, but the external audit agency is appointed by the government	0.50
	Yes	0.00
V.9)	Allocation of the net profits of the central bank	
	Prescribed by the central bank statute	1.00
	Left at the discretion of the central bank	0.67
	A kind of negotiation between the government and the central bank	0.33
	Left at the discretion of the government	0.00

V.10)	How is the allocation of profits to the general reserve fund handled by the central bank?	
	An objective criteria established precisely by the central bank statute	1.00
	Left at the discretion of the central bank	0.67
	Made by the deciding body of the central bank in consultation with the government	0.33
	Left at the discretion of the government	0.00
V.11)	Can the state or the shareholders receive partial payments before the end of the fiscal year, based on an estimate for that year?	
	No	1.00
	Yes	0.00
V.12)	Are unrealized profits included in the calculation of distributable profits?	
	No	1.00
	Yes	0.00

VI. Central bank reporting and accountability

VI.1)	Central Bank reporting	
	Reports to executive branch and informs at least annually the congress.	1.00
	Reports to the executive once a year and submits an annual report to the congress	0.75
	Annual report to the executive. Informs to the executive branch whenever fundamental disequilibria emerge, or reports through the media without specific periodicity	0.50
	Issues annual reports at specific time	0.25
	Distributes an annual report without establishing particular period of time	0.00
VI.2)	Central Bank financial statements	
	Discloses detailed financial statements at least once a year with a certification of an independent auditor	1.00
	Discloses consolidated financial statements at least once a year with seal of the banking superintendent or other public sector authorities	0.75
	Discloses financial statements at least once a year, certified by an internal	0.50
	Publishes partial financial statements	0.25
	Does not publish financial statements or the law authorizes the central bank to deviate from international accounting standards	0.00

Figure 2.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. CWNE: [Jacome and Vazquez \(2008\)](#); ECBI: Extended CBI Index; GMT: [Grilli et al. \(1991\)](#); LVAU: [Cukierman \(1992\)](#); and LVAW: [Cukierman et al. \(1992\)](#).

go: governor and central bank board; *mp*: monetary policy and conflict resolution; *ob*: monetary policy objectives; *ll*: limitations on lending to the government; *fi*: central bank finances; and *ra*: reporting and accountability.

Table 2.B.2: Analyzed countries

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

Table 2.B.3: Information on the criteria of the ECBI index (as of 2014)

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

Table 2.B.4: Panel regressions of inflation on CBI (IV with LIML)

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

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

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

Chapter 3

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

Abstract

What accounts for the worldwide changes in central bank design over the past four decades? Using a new dynamic index of central bank independence, this chapter employs a political economy perspective to explain the timing, pace and extent of reforms in central banking in a sample of 65 countries over the period 1972-2014. I show that incentives generated by initial reforms which increased the level of independence, as well as a regional convergence, represent important drivers of reforms in central bank design. At the same time, an external pressure to reform, such as obtaining an IMF loan or joining a monetary union, also increases the likelihood of reforms, while government changes or crises episodes have little impact. These results are robust to controlling for the size and magnitude of reforms, as well as to alternative indices of central bank independence.

3.1 Introduction

The past four decades have been characterized by significant changes in central banks' institutional design, generally towards assigning monetary authorities a higher degree of independence from the executive branch. Yet, despite the growing consensus on the optimality of this institutional arrangement in fighting inflation, the degree of central bank independence and timing of reforms varies considerably across countries. Moreover, events that unfolded during the 2008-09 global financial crisis reopened the debate on central bank design, arguing that new institutional arrangements aimed not only at price, but also financial stability, are needed (Alesina and Stella, 2010; Brunnermeier and Sannikov, 2012; Cukierman, 2013; Issing, 2013; Taylor, 2013).¹ As a result, recent years have seen a new wave of reforms concerning, in particular, the involvement of central banks in banking and financial supervision.²

This chapter aims to understand why and how central bank reforms, such as the ones that followed the recent crisis, come about. A large literature in central banking has investigated the impact of central bank independence on inflation rates, however the causes of reforms in central bank design have received less attention. Overall, while most of this research supports a negative relationship between the level of central bank independence (CBI) and inflation rates, this link is not consistent across countries or periods (Posen, 1995; Campillo and Miron, 1997). Two empirical challenges in examining the CBI-inflation nexus are represented by the different methodologies of constructing CBI indices and, more importantly, the fact that indices are computed at different points in time and do not necessarily reflect the dynamic process of adopting reforms (Acemoglu et al., 2008).

This thesis overcomes these limitations by introducing a large cross-country database on the timing of legislative changes in central bank design for a set of 65 countries during the period 1972-2014. It proposes a dynamic measure of central bank independence that allows a more precise determination than previously possible of the timing and magnitude of reforms in central bank legislation. This dynamic index extends the two

¹Consequently, central banks around the world are now perceived as public policy institutions with the goal to promote monetary *and* financial stability, a double mandate that might bring a new form of time inconsistency problem (Ueda and Valencia, 2014).

²For example in UK in 2012, Hungary in 2013, Russia in 2013 and Euro area members in 2014.

most common indices 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, when these indices have been created, this new measure of CBI extends previous ones by introducing new elements that can affect the conduct of monetary policy such as financial independence and accountability.

Employing this dynamic index of CBI, I pursue a political economy perspective to examine the likelihood of reforms in central bank design. The starting point is a stylized war of attrition model in which an interest group has an observed bias towards retaining a status quo ([Alesina et al., 2006](#)). 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. I use several empirical strategies to identify a potential learning effect or status quo bias in reforming central bank institutional design. The results suggest an inverse U-shaped relationship between past levels of CBI and the probability of reforms. More specifically, this implies that countries are less likely to reforms at very low and very high levels of central bank independence, where they exhibit a strong status quo bias. I also show that regional convergence has an equally important learning effect, since countries that are the farthest away from the region's average level of independence are also the most likely to reform. These findings suggest a strong dynamic relationship between the current level of central bank independence and subsequent reforms in central bank design.

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 a strong support for the alternative argument that periods of growth are more inducive to reforms, since potential losers from the policy change can recover the losses incurred more easily ([Giuliano et al., 2013](#)). Furthermore, I also find strong support for an international pressure to reform since receiving an IMF loan or becoming a member of a currency union has a positive impact on the probability of changing the level of CBI.

The robustness of these results is checked along several lines. First, I recompute the dynamic evolution of other indices of central bank independence employed in the literature such as [Grilli et al. \(1991\)](#), [Cukierman et al. \(1992\)](#), [Jacome and Vazquez \(2008\)](#) and [Dincer and Eichengreen \(2014\)](#). This guarantees that the baseline results are not driven by the larger number of reforms captured by the extended index of central bank independence proposed in this thesis. Second, I use several econometric specifications and proxies for the main explanatory variables. Finally, I control for the sign and magnitude of reforms, as well as the different dimensions along which central bank legislation can be amended. This closer look at the reform process reveals new insights into the evolution of central bank independence. For example, while crisis episodes do not impact the overall probability of reforming, they do seem to increase the probability of adopting reforms that decrease the level of CBI.

The chapter is organized as follows. Section [3.2](#) reviews previous literature on central bank independence. Section [3.3](#) discusses the methodology followed in identifying reforms. Section [3.4](#) discusses the political economy arguments of reforms and explanatory variables used. Section [3.5](#) presents the empirical strategy and main results, while Section [3.6](#) concludes.

3.2 Literature on Central Bank independence

Theoretically, the concept of central bank independence (CBI) 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 (central banks) that have a clear objective of price stability. Since then the concept of central bank independence has not only shaped the design of central banks over the last four decades, but also created avenues for investigating how independent central banks behave and affect macroeconomic indicators, in particular inflation rates.

A large literature has studied the link between central bank independence and macroeconomic performance. A first step in this endeavor is the identification of measures able to capture the degree of central bank independence from the government. [Bade and Parkin \(1982\)](#); [Alesina \(1988\)](#); [Grilli et al. \(1991\)](#); [Cukierman et al. \(1992\)](#) are among the first to propose indices aimed at capturing the degree of central bank

independence. These indices focus on the statutes of central banks to capture, in the most objective way, the degree of independence of the central bank. They consider three crucial characteristics such as the appointment of central bankers, the presence of a clear objective function and the amount of power the government has, including its ability to borrow from the central bank. Following the development of these measures of central bank independence, an extensive empirical literature has tested the effectiveness of CBI in lowering inflation. Overall, there is a large support for a negative correlation between CBI indices and inflation (Alesina, 1988; Grilli et al., 1991; Cukierman et al., 1992; Alesina and Summers, 1993; Masciandaro and Spinelli, 1994).³

Nonetheless, conflicting views still exist. One set of concerns regards the heterogeneity of the link between CBI and inflation across countries or when different control variables are included. Cargill (1995) shows that the relationship is not robust in a sample of industrialized countries. Evidence from developing countries is also mixed. For example, Cukierman et al. (2002) analyze 26 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. The negative correlation between central bank independence and inflation appears also sensible to various controls. For example, 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.⁴

A second set of difficulties in assessing the impact of central bank independence concerns the way in which CBI indices are built. It might be the case 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. Cukierman et al. (1992) build a measure of *de facto* independence as the turnover rate of the central bank governor and find that, for developing countries, the link between CBI and inflation still holds when we look at *de facto* measures of independence. However, using the turnover rate measure with more recent data, Crowe and Meade (2007) do not find any meaningful statistical relationship.

³See Eijffinger and de Haan (1996); Arnone et al. (2006); Cukierman (2008); Klomp and de Haan (2010) for extensive literature reviews on the relationship between CBI indices and inflation.

⁴However, these findings themselves may not be robust as shown in Brumm (2000), who points out significant measurement errors in Campillo and Miron (1997) in particular and confirms the strong negative correlation between inflation and central bank independence.

They conclude that this is due to the very low correlation between *de jure* measures of CBI and the turnover rate which might, in fact, capture different dynamics. At the same time, *de jure* indices themselves seem quite subjective since [Mangano \(1998\)](#) points out that the two most common measures of CBI, the [Grilli et al. \(1991\)](#) (GMT) and the [Cukierman et al. \(1992\)](#) (CWN) indices, capture quite different information. For example, 40 percent of the criteria collected by the GMT index are not present in the CWN one. [Acemoglu et al. \(2008\)](#) circumvent this problem by constructing a simple dummy variable to capture the year of major reforms leading to increases in CBI.

Finally, disregarding the robustness of the negative correlation between CBI and inflation, a more recent stream of the literature discusses the issue of causality and looks at the endogenous evolution of central banks. A typical example of an endogenous evolution of monetary institutions is represented by the German Bundesbank whose statute has been modified in 1957 as a result of a strong public aversion towards inflation after periods of hyperinflation in Germany ([Alesina and Summers, 1993](#)). Thus, it might be the case that CBI is not imposed “exogenously”, but evolves in response to changing political, social or economic factors.⁵

These arguments created avenues for a recent stream of research that looks at the timing of reforms in central bank legislation. Drawing on a rich political economy literature, these studies are, however, mainly concerned with the probability of reforms and not the magnitude or direction of changes. 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. Using logit regressions, they find that the competition between countries for international capital increases the likelihood of reforms. [Berggren et al. \(2015\)](#) 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, an approach that does not take into account the timing of reforms and might under/overestimate the magnitude of changes given the potentially different interpretation of the central bank charters.

This chapter addresses some of the empirical challenges outlined above in several

⁵See also the discussion on the endogeneity of CBI in Chapter 2.

ways. First, by building a comprehensive survey of the timing and pace of reforms in central bank independence, it aims to answer the question of what drives reforms in central bank legislation. This can shed light on the endogenous evolution of central bank design and provide a useful instrument for central bank independence. Second, I propose a new index of CBI that incorporates and extends the [Grilli et al. \(1991\)](#) and [Cukierman et al. \(1992\)](#) indices of *de jure* independence for a large sample of countries. This index provides the most extensive classification of central bank characteristics and captures the largest number of reforms.

3.3 Central Bank Legislative reforms

This section employs the new index of central bank independence developed in Chapter 2 to document the full set of reforms in central bank design for a sample of 65 countries over the period 1972-2014.⁶ This time span allows the identification of all the reforms adopted by central banks in advanced economies after the collapse of the Bretton Woods system, the full set of reforms implemented by European countries before and after the creation of the euro, as well as the reforms adopted after the 2008-09 Global Financial Crisis.

Over these four decades, central bank legislations in the sample of 65 countries have been changed or amended 1196 times, with 646 reforms in the form of complete changes of statutes or reprints of central bank charters and 550 in the form of legislative amendments.⁷ This means that, over the analyzed period, countries have, on average, modified their legislation about 18 times. Yet these legislative changes may not necessarily modify, in a significant way, the institutional design of these central banks. To gauge the magnitude 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 of modern central banks.

I thus define as a reform each date in which a legislative change that modified the level of the dynamic ECBI index took place. The information collected also allows me to construct the dynamic evolution of the [Grilli et al. \(1991\)](#) (GMT) and the [Cukierman et al. \(1992\)](#) and [Cukierman \(1992\)](#) (CWN) indices as well as several other recent

⁶See Appendix Table 3.A.1 for the full set of countries and information on data availability.

⁷The full list of the analyzed documents is available upon request.

measures of central bank independence proposed in the literature such as the [Jacome and Vazquez \(2008\)](#) (CWNE) and the [Dincer and Eichengreen \(2014\)](#) (CBIU, CBIW) ones.⁸ These additional indices will be used as a robustness check in the identification of the drivers of reforms in central bank legislation. These new indices will thus identify the full set of central bank legislative reforms that modified the degree of central bank independence in the analyzed countries, during 1972-2014. Out of the 1196 legislative changes identified, 144 of them had an actual impact on the degree of CBI.

Table 3.1: Measures of Central Bank Independence and Reforms

Paper	Index	Variables	Countries	Period	Nr. of Ref.
Grilli et al. (1991)	GMT	16	18	1989	–
Cukierman (1992)	LVAU	16	72	1950-1989	35
Cukierman et al. (1992)	LVAU	16	72	1950-1989	35
Cukierman et al. (2002)	LVAU and LVAW	16	26	1991-1998	9
Polillo and Guillén (2005)	LVAW	16	91	1989-2000	60
Crowe and Meade (2008)	LVAU and LVAW	16	99	2003	–
Jacome and Vazquez (2008)	CNWE	17	24	1990-2002	13
Arnone et al. (2009)	GMT	16	162	2003	–
Dincer and Eichengreen (2014)	CBIU and CBIUW	24	85	1998-2010	44
This chapter	ECBI	42	65	1972-2014	144

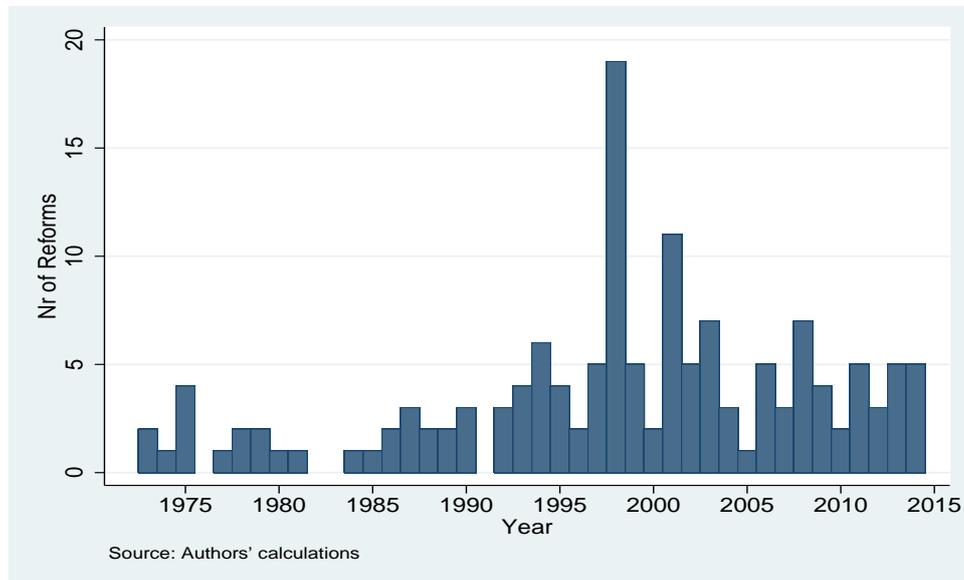
Table 3.1 compares the number of reforms captured in this chapter using the ECBI index with other measures proposed in the literature. The significantly higher number of reforms captured by the ECBI index is mainly due to its dynamic nature, since I recompute the level of CBI *every* time the central bank legislation has been amended. Other studies mainly capture reforms by looking at a particular index at two distinct (usually distant) moments in time.

Figure 3.1 displays the distribution of central bank legislative reforms over time. Interestingly, after 1992, every year has been characterized by the implementation of at least an effective reform.⁹ This finding confirms the popular belief that the spread of the literature on central bank independence might have partially stimulated the reform process. Clearly, the highest number of changes in CBI have been implemented in 1998, year in which the 11 countries that initially joined the euro, moved from having 11 national banks to a unique monetary policy authority, the European Central Bank

⁸The [Cukierman et al. \(1992\)](#) index is recomputed using both the unweighted (LVAU) and weighted (LVAW) aggregation methods (see also [Arnone et al., 2006](#), for additional discussions on the weighting of indices).

⁹[Cukierman et al. \(2002\)](#) document how, during the period 1991-1998, all the formal socialist economies (FSE) analyzed in their sample created completely new central bank legislations, or reformed existing laws, at least once. Unfortunately, since the legislation of these countries before the fall of the USSR is not available, the first index of central bank independence captured in this chapter corresponds to the one of the post reform period.

Figure 3.1: CB Legislative reforms (1972-2014)

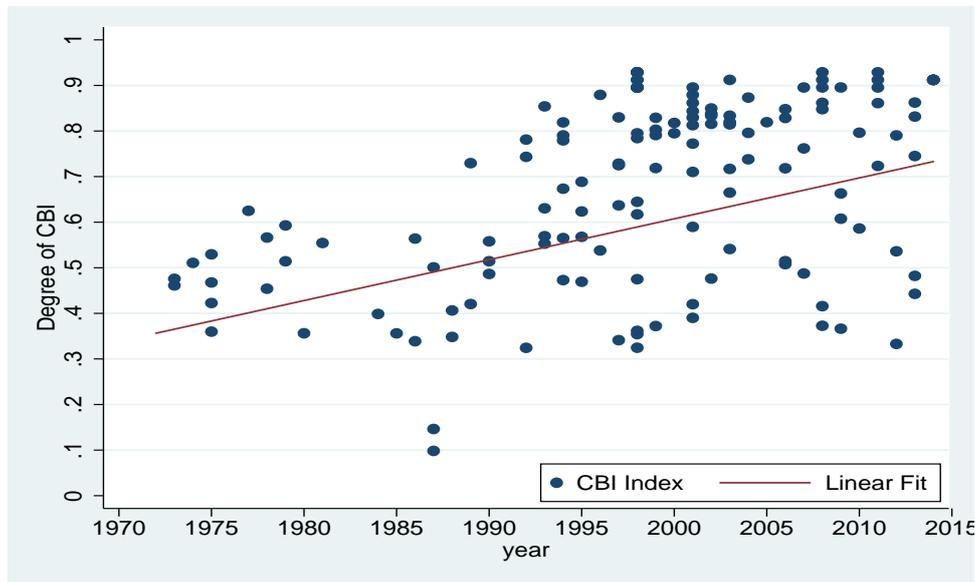


(ECB). However, the process of reforms in CBI did not end in the 1990s, but continued over the 2000s, where a new impetus for reforms started after the 2008-09 financial crisis.

Figure 3.2 presents the trend in adopting reforms by plotting the level of CBI (proxied by the ECBI) adopted by the country reforming its central bank institutional design in a given year (such that each point in the graph represents a country-year reform). Comparing the GMT and the CWN indices of CBI in 1992 versus 2003, [Arnone et al. \(2009\)](#) document a significant increase in CBI, in particular for developing countries. This trend towards the adoption of a higher degree of CBI over time is also clear in Figure 3.2.

Table 3.2 adds more details to this evolution by comparing the ECBI index with two other indices of central bank independence across decades. It shows a clear increase in the mean level of CBI in all three measures, which almost doubled between the 1970s and nowadays. It also clearly stresses the higher number of reforms captured by the extended central bank independence index proposed in this thesis. Finally, Table 3.2 also points out a key difference between the dynamic indices of independence employed in this thesis and previous studies on central bank legislative reforms. For example, [Acemoglu et al. \(2008\)](#) build a dummy variable that captures reforms in CBI by simply looking at the CWN index computed at different points in time. They identify 40 major central bank legislative reforms for a sample of 52 countries, over 1972-2005. This

Figure 3.2: Evolution of Central Bank Independence (1972-2014)



approach, however, overlooks the fact that significant changes in CBI may have occurred between the dates at which the CBI indexes are computed. Indeed, by looking at the full set of legislative changes, I identify 144 reforms that modify the degree of CBI in a sample of 65 countries. This shows that CBI indices are rather dynamic over time and that countries reform their central bank legislation quite often. This motivates my main empirical investigation in which I aim at understanding the triggers behind these many reforms.

Table 3.2: Evolution of central bank independence indices

Decade	# of Ctys	ECBI			GMT			CWN					
		# of Ref	Mean	Min	Max	# of Ref	Mean	Min	Max	# of Ref	Mean	Min	Max
1972-1979	40	12 (5 ; 7)	0.428	0.121	0.691	8 (5 ; 3)	0.356	0.125	0.750	11 (3 ; 8)	0.382	0.041	0.808
1980-1989	43	13 (6 ; 7)	0.443	0.098	0.730	10 (2 ; 5)	0.365	0.063	0.750	9 (3 ; 6)	0.404	0.041	0.841
1990-1999	64	51 (5 ; 46)	0.528	0.142	0.929	42 (3 ; 38)	0.489	0.063	1.000	42 (2 ; 40)	0.522	0.041	0.987
2000-2009	65	48 (7 ; 40)	0.684	0.142	0.929	33 (5 ; 28)	0.663	0.125	1.000	31 (2 ; 29)	0.716	0.041	0.987
2010-2014	65	21 (11 ; 10)	0.709	0.325	0.929	15 (10 ; 4)	0.684	0.125	1.000	6 (1 ; 5)	0.746	0.157	0.987

Note: ECBI = Extended CBI Index; GMT = Grilli et al. (1991) (recomputed by the author); CWN = Cukierman et al. (1992) (recomputed by the author).

All indices go from [0 ; 1]. Number of Negative and Positive changes in CBI in parentheses (N ; P).

3.4 The political economy of reforms

What drives reforms in CBI? This section uses a political economy perspective to shed some light on the timing and pace of reforms in central bank legislation over the past half of century. The starting point of the analysis is a war of attrition model in the spirit of [Alesina and Drazen \(1991\)](#). The essence of a war-of-attrition 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 in 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 will delay the implementation of stabilization reforms until the passage of time will reveal which group is weaker and bears a higher cost of waiting.

A similar mechanism can explain reforms in central bank legislation if we assume that an established interest group derives a benefit 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 type of governments might resist increasing the degree of independence of the central bank since this will reduce their ability to monetize fiscal deficits (see, for example, [Alesina and Roubini, 1992](#)). Thus, the status quo in the level of CBI will persist as long as the benefits of maintaining it outweigh the costs of implementing a reform. On a similar note, uncertainty about the outcome of reforms can also explain why countries maintain the status quo of monetary policy institutions ([Fernandez and Rodrik, 1991](#)). Thus, conflicting political interests coupled with some uncertainty about the cost or benefits of reforming central bank legislation can lead to a war-of-attrition game which can explain why some countries do not reform their central bank legislation. So what can trigger a reform?

Theories of reforms suggest several categories of factors that can explain the timing of reforms as a function of politico-economic characteristics of countries ([Drazen, 2000](#); [Alesina et al., 2006](#); [Abiad and Mody, 2005](#)). These include: (i) status quo and learning; (ii) crises that alter the balance of decision-making power and/or the cost and benefits of implementing a reform; (iii) external factors such as international financial institutions able to induce reforms; (iv) ideology or political structure; and (v) economic conditions. I briefly discuss how each of these factors can impact the probability of reforming central

bank statutes.

(i) *Status quo and learning*. The possibility of “learning” is an important driver of reforms. Learning can result in a better understanding of the costs and benefits of reforming and increases the probability of adopting a reform. This is particularly the case if reforms are a multistage process, since early reforms can reveal information about the policy regime in place and, in turn, diminish the political opposition to reforming (Abiad and Mody, 2005).

(ii) *Crises*. It is often stated that “it takes a crisis to reform” (Masciandaro et al., 2008). This claim is usually motivated by the fact that crises make the cost of (not) reforming (higher) lower (Drazen, 2000). For example, numerous country-studies highlight the importance of episodes of hyperinflation in shaping monetary policy institutions. Alesina and Summers (1993) and Hayo (1998) discuss how the hyperinflation in Germany in the 1920s has played an important role in the design of the Bundesbank Act of 1957, that established the German Bundesbank. Similarly, financial crises can bring an important incentive to undertake reforms. In the wake of financial crises, in particular, uncertainty about monetary policy may increase uncertainty in the financial sector, worsening the crisis. This might lead policymakers to modify the degree of independence of the central bank as a way of stabilizing the economy (Alesina and Stella, 2010). For example, especially following the 2008-09 financial crisis, many governments have increased the involvement of central banks in banking and financial sector supervision (Masciandaro and Romelli, 2015a). 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.

(iii) *External Inducements*. International institutions or foreign aids can provide an equally important incentive to reform. For example, binding agreements with international lending organizations like the IMF or the World Bank often require countries to commit to a particular set of policies usually to align with the “Washington consensus”. Among these policy guidelines, granting more independence to the central bank is often suggested (Rodrik and Bank, 2006). Empirical evidence on the ability of such international institutions to provide the incentives for countries to implement long-lasting

reforms is mixed. For example, [Alesina et al. \(2006\)](#) find a weak support that IMF-assisted programs induced fiscal stabilization reforms, while [Abiad and Mody \(2005\)](#) and [Berggren et al. \(2015\)](#) find a positive impact of IMF programs on the probability of undertaking reforms to liberalize financial markets or increase central bank independence, respectively.

(iv) *Ideology, political structure and institutional environment.* Reforms are more likely to occur following elections that lead to a political consolidation or a shift to a more right-wing political majority. Studies on political economy and central bank independence generally support the idea that the degree of *de facto* central bank independence is influenced by political cycles. For example, [Cukierman and Webb \(1995\)](#) show that less independent central banks tend to experience higher turnover rates of the central bank governor just after government changes. However, this approach does not explain why legislative reforms are likely to be implemented following changes in the political 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". Theories of reforms highlight also several economic structural factors as conducive to reforms. For example, countries' legal origins, i.e. common or civil law, have been related to several institutional developments such as the evolution of financial sector development ([La Porta et al., 1999](#)). [Masciandaro et al. \(2008\)](#) further argue that common law countries have a more market friendly environment which might explain the assignment of financial supervision to an authority different from the central bank. Regarding the probability of reforming the legislation of the central bank, 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.

(v) *Economic conditions.* While crises or periods of instability can potentially reduce the costs of reforms, the opposite view might apply as well. One could also argue that reforms are more likely to happen during periods of growth since wealthier economies might find it easier to compensate potential losers from the reform and cover their incurred losses ([Giuliano et al., 2013](#)). Similarly, the degree of internationalization of a country and/or its willingness to attract international capital, might influence the

likelihood of reforms.

In summary, reforms are likely to occur under a rich set of conditions. Consequently, the next section describes a set of variables that are likely to capture each of these conditions.

3.4.1 Other data

The choice of explanatory variables reflects the theoretical and empirical literature arguments discussed above. To explain why countries reform their central bank legislation, I consider four sets of explanatory variables: a) learning, b) shocks or crises, c) external inducements and d) political-economic elements.

Following previous literature that looks at the political economy of reforms (see also, [Abiad and Mody, 2005](#)), I introduce two proxies for learning. First, domestic learning is modeled following a simple reduced-form process which assumes that policy changes are driven by the difference between the desired level of CBI, which can be considered as full independence (a value of 1 for the ECBI index) and the level of independence prior to the reform, i.e. $(1 - ECBI_{i,t-1})$. Furthermore, this dynamic process is affected by the reforms that have been previously undertaken to allow for a learning effect. In particular, the specification I use follows [Abiad and Mody \(2005\)](#): $ECBI_{i,t-1}(1 - ECBI_{i,t-1})$. This means that the effect of domestic learning is the lowest at very high and very low levels of independence, allowing for an inverse U-shaped relationship between previous levels of CBI and the probability of reforming. Countries with very low levels of independence are very likely to have a strong status quo bias and resist reforms. Equally, countries with very high levels of CBI are also less likely to adopt further reforms. Therefore, the highest probability to reform is encountered in countries characterized by an average degree of independence.

Apart from domestic learning, I also consider the possibility that countries are more likely to reform when other countries in their region are also reforming. Thus, I measure a regional bias in a similar way, as the difference between the average level of CBI in a region and a country's own level: $(REG_{i,t-1} - ECBI_{i,t-1})$. Region, in this context, refers to geo-political areas as defined in Appendix Table [3.A.1](#).

Looking now at shocks and crises, I introduce a financial crisis dummy that takes the value 1 if a country experienced a systemic banking crisis in the two years prior to a

reform in central banking. Apart from financial sector crises, episodes of high inflation are of particular importance in explaining the probability of reforms in central bank legislation. I thus 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 previous period (see [Reinhart and Rogoff, 2004](#)). It can be expected that governments, after periods of high inflation, will try to stabilize inflation expectations by assigning more independence to the monetary policy institution. Finally, recessions can alter the cost and benefits of adopting reforms, since agents bearing the costs of policy reforms are less willing to adopt a reform in periods of economic downturns. Consequently, I build a recession dummy that takes the value of 1 if a recession was recorded in the two years prior to a reform. Recession episodes are identified following a methodology proposed in [Braun and Larrain \(2005\)](#) (see Appendix 3.A.2 for details).

Proxies for an international pressure to reform (external inducements) include : IMF loan programs and membership to a currency union.¹⁰ The International Monetary Fund clearly states that an IMF loan provides a cushion that eases the adjustment policies and reforms that a country must make to correct its balance of payments problems and restore conditions for strong economic growth. Given that central bank independence has often been considered as a *free lunch* among these reforms, one might expect improvements in CBI as one of the conditions imposed for obtaining such loans (see [Grilli et al., 1991](#); [Gutierrez, 2003](#), among others). The second variable of international pressure is represented by a currency union dummy variable, that assumes value 1 if the country is member of a currency union. Given the sample of countries analyzed, the Euro area is the only currency union captured by this variable. Prior to joining the European Monetary Union and adopting the euro, countries are required to grant more independence to their central bank. After a country becomes part of the Euro area, its monetary policy authority is the European Central Bank, that has been created following the best practices in central bank independence.

The political variables include a dummy variable capturing the political orientation of the government (Left Government), that assumes values equal to 1 whether the executive party is left-wing, and a measure of democracy taken from the Polity IV database. More

¹⁰In robustness checks, I also consider World Bank loan programs, however these are not included in the baseline specification due to a high collinearity with the IMF loan programs. These additional results are available upon request.

specifically, I use the polity2 index (PolityIV, 2014) ranging from -10 to 10 (-10=high autocracy; 10=high democracy). In line with previous studies that argue how right-wing governments are normally considered more inclined to market-oriented reforms (Alesina and Roubini, 1992), I expect a negative impact of left-wing governments on the likelihood of central bank legislative changes. On the other hand, I expect a positive influence of the Polity score on reforms, given that democracy has been shown to have a positive impact on the likelihood of implementing economic reforms in a country (see Giuliano et al., 2013, among others). Finally, as discussed in the previous section, I also include an institutional environment variable and I investigate the legal origin hypothesis by considering the distinction between common and civil law countries (La Porta et al., 1999; Masciandaro et al., 2008).

Turning to economic variables, I control for the level of growth in per capita GDP as a proxy for the economic cycle. Similarly, I control for the degree of internationalization of a country proxied by the degree of openness to trade and the KOF Index of Globalization. As discussed in Section 3.2, 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 might 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, we might expect that the benefits of reforms are higher the more a country is open to trade and/or globalized.

I describe in more detail the definition of all these variables and sources of data in Appendix Table 3.A.2, while Appendix Table 3.A.3 provides some summary statistics for these variables.

3.5 Determinants of reforms: multivariate analysis

The dependent variable in the baseline regression is $\Delta ECBI_{it}$ which measure the change in the level of central bank independence in year t in country i . Recall that the ECBI index is a normalized measure taking values between 0 and 1 (0=no independence; 1=full

independence). Given this discrete, ordinal nature of the proposed index, the baseline estimation uses an ordered logit model which allows for multiple discrete outcomes to be ranked.

The baseline specification thus becomes:

$$\begin{aligned} \Delta ECBI_{it} = & \beta_1 ECBI_{i,t-1}(1 - ECBI_{i,t-1}) + \beta_2(REG_{i,t-1} - ECBI_{i,t-1}) + \\ & \beta_3' \phi^{Crises} + \beta_4' \phi^{International} + \beta_5' \phi^{Pol+} + \beta_6' \phi^{Econ} + \epsilon_{it}, \end{aligned} \quad (3.1)$$

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

The results of this baseline specification are presented in Table 3.3. Columns (1) to (5) gradually add the five sets of determinants of policy changes discussed in Section 3.4. 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 at the 1-percent level, confirming the inverse U-shaped relationship between policy changes and the 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. Similarly, a regional pressure appears equally important; the positive and significant sign of $(REG_{i,t-1} - ECBI_{i,t-1})$ suggests that countries more far from the regional average level of CBI are more likely to reform their legislation as well. Column (2) considers the effect of crises/shocks dummies. Contrary to popular belief, none of the crisis proxies are statistically significant suggesting that harsh economic environments do not necessarily drive reforms.

Column (3) adds the external inducement proxies. I find that legislative changes are more likely to happen in countries that have been assisted by an IMF loan program in the two years prior a reform. This is in line with expectations and previous literature,

Table 3.3: Ordered logit estimates: benchmark specification

	(1)	(2)	(3)	(4)	(5)	(6)
$ECBI_{i,t-1}*(1-ECBI_{i,t-1})$	3.4571** (1.400)	4.0621*** (1.425)	14.3652*** (3.817)	4.2391*** (1.531)	22.6393*** (5.827)	8.4846** (3.832)
$REG_{i,t-1}-ECBI_{i,t-1}$	2.2131** (0.877)	2.1647** (0.987)	3.7410*** (1.119)	1.5704** (0.782)	3.4813*** (1.242)	2.6857** (1.084)
Financial Crises		0.1357 (0.324)			-0.1357 (0.396)	-0.3501 (0.679)
Recession		-0.3928 (0.257)			-0.4040* (0.230)	-0.4049 (0.438)
Inflation Crises		0.1060 (0.370)			0.3253 (0.424)	0.7336 (0.539)
IMF Programs			0.7504*** (0.269)		0.7516*** (0.290)	1.2508*** (0.282)
Currency Union			3.2579*** (0.561)		3.4384*** (0.700)	
Left Government $_{i,t}$				0.1365 (0.225)	0.0123 (0.261)	-0.3059 (0.364)
Polity $_{i,t-1}$				0.0294** (0.013)	0.0174 (0.026)	-0.0290 (0.026)
Common Law				-0.8507*** (0.205)	-1.1425*** (0.369)	-0.2433 (0.272)
GDP per capita growth $_{i,t-1}$					0.0617** (0.028)	0.0481 (0.040)
Openness $_{i,t-1}$					0.0031 (0.002)	0.0024 (0.002)
KOF Globalization Index $_{i,t-1}$					0.0243** (0.012)	0.0238** (0.010)
Observations	2,259	1,929	2,075	1,933	1,609	891
Number of countries	65	64	65	59	54	28
Log Likelihood	-1199	-1021	-1078	-1024	-838.5	-310.8
Wald test (P-value)	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is the change in the Extended Central Bank Independence index, $\Delta ECBI_{i,t}$. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP. Column (6) excludes European Union countries.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

since the IMF is known to provide technical assistance to borrowing countries in order to help them adopt the best standard in central bank institutional design (Lybek, 1999). For example, Gutierrez (2003) discusses how, in Latin America, central bank legislative reforms were often one of the conditions imposed by international financial institutions, such as the IMF and the World Bank, for the disbursement of loans to the country. Results also confirm the positive relationship between the probability of reforms and the

currency union dummy. This is expected since countries that join a currency union like the Euro area also undergo significant reforms in their central bank legislation.

Finally, several politico-economic variables are also highly significant in explaining reforms. Political parties' orientation does not seem to have a statistically significant effect on the probability of reforming CBI, while being a more democratic country has a marginal effect, which however is not robust to the inclusion of economic characteristics such as per capita GDP growth and openness. Moreover, I find that countries in a Common Law system are characterized by a lower probability of reforming their *de jure* level of central bank independence. This is in line with the idea that common law countries, which rely less on regulations, are less likely to implement many legislative reforms which change the level of CBI. Furthermore, high previous growth levels increase the likelihood of improving the level of CBI. This evidence provides strong support for the argument that periods of boom might foster reforms since potential losers from the policy change can more easily recover the costs of reforming. Moreover, when controlling for previous growth levels, also the coefficient of the recession dummy turns significant in Column (5) and its negative sign suggests that central bank independence is, in fact, set back during recession episodes. This reinforces the idea that periods of growth are more conducive to reforms that increase the level of independence than periods of recessions and adverse economic conditions. Lastly, being a more open economy as proxied by the KOF Globalization index also increases the probability of reforming. The last column in Table 3.3 excludes European Union (EU) countries from the estimation of equation (3.1). Countries members of the EU have a long-term objective of joining the euro area which also requires the implementation of reforms in central bank legislation to align with the level of independence of the ECB. The main results are robust to the exclusion of this large sample of countries, however some of the political-economy variable are now less precisely estimated.

One important characteristic of the ECBI index proposed in this thesis is the more extensive characterization of central bank institutional design. It is thus important to check whether these findings are robust to alternative indices of central bank independence proposed in the literature. This guarantees that results are not necessarily driven by the fact that the extended index of CBI captures a larger set of reforms. As discussed in the previous chapter, the large database on central bank design allows me to

recompute several other indices employed in the literature. I thus compute the variation in these alternative indices as well. Findings from estimating equation 3.1 using these alternative measures of reforms are presented in Appendix Table 3.A.4. Overall, results are very similar regardless of the measure employed, confirming the robustness of the ECBI index proposed in this thesis. These additional findings also stress the strong learning effect and importance of external pressures in determining reforms in central bank design.

Table 3.4: Ordered Logit estimates: alternative specifications

	(1)	(2)	(3)	(4)	(5)	(6)
ECBI _{<i>i,t-1</i>}	8.9006*** (2.235)	9.5302*** (2.513)	18.1282*** (4.210)	7.4584*** (2.612)	19.9824*** (6.108)	6.1603 (4.012)
(ECBI _{<i>i,t-1</i>}) ²	-6.7554*** (1.796)	-7.3675*** (1.990)	-16.3144*** (4.002)	-6.0774*** (2.087)	-21.5472*** (5.544)	-8.8120*** (3.203)
REG _{<i>i,t-1</i>} -ECBI _{<i>i,t-1</i>}	3.5916*** (1.105)	3.5390*** (1.217)	4.8270*** (1.432)	2.5105** (1.015)	2.5069 (1.619)	0.7734 (2.115)
Financial Crises		0.0238 (0.334)			-0.1188 (0.399)	-0.3061 (0.686)
Recession		-0.3117 (0.252)			-0.4382* (0.229)	-0.4530 (0.432)
Inflation Crises		0.2287 (0.350)			0.3021 (0.439)	0.6017 (0.530)
IMF Programs			0.7366*** (0.261)		0.8072** (0.319)	1.3229*** (0.285)
Currency Union			3.0443*** (0.603)		3.5634*** (0.688)	
Left Government _{<i>i,t</i>}				0.1247 (0.220)	0.0094 (0.265)	-0.3346 (0.381)
Polity _{<i>i,t-1</i>}				0.0263** (0.013)	0.0177 (0.026)	-0.0180 (0.027)
Common Law				-0.8055*** (0.206)	-1.2687*** (0.377)	-0.5150 (0.385)
GDP per capita growth _{<i>i,t-1</i>}					0.0626** (0.028)	0.0499 (0.041)
Openness _{<i>i,t-1</i>}					0.0031 (0.002)	0.0021 (0.002)
KOF Globalization Index _{<i>i,t-1</i>}					0.0309** (0.012)	0.0337*** (0.012)
Observations	2,259	1,929	2,075	1,933	1,609	891
Number of countries	65	64	65	59	54	28
Log Likelihood	-1196	-1018	-1076	-1023	-837.8	-310.0
Wald test (P-value)	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is the change in the Extended Central Bank Independence index, $\Delta\text{ECBI}_{i,t}$. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP. Column (6) excludes European Union countries.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

3.5.1 Alternative specifications

This section considers several alternative econometric specifications. First, I allow for a more relaxed learning effect by not restricting the optimal level of CBI to the maximum value of 1. To capture the non-linear relationship between past reforms and the probability of policy changes, I include both the past levels of $ECBI_{i,t-1}$ and its squared value $(ECBI_{i,t-1})^2$. Results are presented in Table 3.4 and remain robust to this alternative specification. The coefficient of $ECBI_{i,t-1}$ is significant and positive across all specifications and suggests that higher levels of CBI increase the likelihood of reforming. Yet, the squared value of ECBI is negative and highly significant suggesting that this relationship is indeed non-linear, since countries with very high levels of CBI are less likely to reform. All the other determinants of reforms are robust in this alternative specification. Again, I check the robustness of these results when considering the policy changes captured by the dynamic indices re-computed following the GMT and the CWN (LVAU, LVAW) methodologies as well as the [Jacome and Vazquez \(2008\)](#) (CWNE) and [Dincer and Eichengreen \(2014\)](#) (CBIU, CBIW) indices. Results, presented in Appendix Table 3.A.5, are qualitatively similar.

An 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:

$$\begin{aligned} Prob(e_{it} = 1) = & F(\beta_1 ECBI_{i,t-1}(1 - ECBI_{i,t-1}) + \beta_2(REG_{i,t-1} - ECBI_{i,t-1}) + \\ & \beta_3\phi^{Crises} + \beta_4\phi^{International} + \beta_5\phi^{Pol+} + \beta_6\phi^{Econ} + \epsilon_{it}), \end{aligned} \quad (3.2)$$

where e_{it} is a reform dummy variable that takes the value 1 if country i is experiencing a reform in year t . The appropriate methodology to estimate Equation (3.2) is determined by the distribution of the cumulative distribution function, $F(\cdot)$. Since episodes of reforms occur irregularly (95% of the sample is zeros), $F(\cdot)$ is asymmetric. Therefore, I estimate Equation (3.2) using the complementary logarithmic (or cloglog) framework, which assumes that $F(\cdot)$ is the cumulative distribution function (cdf) of the extreme value distribution. In other words, this estimation strategy assumes that:

$$F(z) = 1 - \exp[-\exp(z)]. \quad (3.3)$$

The results obtained under this alternative econometric specification are presented in Table 3.5 for the model in Equation (3.2) for both the ECBI index, as well as alternative dynamic indices of central bank independence.¹¹ Overall, these additional findings stress an equally strong effect of learning, external inducements, growth and internationalization on the probability of central bank legislative reforms.

Table 3.5: Complementary logarithmic estimates

Dependent Variable:	ECBIRef (1)	GMTRef (2)	LVAURef (3)	LVAWRef (4)	CWNERef (5)	CBIURef (6)	CBIWRef (7)
CBI _{i,t-1} *(1-CBI _{i,t-1})	10.4531** (4.596)	9.1248** (3.556)	10.1369** (4.053)	12.4986*** (4.667)	14.9229*** (5.428)	12.9859*** (4.033)	12.4389*** (4.286)
REG _{i,t-1} -CBI _{i,t-1}	3.4050*** (1.089)	2.7412** (1.343)	2.6941*** (0.958)	3.2443*** (1.028)	4.4881*** (1.271)	3.3046*** (1.046)	3.5126*** (1.070)
Financial Crises	0.1021 (0.276)	0.1620 (0.314)	0.0322 (0.329)	0.0256 (0.330)	-0.0493 (0.297)	0.1419 (0.309)	0.1283 (0.309)
Recession	0.1130 (0.263)	0.1212 (0.252)	0.1954 (0.232)	0.1778 (0.242)	0.1566 (0.224)	0.0697 (0.241)	0.0943 (0.245)
Inflation Crises	0.8133** (0.347)	0.6442 (0.402)	0.6396* (0.349)	0.6339* (0.369)	0.6233* (0.331)	0.7390* (0.386)	0.7324* (0.392)
IMF Programs	0.6500** (0.285)	0.8216*** (0.317)	0.9655*** (0.257)	0.9701*** (0.253)	0.9747*** (0.291)	0.8830*** (0.261)	0.8717*** (0.251)
Currency Union	2.0736*** (0.691)	1.7266*** (0.659)	2.2051*** (0.588)	2.5145*** (0.585)	3.2803*** (0.714)	2.7513*** (0.686)	2.6257*** (0.676)
Left Government _{i,t}	0.0383 (0.232)	0.0792 (0.251)	0.2386 (0.294)	0.2203 (0.290)	0.2514 (0.281)	0.2788 (0.301)	0.2963 (0.298)
Polity _{i,t-1}	0.0342 (0.027)	0.0002 (0.032)	0.0015 (0.034)	0.0023 (0.033)	-0.0033 (0.032)	0.0025 (0.036)	0.0026 (0.036)
Common Law	-1.0662*** (0.389)	-0.9515* (0.496)	-1.3199*** (0.471)	-1.4500*** (0.485)	-1.4651*** (0.453)	-1.4749*** (0.549)	-1.5458*** (0.530)
GDP per capita growth _{i,t-1}	0.0519** (0.026)	0.0267 (0.028)	0.0382 (0.031)	0.0377 (0.031)	0.0347 (0.033)	0.0338 (0.031)	0.0348 (0.030)
Openness _{i,t-1}	0.0040* (0.002)	0.0029* (0.002)	0.0036 (0.002)	0.0040* (0.002)	0.0025 (0.002)	0.0034 (0.003)	0.0034 (0.003)
KOF Globalization Index _{i,t-1}	0.0213** (0.010)	0.0279* (0.015)	0.0305* (0.016)	0.0296* (0.015)	0.0252* (0.015)	0.0340** (0.015)	0.0332** (0.015)
Constant	-7.3976*** (1.219)	-7.3026*** (1.364)	-7.8766*** (1.514)	-8.4019*** (1.573)	-8.7674*** (1.555)	-8.7312*** (1.300)	-8.5690*** (1.320)
Observations	1,609	1,609	1,609	1,609	1,609	1,609	1,609
Number of countries	54	54	54	54	54	54	54
Log Likelihood	-358.1	-290.5	-269.2	-266.0	-258.0	-273.8	-273.4
Wald test of joint significance (P-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is a dummy that takes value one in years in which a reform that modified the degree of CBI index took place, where independence is measured alternatively by the ECBI index, the GMT (Grilli et al., 1991), LVAU (Cukierman, 1992), LVAW (Cukierman et al., 1992), CWNE (Jacome and Vazquez, 2008) and CBIU, CBIW (Dincer and Eichengreen, 2014). Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

¹¹As before, I check whether these results hold under the alternative learning effects considered in Table 3.4. These additional robustness checks are presented in Appendix Table 3.A.6 and are qualitatively the same.

Interestingly, under this alternative specification inflation crises seem to increase the probability of adopting reforms. The coefficient of the inflation crisis dummy is highly significant in the model that uses the ECBI index in Column (1), but less precisely estimated in the specifications using the alternative indexes of CBI in Columns (2)-(7). The importance of inflation crises in the cloglog estimations, but not in the ordered logit ones in Table 3.3, suggests that the sign and magnitude of reforms might also matter. Thus, I check the robustness of these results by explicitly looking at the direction and magnitude of reforms. These additional estimations are presented in Table 3.6.

Columns (1) and (5) in Table 3.6 re-estimate the full sample results under the two specifications for the learning effects. The rest of the columns split the sample into reforms that increase the level of CBI (Columns (2) and (6)), decrease it (Columns (3) and (7)) or are very large positive reforms (Columns (4) and (8)). The results for (very large) positive reforms confirm the previous findings and are largely in line with the estimations obtained in the full sample. Reforms that bring reversals in CBI (Columns (3) and (7)), however, show different patterns. First, the sign of the status quo bias coefficients $ECBI_{i,t-1}(1 - ECBI_{i,t-1})$, $ECBI_{i,t-1}$ and $ECBI_{i,t-1}^2$, is reversed. This implies that countries with very low and very high levels of independence are more likely to adopt reforms that decrease the level of independence. Next, while higher levels of independence in a country's region increase its likelihood of adopting positive reforms (in Columns (1) and (5)), they do not, however, impact its likelihood of reversing the level of CBI. Finally, crises variables, which had an ambiguous impact on the overall likelihood of adopting reforms, do seem to influence the probability of reducing the level of independence. Both the inflation and recession dummies increase the chances of adopting reforms that decrease the level of CBI. These are in line with [Masciandaro and Romelli \(2015a\)](#) 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. Overall, these results stress the importance of looking at the size and sign of reforms as opposed to the use of simple dummy variables to capture reforms as in previous research ([Acemoglu et al., 2008](#); [Berggren et al., 2015](#)).

Having confirmed the importance of many political economy variables in influencing the likelihood and size of reforms in central bank independence, the next section takes a closer look to whether these results are driven by amendments adduced to specific

Table 3.6: Cloglog estimates: sign and magnitude of reforms

Dependent Variable:	ECBRef	ECBRef > 0	ECBRef < 0	ECBRef > 0.10	ECBRef	ECBRef > 0	ECBRef < 0	ECBRef > 0.10
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ECBI _{i,t-1} *(1-ECBI _{i,t-1})	9.4887** (4.510)	19.0108*** (5.807)	-13.5271*** (4.784)	33.2517*** (12.204)				
ECBI _{i,t-1}					7.9966* (4.662)	15.4050** (6.579)	-12.0691** (5.266)	22.6591* (13.421)
(ECBI _{i,t-1}) ²					-8.9091** (4.287)	-17.3311*** (5.651)	13.1731*** (4.652)	-28.0714** (11.231)
REG _{i,t-1} -ECBI _{i,t-1}	3.4733*** (1.110)	4.3968*** (1.623)	0.3107 (1.069)	5.1067** (2.200)	2.9782** (1.319)	3.5053* (1.900)	1.3372 (2.445)	2.7168 (2.596)
Financial Crises	0.1191 (0.288)	0.0185 (0.349)	0.4973 (0.541)	0.4878 (0.429)	0.1279 (0.291)	0.0334 (0.356)	0.4736 (0.546)	0.5597 (0.452)
Recession	0.1145 (0.274)	-0.2684 (0.272)	1.0128* (0.599)	-0.1852 (0.415)	0.0861 (0.263)	-0.3152 (0.263)	1.0414* (0.591)	-0.3192 (0.409)
Inflation Crises	0.8870** (0.362)	0.8461** (0.427)	1.4027* (0.844)	0.8630* (0.480)	0.8807** (0.371)	0.8417* (0.440)	1.4260* (0.846)	0.9027* (0.485)
IMF Programs	0.6819** (0.291)	0.7704** (0.316)	-0.1314 (0.701)	1.0414*** (0.395)	0.7201** (0.320)	0.8263** (0.357)	-0.1714 (0.685)	1.3116*** (0.481)
Currency Union	1.9201*** (0.708)	2.9713*** (0.753)	-1.2473 (0.849)	5.1323*** (1.193)	2.0125*** (0.721)	3.1334*** (0.745)	-1.2809 (0.827)	5.7853*** (1.027)
Left Government _{i,t}	0.0457 (0.245)	0.0014 (0.297)	0.0215 (0.522)	0.3662 (0.313)	0.0341 (0.254)	-0.0165 (0.306)	0.0244 (0.527)	0.3382 (0.340)
Polity _{i,t-1}	0.0341 (0.027)	0.0254 (0.035)	0.1096 (0.074)	0.0281 (0.042)	0.0353 (0.028)	0.0266 (0.036)	0.1082 (0.076)	0.0278 (0.037)
Common Law	-1.0762*** (0.377)	-1.6247*** (0.520)	0.0265 (0.509)	-1.5385** (0.732)	-1.1643*** (0.400)	-1.8056*** (0.539)	0.1202 (0.606)	-1.6422** (0.817)
GDP per capita growth _{i,t-1}	0.0531** (0.027)	0.0672* (0.035)	-0.0292 (0.044)	0.0687 (0.045)	0.0551** (0.027)	0.0710** (0.036)	-0.0278 (0.043)	0.0862* (0.050)
Openness _{i,t-1}	0.0040* (0.002)	0.0048* (0.003)	0.0002 (0.004)	0.0040 (0.003)	0.0041* (0.002)	0.0051* (0.003)	-0.0001 (0.004)	0.0038 (0.003)
KOF Globalization Index _{i,t-1}	0.0223** (0.010)	0.0339** (0.014)	0.0007 (0.020)	0.0272 (0.020)	0.0260** (0.011)	0.0422*** (0.016)	-0.0039 (0.022)	0.0417** (0.020)
Observations	1,609	1,609	1,609	1,609	1,609	1,609	1,609	1,609
Number of countries	54	54	54	54	54	54	54	54
Log Likelihood	-359.4	-302.3	-89.30	-165.8	-359.2	-301.7	-89.21	-162.6
Wald test (P-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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 (2) and (6) only considers country-years in which a positive change in the level of ECBI took place, Columns (3) and (7) look only at negative variations, while the the dependent variable in Columns (4) and (8) is a dummy that takes the value one only in years where very large changes in ECBI occurred. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP.

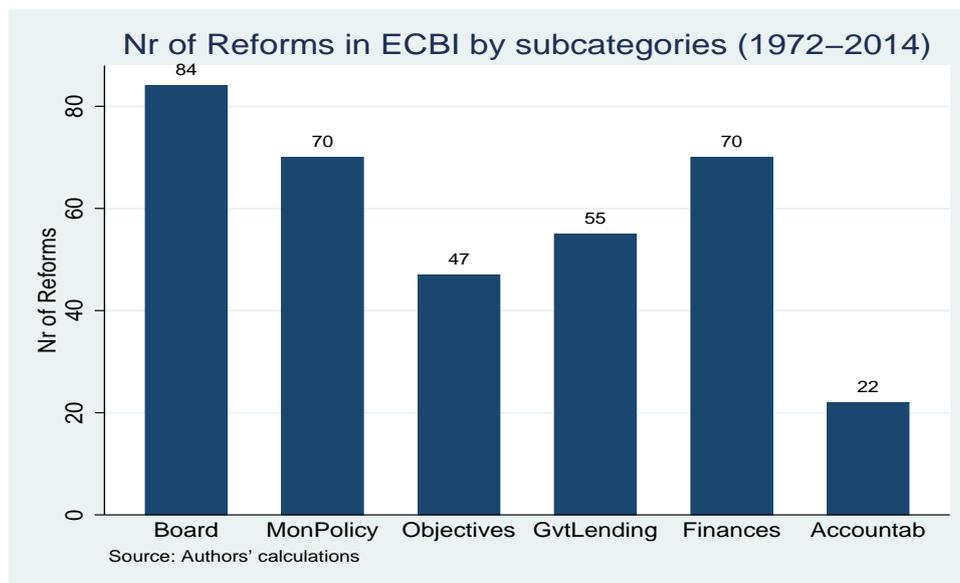
Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

sections of the central bank charter.

3.5.2 Types of reforms

Are the results presented above driven by reforms in a specific dimension of the index of central bank independence? I explore this possibility by looking at the impact of the determinants of reforms along the six categories of the ECBI index: 1) Governor and central bank board, 2) Monetary policy and conflict resolution, 3) Objectives, 4) Limitations on lending to the government, 5) Central bank finances and 6) Reporting and accountability. Similar to the baseline analysis, the dependent variable for each dimension is represented by the change in the level of central bank independence in year t in country i for dimension d . 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 3.3: Legislative reforms by subcategories (1972-2014)



Each bar indicates the number of reforms undertaken for the different dimensions of the ECBI index. *Board*: Governor and central bank board. *MonPolicy*: Monetary policy and conflict resolution. *Objectives*: Monetary policy objectives. *GvtLending*: Limitations on lending to the government. *Finances*: Central bank finances. Finally, *Accountab*: Reporting and accountability.

Figure 3.3 displays the distribution of reforms by dimensions of central bank independence over the period 1972-2014. Interestingly, the reforms related to central bank governance (Governor and central bank board) are the most common over the period

considered. On the contrary, the reporting and accountability dimension is the least reformed, being modified only 22 times across the whole sample. Moreover, if we look at each of the 42 questions codified for constructing the ECBI index, the criteria that has been, in fact, modified the most over the period 1972-2014 is the one on the objectives of monetary policy. This information, summarized under the Objectives dimension (47 reforms), confirms the increasing focus on the goal of price stability of most of the central banks in the sample.

To obtain consistent econometric tests, I also recompute the two proxies of domestic and regional learning for each dimension. In particular, for the domestic learning I compute the past level of central bank independence of dimension d in country i ($ECBI_{d,i,t-1}$) and its squared value. The proxy of regional bias, on the other hand, is computed as the difference between the average level of independence of dimension d in country i 's region and the level of d in country i : $(REG_{d,i,t-1} - ECBI_{d,i,t-1})$.

The findings on the determinants of legislative reforms by dimension of CBI are presented in Table 3.7. Columns (1), (3), (5), (7), (9) and (11) only look at the impact of learning effects in adopting reforms in the different dimensions of central bank independence. The sign of the proxies of domestic learning and regional bias provide similar results across most dimensions. However, the measure of domestic learning is less precisely estimated in Columns (1) and (5) that relate to the changes in the degree of central bank governance and monetary policy objectives, while the proxy of regional bias is strongly significant in all specifications except Columns (9), which refers to changes in central bank financial independence. The remaining columns investigate the full set of determinants of reforms for each dimension. Overall, after the inclusion of additional control variables, the drivers of reforms in different dimensions are quite similar to the ones for the changes to the aggregated ECBI index (presented in Table 3.4). The sign of the domestic learning variables is consistent across all specifications, even if the lagged levels of the dimensions related to central bank financial independence and accountability are not precisely estimated. Similar to the findings in the previous sections, the degree of independence of the central bank board (Column (2)) and that of monetary objectives (Column (6)) is set back following recession episodes, while increases in central bank financial independence (Column (10)) are more likely to occur during economic downturns. Looking at other crisis episodes, I find that reforms that increase the inde-

Table 3.7: Ordered Logit estimates: sub-categories

Dependent Variables:	Δ ECBIBoard		Δ ECBIPolicy		Δ ECBIObj		Δ ECBILending		Δ ECBIFinances		Δ ECBIReport	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ECBI $_{d,i,t-1}$	1.7741 (1.457)	7.2017** (3.268)	8.8214*** (3.385)	5.9058* (3.577)	2.5037 (1.569)	7.8520*** (2.450)	8.6008*** (2.890)	6.3026** (2.997)	9.4314*** (3.592)	5.0992 (5.859)	4.5644** (1.815)	8.6961 (5.332)
(ECBI $_{d,i,t-1}$) ²	-1.4343 (1.195)	-17.8616*** (2.935)	-11.0620*** (3.416)	-13.8142*** (4.150)	-3.1360** (1.428)	-16.3833*** (2.988)	-7.3538*** (2.201)	-9.8395*** (2.701)	-5.6917*** (1.801)	-15.5814*** (5.290)	-4.6151*** (1.332)	-22.2008** (10.218)
REG $_{d,i,t-1}$ -ECBI $_{d,i,t-1}$	3.6272*** (0.885)	-0.6653 (1.470)	3.2538*** (1.227)	-0.8433 (1.337)	2.4397** (0.950)	1.3693 (1.130)	4.8732*** (1.646)	2.0399 (1.280)	4.7726 (2.906)	-4.9964 (3.994)	3.0775** (1.320)	5.4771 (8.367)
Financial Crises		0.6404 (0.503)		-0.4914 (0.614)		0.3281 (0.476)		0.5107 (0.391)		-0.3086 (0.513)		1.2302* (0.638)
Recession		-0.7230** (0.316)		-0.4228 (0.350)		-1.0163** (0.487)		-0.0382 (0.347)		0.5952* (0.307)		-0.3099 (0.496)
Inflation Crises		-0.0659 (0.575)		0.6498 (0.582)		0.5886 (0.476)		1.7509*** (0.643)		-0.3748 (0.907)		2.3395** (1.292)
IMF Programs		1.2664*** (0.393)		1.3991*** (0.445)		1.1566** (0.466)		0.9118** (0.415)		0.3720 (0.609)		1.0813 (0.664)
Currency Union		7.4452*** (0.656)		0.8470 (0.551)		7.3297*** (0.958)		2.5448*** (0.943)		4.3898*** (1.175)		5.8811*** (1.762)
Left Government $_{i,t}$		0.3416 (0.341)		0.3006 (0.324)		0.8324** (0.345)		0.5415* (0.311)		-0.0271 (0.382)		0.7140 (0.836)
Polity $_{i,t-1}$		0.0477 (0.034)		0.0167 (0.029)		0.0139 (0.037)		-0.0505 (0.045)		-0.0217 (0.047)		-0.0931 (0.076)
Common Law		-0.7693*** (0.285)		-0.9711*** (0.324)		-1.0698** (0.499)		-1.8305** (0.792)		-1.0091 (0.623)		-5.6655 (5.078)
GDP per capita growth $_{i,t-1}$		0.0222 (0.037)		0.0764** (0.039)		0.0615 (0.071)		0.0881 (0.060)		0.0209 (0.037)		0.0754 (0.072)
Openness $_{i,t-1}$		0.0019 (0.002)		-0.0013 (0.003)		0.0052** (0.002)		0.0024 (0.003)		0.0115** (0.006)		0.0001 (0.009)
KOF Globalization Index $_{i,t-1}$		0.0303** (0.013)		0.0607*** (0.015)		0.0220 (0.016)		0.0816*** (0.023)		-0.0174 (0.021)		0.1847 (0.113)
Observations	2,259	1,609	2,259	1,609	2,259	1,609	2,259	1,609	2,259	1,609	2,259	1,609
Number of countries	65	54	65	54	65	54	65	54	65	54	65	54
Log Likelihood	-683.7	-433.0	-519.9	-363.1	-278.7	-175.3	-446.6	-326.6	-534.5	-414.1	-239.2	-163.3
Wald test (P-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is the change in dimension d of the Extended Central Bank Independence index, Δ ECBI $_{d,i,t}$. Δ ECBIBoard captures the changes brought to dimension 1: Governor and central bank board. Δ Policy indicates the variation of the dimension related to monetary policy and conflict resolution. Δ Objectives captures changes in the objectives of the monetary policy of the central bank. Δ GvtLending is the variation of the dimension related to limitations on lending to the government. Δ Finances captures the magnitude of changes in the central bank finances. Δ Accountab refers to the changes in the dimension concerning reporting and accountability. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

pendence of the central bank with respect to lending to the government are positively related to inflation crises episodes (Column (8)). Moreover, the coefficient of IMF loan programs is strongly 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. For example, [Lybek \(1999\)](#) proposes an index of central bank independence “tailored to cover the guidelines use by the Monetary and Exchange Affairs Department and the Legal Department of the International Monetary Fund when they provide technical assistance”, where marginal importance is assigned to central bank financial independence and accountability. These findings stress even more the external inducement effect of IMF programs that, when put in place, could contribute to stimulate the implementation of reforms aimed at increasing the degree of central bank independence of specific dimensions of central bank institutional design.

3.5.3 Other robustness checks

Previous studies have documented how structural reforms and democratization sometimes come in waves (see [Giavazzi and Tabellini, 2005](#); [Giuliano et al., 2013](#), among others). Insofar, the results presented do not show a strong effect of democracy, as captured by the Polity2 Score. However, the ordinal nature of this index does reflect a clear distinction between authoritarian regimes and democracies. To overcome this issue, I follow [Giavazzi and Tabellini \(2005\)](#) and create a democracy 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 3.8](#). Columns (1) to (8) present the estimates for the ordered logit estimations, while Columns (9) to (12) those obtained with the complementary logarithmic methodology. In particular, in Columns (1) to (4) the domestic learning variable is the baseline measure also used in [Table 3.3](#), while Columns (5) to (8) re-propose the same estimates using the alternative measure of domestic learning, i.e., the lagged value of ECBI and its squared value. Columns (1), (5) and (9) focus on the impact of democracy while taking into account only the measure of learning as additional controls. The positive and statistically significant sign of the democracy dummy variable across all specifications suggests that democratic countries have an higher probability of enhancing their central bank independence. These results are robust to the inclusion of the other control

Table 3.8: Ordered Logit estimates: other regressions

Dependent Variable:	Δ ECBI								ECBIRef			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ECBI _{<i>i,t-1</i>} *(1-ECBI _{<i>i,t-1</i>})	4.2615*** (1.478)	22.6523*** (5.678)	3.6634** (1.435)	22.7488*** (6.049)								
ECBI _{<i>i,t-1</i>}					8.4596*** (2.286)	19.7078*** (5.890)	9.2615*** (2.377)	20.2746*** (6.048)	3.9019 (2.822)	8.3294* (4.803)	4.3589* (2.585)	9.0878** (4.506)
(ECBI _{<i>i,t-1</i>}) ²					-6.7392*** (1.850)	-21.4412*** (5.327)	-7.0000*** (1.899)	-21.8229*** (5.612)	-2.2302 (2.268)	-9.6158** (4.284)	-1.8918 (2.086)	-9.7938** (4.252)
REG _{<i>i,t-1</i>} -ECBI _{<i>i,t-1</i>}	1.8419** (0.840)	3.5106*** (1.249)	1.8518** (0.868)	3.3873*** (1.234)	2.9654*** (1.111)	2.4408 (1.624)	3.3365*** (1.123)	2.4074 (1.607)	2.6895*** (0.807)	2.7421** (1.309)	3.3246*** (0.821)	2.8167** (1.193)
Financial Crises		-0.1401 (0.388)		-0.1699 (0.388)		-0.1203 (0.391)		-0.1524 (0.391)		0.0966 (0.272)		0.0437 (0.279)
Recession		-0.4045* (0.231)		-0.3838 (0.238)		-0.4427* (0.232)		-0.4194* (0.237)		0.0906 (0.246)		0.1260 (0.250)
Inflation Crises		0.3138 (0.425)		0.4260 (0.444)		0.2874 (0.443)		0.4058 (0.459)		0.7958** (0.367)		0.8808** (0.357)
IMF Programs		0.7292** (0.293)		0.7079** (0.290)		0.7925** (0.323)		0.7590** (0.313)		0.6635** (0.316)		0.6474** (0.313)
Currency Union		3.4612*** (0.697)		3.3998*** (0.705)		3.6070*** (0.688)		3.5318*** (0.694)		2.2100*** (0.673)		2.0470*** (0.692)
Left Government _{<i>i,t</i>}		0.0151 (0.261)		0.0273 (0.267)		0.0109 (0.265)		0.0249 (0.271)		0.0401 (0.244)		0.0573 (0.235)
Democracy _{<i>i,t</i>}	0.6182*** (0.220)	0.5587* (0.329)			0.5222** (0.223)	0.6149* (0.349)			0.9387** (0.373)	0.7909* (0.442)		
Democratic Reform _{<i>i,t</i>}			1.7081** (0.747)	2.5570*** (0.695)			1.8993** (0.770)	2.5544*** (0.690)			1.8690*** (0.434)	1.9025*** (0.574)
Common Law		-1.1599*** (0.364)		-1.1135*** (0.371)		-1.3024*** (0.379)		-1.2423*** (0.386)		-1.1843*** (0.408)		-1.1197*** (0.398)
GDP per capita growth _{<i>i,t-1</i>}		0.0629** (0.029)		0.0616** (0.031)		0.0641** (0.029)		0.0625** (0.031)		0.0550** (0.027)		0.0557** (0.026)
Openness _{<i>i,t-1</i>}		0.0037* (0.002)		0.0025 (0.002)		0.0038 (0.002)		0.0025 (0.002)		0.0047* (0.003)		0.0030 (0.002)
KOF Globalization Index _{<i>i,t-1</i>}		0.0215* (0.011)		0.0328*** (0.011)		0.0282** (0.011)		0.0397*** (0.012)		0.0255*** (0.009)		0.0355*** (0.009)
Constant									-4.9979*** (0.885)	-7.3058*** (1.286)	-4.6377*** (0.750)	-7.5412*** (1.291)
Observations	2,167	1,608	2,162	1,608	2,167	1,608	2,162	1,608	2,167	1,608	2,162	1,608
Number of countries	62	54	61	54	62	54	61	54	62	54	61	54
Log Likelihood	-1136	-837.4	-1129	-831.9	-1134	-836.5	-1125	-831.2	-497.6	-356.6	-493.8	-353.7
Wald test (P-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is a dummy that takes value one in years in which a reform that modified the degree of Central Bank Independence index took place, $CBIRef_{i,t}$. Crises is a dummy that takes the value one whether a systemic banking crisis, a recession or an inflation crisis happened in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Democracy is an alternative measure of the level of democracy in a country, computed as a dummy variable that assumes value 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. Openness is the ratio of the sum of exports and imports to GDP. Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

variables.

An alternative approach to looking at the impact of democracy on central bank legislative reforms, is to analyze whether political liberalizations, i.e. the event of becoming a democracy, are followed by changes in the institutional design of central banks. To do so, I create a dummy variable able to capture the years in which political liberalizations (democratic reform) took place. More specifically, this dummy variable takes the value of one in the first year in which a country moves from an autocracy ($\text{democracy}_{t-1}=0$, i.e., Polity2 values lower or equal 0) to a democracy ($\text{democracy}_t=1$, i.e., strictly positive values of the Polity2 score). Similarly to the estimates proposed using the democracy dummy variable, Columns (3), (7) and (11) include only the two proxies of learning, while Columns (4), (8) and (12) also take into account the additional controls. Interestingly, the statistical significance and the magnitude of the dummy variable for political liberalizations is stronger than the one of democracy.

The results presented in Table 3.8 show strong support that democracy and, more importantly, political liberalizations, promote reforms in central bank institutional design by increasing the likelihood of legislative changes that enhance the degree of independence of the monetary policy institution.

3.6 Concluding remarks

This chapter investigates the drivers of reforms in central bank legislation in a set of 65 countries over the period 1972-2014. Employing a comprehensive survey of central bank design, it documents 1196 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. Looking at the dynamics of the level of central bank independence, I show that countries adopt legislation that increases the independence of their central bank through time and have undertaken many reforms following the global financial crisis in 2008-09. The new index of central bank independence proposed in this thesis takes account of these recent changes in central bank statutes and extends previous indexes by incorporating new information on central bank financial independence and accountability.

I use a political economy framework to investigate the drivers behind the many reforms central banks have implemented over the past four decades. Employing different econometric specifications, I find a strong status quo bias in reforming the level of central bank independence. This is captured by a dynamic inverse U-shaped relationship between the level of independence and subsequent reforms. I also find evidence that the likelihood of reforms is influenced by regional converge and international pressures to reform such as receiving an IMF loan or becoming a member of a currency union. However, contrary to studies that document a positive link between electoral cycles and *de facto* measures of CBI, I find that the probability of reforms in *de jure* independence is not influenced by the political orientation of the government. The analysis also suggests that changes in central bank legislation are more likely to happen in countries that are more open and democratic. 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 chapter, 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 also suggests that further insights into the reform process will be achieved by considering particular reform areas, since I find that the sign, magnitude and targeted institutional setting of the reform also matter. More importantly, future empirical analysis must also allow for a dynamic specification of the reform process and employ dynamic indices of central bank independence.

Appendices

3.A Countries, data sources and summary statistics

Table 3.A.1: Analyzed countries

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

Table 3.A.2: Data sources

Variable	Definition	Data sources
Dependent variables		
• Δ CBI	Variable that captures the change in the level of central bank independence (CBI) in year t in country i . More specifically, changes in the degree of central bank independence are captured for the Extended Central Bank Independence (ECBI) index, as well as for the alternative measures used for robustness checks, i.e., GMT, LVAU, LVAW, CWNE, CBIU and CBIW. Information on these alternative indices are provided below.	Authors
• CBI Reforms	Dummy that signals whether a central bank legislative reform that modified the ECBI, GMT, LVAU, LVAW, CWNE, CBIU or CBIW indices of central bank independence, have occurred or not in the current year.	Authors
• ECBI Index	See description provided in Chapter 2 and in Section 3.3.	Authors
• GMT Index of CBI	The index is calculated as the sum of central bank's fulfillment of 15 criteria, 8 for political independence and 7 for operational independence. Political independence is defined as the ability of central bank to select the final objectives of monetary policy, based on the following eight criteria: (1) governor is appointed without government involvement; (2) governor is appointed for more than five years; (3) other board members are appointed without government involvement; (4) other board members are appointed for more than five years; (5) there is no mandatory participation of government representatives in the board; (6) no government approval is required for the formulation of monetary policy; (7) central bank is legally obliged to pursue monetary stability as one of its primary objectives; and (8) there are legal provisions that strengthen the central bank's position in the event of a conflict with the government. Economic independence is the central bank's operational independence based on seven criteria: (1) there is no automatic procedure for the government to obtain direct credit from the central bank; (2) when available, direct credit facilities are extended to the government at market interest rates; (3) this credit is temporary; (4) and for a limited amount; (5) the central bank does not participate in the primary market for public debt; (6) the central bank is responsible for setting the policy rate; and (7) the central bank has no responsibility for overseeing the banking sector (two points) or shares responsibility (one point).	Authors following Grilli et al. (1991)
• LVAU and LVAW Indices of CBI	The index is calculated as the sum of central bank's fulfillment of 16 criteria which are grouped under four main headings: 1) Central Bank Governor: it contains proxies for (i) the length of the term of office of the governor; (ii) the entity delegated to appoint him/her; (iii) the provisions for his/her dismissal; (iv) and his/her ability to hold another office. 2) Policy Formulation: it contains proxies for (v) the entity responsible for formulating monetary policy; (vi) the rules concerning the resolution of conflicts between the central bank and the government; and (vii) the degree of the bank's participation in formulating the government budget. 3) Objectives of the central bank): it contains proxies for (viii) the provisions of charters regarding primary monetary objectives and the relative role of monetary stability. 4) Limitations on central bank lending to the government): it contains proxies for (ix) advances and (x) securitized lending; (xi) the authority that has control over the terms (maturity, interest rate and amount) of lending; (xii) the size of the circle of potential borrowers from the central bank; (xiii) the types of limitations on loans, where limits exist; (xiv) the maturity of possible loans; (xv) the limitations on interest rates applicable to these loans; (xvi) and prohibitions on central bank participation in the primary market for government securities. These sixteen criteria are then aggregated into eight subcategories. Cukierman (1992) proposes the LVAU index, that is computed as the unweighted average of these subcategories, while Cukierman et al. (1992) develop the LVAW index, that assigns different weights to these different categories and is finally computed as their weighted average.	Authors following Cukierman (1992) ; Cukierman et al. (1992)

Table 3.A.2 Continued: Data sources

Variable	Definition	Data sources
<ul style="list-style-type: none"> • CWNE Index of CBI • CBIU and CBIW Indices of CBI 	<p>Jacome and Vazquez (2008) propose an extension of the LVAW index of CBI, by introducing some modifications to the subcategories of the former index and incorporating an additional category reflecting central bank accountability.</p> <p>Dincer and Eichengreen (2014) augment the LVAU and LVAW indices by adding additional aspects of central bank independence such as a measure of limits on the reappointment of the central bank Governor, measures of provisions affecting (re)appointment of other board members similar to those affecting the Governor, restrictions on government representation on the board, and intervention of the government in exchange rate policy formulation. None of the information collected in the new database on central bank institutional design presented in Chapter 2 provides details on this last criteria. For this reason, I recomputed their index assigning a double weight to the information on the authority responsible for the formulation of monetary policy.</p>	<p>Authors following Jacome and Vazquez (2008)</p> <p>Authors following Dincer and Eichengreen (2014)</p>
Explanatory variables		
<ul style="list-style-type: none"> • Financial Crises • Recession • Inflation Crises • Crises • IMF Programs • Currency Union • Left Government • Polity • Democracy • Democratic Reform • Common Law 	<p>Dummy that signals whether a systemic banking crisis have occurred in country i in the two previous years.</p> <p>Dummy which takes the value 1 in the years between the peak and the trough of the cyclical component of real GDP, computed following the methodology proposed by Braun and Larrain (2005). More specifically, for each country, troughs are identified in years when the current logarithm of real local currency GDP (World Bank data) deviates by more than one standard deviation from its trend level (computed using the Hodrick-Prescott filter with a smoothing parameter of 100). For each trough, a local peak is defined as the closest preceding year for which cyclical GDP (the difference between actual and trend values) is higher than during the previous and posterior years.</p> <p>Dummy that signals whether an inflation crisis (inflation rate higher than 40%) has occurred or not in country i in the two previous years.</p> <p>Dummy that signals whether Financial Crises, Recessions or Inflation Crises have occurred or not in country i in the two previous years.</p> <p>Dummy that equals one if an IMF program has been in effect in country i in the two previous years.</p> <p>Dummy of countries member of a currency union. 1= Euro area member; 0 = non-Euro area member.</p> <p>Dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in country i.</p> <p>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).</p> <p>Dummy that signals whether country i is a democracy or not (where democracy=1 if polity2 has positive values).</p> <p>Dummy that signals whether country i become a democracy in the current year (where democracy$_t$=1 and democracy$_{t-1}$=0).</p> <p>Dummy for Common Law legal roots: 1= Anglo-Saxon Law; 0 = non-Anglo-Saxon Law.</p>	<p>Authors following Masciandaro (2009); Laeven and Valencia (2013)</p> <p>Authors following Braun and Larrain (2005)</p> <p>Authors following Reinhart and Rogoff (2004)</p> <p>Authors</p> <p>Authors following Dreher (2006b)</p> <p>Authors</p> <p>Beck et al. (2001); Keefer and Stasavage (2003)</p> <p>PolityIV (2014)</p> <p>Authors following Giavazzi and Tabellini (2005)</p> <p>Authors</p> <p>Authors following La Porta et al. (1999)</p>

Table 3.A.2 Continued: Data sources

Variable	Definition	Data sources
• GDP per capita growth	Annual percentage growth rate of per capita GDP based on constant local currency.	World Bank (2014)
• Openness	Ratio of the sum of exports and imports to GDP.	Authors' calculations
• KOF 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)
• Gvt Consumption	General government final consumption expenditure (% of GDP) includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.	World Bank (2014)

Table 3.A.3: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Extended Index of CBI (ECBI) [0;1]	0.566	0.202	0.098	0.929	2286
Change in ECBI	0.006	0.042	-0.181	0.583	2259
ECBI Reform dummy	0.063	0.243	0	1	2286
ECBI Board Index	0.492	0.224	0.036	0.940	2286
Change in ECBIBoard	0.006	0.053	-0.446	0.809	2259
ECBI Monetary Policy Index	0.487	0.203	0	0.8	2286
Change in ECBIPolicy	0.004	0.045	-0.334	0.6	2259
ECBI Objectives Index	0.529	0.349	0	1	2286
Change in ECBIObj	0.009	0.079	-0.75	1	2259
ECBI Gvt Lending Index	0.547	0.358	0	1	2286
Change in ECBILending	0.01	0.08	-0.386	1	2259
ECBI Finances Index	0.65	0.189	0	1	2286
Change in ECBIFinances	0.002	0.028	-0.375	0.472	2259
ECBI Accountability Index	0.690	0.25	0	1	2286
Change in ECBIAccount	0.006	0.052	-0.25	0.875	2259
GMT Ind. [0;1]	0.521	0.264	0.063	1	2286
Change in GMT	0.007	0.05	-0.125	0.625	2259
GMT Reform dummy	0.047	0.211	0	1	2286
CWN LVAU Ind. [0;1]	0.565	0.281	0.041	0.987	2286
Change in LVAU	0.008	0.059	-0.265	0.739	2259
CWN LVAW Ind. [0;1]	0.553	0.265	0.055	0.979	2286
Change in LVAW	0.008	0.056	-0.245	0.687	2259
CWN Reform dummy	0.043	0.204	0	1	2286
CWNE Ind. [0;1]	0.539	0.236	0.033	0.97	2286
Change in CWNE	0.008	0.049	-0.208	0.621	2259
CWNE Reform dummy	0.043	0.204	0	1	2286
CBIU Ind. [0;1]	0.551	0.267	0.038	0.959	2286
Change in CBIU	0.008	0.056	-0.235	0.689	2259
CBIW Ind. [0;1]	0.545	0.266	0.044	0.953	2286
Change in CBIW	0.008	0.056	-0.245	0.709	2259
CBIU/CBIW Reform dummy	0.046	0.209	0	1	2286
Financial Crises	0.152	0.359	0	1	2072
Recession	0.229	0.42	0	1	2227
Inflation Crises	0.08	0.271	0	1	2187
Crises	0.32	0.467	0	1	1991
IMF Programs	0.186	0.389	0	1	2102
Currency Union	0.102	0.303	0	1	2286
Left Government	0.294	0.456	0	1	2030
Polity	5.497	6.856	-10	10	2188
Democracy	0.783	0.412	0	1	2188
Democratic Reform	0.01	0.098	0	1	2177
Common Law	0.266	0.442	0	1	2286
Openness	78.237	53.459	7.603	439.657	2196
KOF Globalization Index	63.29	16.628	21.221	92.372	2146
Gvt Consumption	16.91	5.167	2.976	76.222	2182

Table 3.A.4: Ordered logit estimates: alternative CBI indices

Dependent Variables:	Δ GMT (1)	Δ LVAU (2)	Δ LVAV (3)	Δ CWNE (4)	Δ CBIU (5)	Δ CBIW (6)
$CBI_{i,t-1}*(1-CBI_{i,t-1})$	9.6678*** (3.191)	11.6511** (4.790)	12.8856** (6.114)	19.0561*** (5.065)	15.7025*** (5.425)	14.6871** (5.792)
$REG_{i,t-1}-CBI_{i,t-1}$	3.3171*** (0.892)	3.0029*** (1.157)	3.8428*** (1.173)	5.7526*** (1.541)	4.0260*** (1.151)	3.8710*** (1.112)
Financial Crises	-0.1314 (0.425)	0.0713 (0.366)	0.0461 (0.371)	0.1186 (0.351)	0.0247 (0.408)	0.0362 (0.402)
Recession	0.0969 (0.275)	0.2892 (0.210)	0.2508 (0.237)	0.1197 (0.257)	0.2120 (0.218)	0.2083 (0.207)
Inflation Crises	0.2871 (0.437)	0.4777 (0.469)	0.4294 (0.479)	0.6838* (0.355)	0.4604 (0.483)	0.3886 (0.490)
IMF Programs	0.7083** (0.292)	1.0178*** (0.308)	1.0634*** (0.337)	0.7565** (0.347)	1.1212*** (0.328)	0.9968*** (0.307)
Currency Union	1.7982*** (0.562)	2.5719*** (0.718)	2.8706*** (0.776)	3.9997*** (0.656)	3.5400*** (0.787)	3.4649*** (0.730)
Left Government $_{i,t}$	0.0421 (0.257)	0.3304 (0.298)	0.2635 (0.308)	0.2207 (0.302)	0.2693 (0.320)	0.4622 (0.285)
Polity $_{i,t-1}$	0.0394* (0.022)	-0.0160 (0.035)	0.0029 (0.035)	0.0014 (0.036)	-0.0037 (0.038)	-0.0028 (0.035)
Common Law	-0.8941*** (0.284)	-1.2730*** (0.493)	-1.2291*** (0.427)	-1.2220*** (0.467)	-1.2532** (0.512)	-1.0674*** (0.414)
GDP per capita growth $_{i,t-1}$	0.0832*** (0.031)	0.0713* (0.042)	0.0689 (0.042)	0.0545 (0.043)	0.0699* (0.041)	0.0596 (0.041)
Openness $_{i,t-1}$	0.0036** (0.002)	0.0029 (0.003)	0.0031 (0.002)	0.0022 (0.002)	0.0014 (0.003)	0.0018 (0.002)
KOF Globalization Index $_{i,t-1}$	0.0176** (0.009)	0.0342** (0.016)	0.0305** (0.015)	0.0210 (0.015)	0.0347** (0.015)	0.0266* (0.016)
Observations	1,609	1,609	1,609	1,609	1,609	1,609
Number of countries	54	54	54	54	54	54
Log Likelihood	-453.2	-594.0	-592.2	-573.2	-614.8	-606.0
Wald test of joint significance (P-value)	0.00	0.00	0.00	0.00	0.00	0.00

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), LVAU (Cukierman, 1992), LVAV (Cukierman et al., 1992), CWNE (Jacome and Vazquez, 2008) and CBIU, CBIW (Dincer and Eichengreen, 2014) indices of CBI. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

Table 3.A.5: Ordered Logit estimates: alternative specifications and CBI indices

Dependent Variables:	Δ GMT (1)	Δ LVAU (2)	Δ LVAW (3)	Δ CWNE (4)	Δ CBIU (5)	Δ CBIW (6)
CBI _{<i>i,t-1</i>}	6.4339** (3.214)	8.5296** (4.326)	8.3068* (4.361)	8.7592** (3.450)	10.1594** (4.712)	10.7385** (4.311)
(CBI _{<i>i,t-1</i>}) ²	-8.7486*** (3.002)	-10.7133*** (3.971)	-11.9676*** (4.226)	-14.9922*** (3.263)	-13.5399*** (4.362)	-13.8783*** (3.908)
REG _{<i>i,t-1</i>} -CBI _{<i>i,t-1</i>}	1.7751 (1.104)	1.4798 (1.299)	1.4486 (1.244)		1.6799 (1.198)	1.9189 (1.179)
Financial Crises	-0.0748 (0.436)	0.1147 (0.366)	0.1192 (0.369)	0.3236 (0.358)	0.0991 (0.412)	0.1050 (0.404)
Recession	-0.0092 (0.272)	0.1908 (0.206)	0.0618 (0.217)	-0.1624 (0.229)	0.0770 (0.201)	0.0379 (0.199)
Inflation Crises	0.2860 (0.431)	0.4359 (0.459)	0.3628 (0.460)	0.6469* (0.339)	0.3609 (0.472)	0.3480 (0.449)
IMF Programs	1.0253*** (0.340)	1.2428*** (0.352)	1.5065*** (0.406)	1.2413*** (0.423)	1.4669*** (0.392)	1.3604*** (0.366)
Currency Union	2.1199*** (0.595)	2.8838*** (0.718)	3.5305*** (0.727)	4.4558*** (0.694)	3.9633*** (0.714)	4.0070*** (0.662)
Left Government _{<i>i,t</i>}	0.0647 (0.260)	0.3457 (0.304)	0.2587 (0.319)	0.1720 (0.282)	0.2869 (0.328)	0.4730 (0.291)
Polity _{<i>i,t-1</i>}	0.0519** (0.021)	-0.0125 (0.033)	0.0101 (0.032)	0.0094 (0.027)	0.0068 (0.035)	0.0040 (0.032)
Common Law	-1.0822*** (0.294)	-1.4779*** (0.526)	-1.4870*** (0.437)	-1.2899*** (0.395)	-1.5440*** (0.517)	-1.3141*** (0.441)
GDP per capita growth _{<i>i,t-1</i>}	0.0912*** (0.031)	0.0776* (0.042)	0.0799* (0.043)	0.0631 (0.043)	0.0779* (0.041)	0.0682 (0.042)
Openness _{<i>i,t-1</i>}	0.0030* (0.002)	0.0028 (0.003)	0.0028 (0.003)	0.0017 (0.002)	0.0012 (0.003)	0.0016 (0.002)
KOF Globalization Index _{<i>i,t-1</i>}	0.0319*** (0.010)	0.0431*** (0.015)	0.0457*** (0.014)	0.0458*** (0.014)	0.0485*** (0.014)	0.0401*** (0.015)
Observations	1,609	1,609	1,609	1,609	1,609	1,609
Number of countries	54	54	54	54	54	54
Log Likelihood	-450.4	-591.8	-586.0	-567.7	-610.0	-601.2
Wald test of joint significance (P-value)	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is the change in the indices of Central Bank Independence, Δ CBI_{*i,t*}. These alternative measure are the GMT (Grilli et al., 1991), LVAU (Cukierman, 1992), LVAW (Cukierman et al., 1992), CWNE (Jacome and Vazquez, 2008) and CBIU, CBIW (Dincer and Eichengreen, 2014) indices of CBI. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year *t*. Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

Table 3.A.6: Complementary logarithmic estimates

Dependent Variable:	ECBRef (1)	GMTRef (2)	LVAURef (3)	LVAWRef (4)	CWNERef (5)	CBIURef (6)	CBIWRef (7)
$CBI_{i,t-1}$	8.6906* (4.925)	5.5866* (3.055)	6.7461* (3.842)	8.8335** (4.192)	9.0346** (4.547)	9.3846** (4.203)	9.0322** (4.113)
$(CBI_{i,t-1})^2$	-9.6715** (4.402)	-8.1693*** (2.774)	-8.9823** (3.510)	-11.5459*** (3.866)	-12.7825*** (4.594)	-11.5237*** (3.812)	-11.3279*** (3.868)
$REG_{i,t-1}-CBI_{i,t-1}$	2.8798** (1.297)	1.0117 (0.945)	1.0885 (1.161)	1.4259 (1.215)	2.3376* (1.367)	1.8615 (1.317)	2.0316 (1.278)
Financial Crises	0.1112 (0.279)	0.2580 (0.328)	0.0935 (0.335)	0.0920 (0.334)	0.0720 (0.299)	0.1932 (0.319)	0.1825 (0.316)
Recession	0.0814 (0.248)	-0.0524 (0.239)	0.0711 (0.224)	0.0231 (0.229)	-0.0110 (0.192)	-0.0279 (0.229)	-0.0323 (0.229)
Inflation Crises	0.8118** (0.356)	0.6496* (0.380)	0.5962 (0.363)	0.5738 (0.380)	0.5330 (0.326)	0.6832* (0.407)	0.6814* (0.406)
IMF Programs	0.6847** (0.313)	1.1286*** (0.370)	1.2184*** (0.318)	1.2733*** (0.320)	1.3397*** (0.364)	1.0852*** (0.348)	1.1106*** (0.345)
Currency Union	2.1590*** (0.676)	2.1107*** (0.628)	2.5372*** (0.601)	2.9671*** (0.596)	3.8663*** (0.962)	3.0190*** (0.757)	2.9848*** (0.756)
Left Government $_{i,t}$	0.0263 (0.240)	0.0862 (0.253)	0.2638 (0.313)	0.2235 (0.317)	0.2392 (0.298)	0.2830 (0.318)	0.2905 (0.316)
Polity $_{i,t-1}$	0.0351 (0.028)	0.0173 (0.029)	0.0065 (0.032)	0.0089 (0.031)	0.0026 (0.029)	0.0090 (0.035)	0.0087 (0.034)
Common Law	-1.1552*** (0.413)	-1.0693*** (0.390)	-1.4233*** (0.453)	-1.5961*** (0.502)	-1.5666*** (0.434)	-1.6126*** (0.552)	-1.6987*** (0.553)
GDP per capita growth $_{i,t-1}$	0.0543** (0.026)	0.0363 (0.029)	0.0449 (0.031)	0.0460 (0.031)	0.0456 (0.034)	0.0403 (0.031)	0.0421 (0.030)
Openness $_{i,t-1}$	0.0041* (0.002)	0.0024 (0.002)	0.0035 (0.002)	0.0039 (0.002)	0.0028 (0.002)	0.0033 (0.003)	0.0034 (0.003)
KOF Globalization Index $_{i,t-1}$	0.0251** (0.011)	0.0405*** (0.014)	0.0368** (0.015)	0.0386*** (0.014)	0.0369*** (0.014)	0.0410*** (0.014)	0.0413*** (0.013)
Constant	-6.9552*** (1.316)	-6.8022*** (0.872)	-6.9854*** (1.411)	-7.5213*** (1.393)	-7.3613*** (1.269)	-7.8670*** (1.379)	-7.7862*** (1.280)
Observations	1,609	1,609	1,609	1,609	1,609	1,609	1,609
Number of countries	54	54	54	54	54	54	54
Log Likelihood	-357.8	-286.9	-266.7	-262.6	-252.7	-271.9	-270.9
Wald test of joint significance (P-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The dependent variable is a dummy that takes value one in years in which a reform that modified the degree of Central Bank Independence index took place, $CBIRef_{i,t}$. Financial crises is a dummy that takes the value one if a country experienced a systemic banking crisis in the two previous years. Recession is a dummy that takes the value one if a country experienced a recession in the two previous years. Inflation Crises is a dummy that takes the value one if a country experienced an inflation rate higher than 40% in the two previous years. IMF Programs is a dummy that takes the value one if an IMF program has been in effect in the country in the two previous years. Left Government is a dummy that signals whether a party with left-wing (communist, socialist, social democratic, or left-wing) orientation with respect to economic policy is in power in the country in year t . Polity measures the level of democracy of a country in the previous year. Openness is the ratio of the sum of exports and imports to GDP.

Robust standard errors in parentheses, adjusted for clustering by country. *** denotes significance at the 1-percent level; ** denotes significance at the 5-percent level; * denotes significance at the 10-percent level.

Conclusions

This thesis contributes to the literature on central bank independence by focusing on three ongoing issues in the literature: (i) the development of comprehensive indices that capture the degree of independence of central banks, (ii) the validity of the CBI-inflation nexus in the presence of an endogenous level of independence and (iii) the driving forces behind the many reforms central banks undertook over the past decades.

Building an extensive survey of central bank institutional design, this thesis provides a more comprehensive characterization of monetary policy institutions than previously attempted. The different empirical investigations in its three chapters stress the importance of considering the dynamic process of reforming central bank legislations. Further empirical analyses must also consider the dynamic evolution of central bank independence in relation to macroeconomic outcomes. Future research can thus employ these dynamic indices to go beyond the CBI-inflation nexus and assess whether focusing on the mandate of independent central banks comes, over the long run, with other costs such as lower GDP growth, higher unemployment rates or financial instability. Testing this richer set of hypothesis linking the dynamic evolution of central bank independence, its determinants and economic performance is open to further empirical exploration.

The main conclusions of this work have strong policy implications as well. Results suggest that reform processes tend to build a momentum for future changes. Policymakers can thus consider implementing gradual reforms whenever the political conditions do not allow for large, structural reforms. Moreover, the analysis suggests that countries tend to increase the level of independence of their central banks along specific characteristics of central bank design and by mimicking their peers. This can provide a “best practices” standard for countries in the process of reforming their legislation. Finally, we observed that reversal in central bank independence are also likely to materialize under

certain situations – especially during crises –, so policymakers may need to safeguard against such developments.

Bibliography

- Abiad, A. and A. Mody (2005). Financial reform: What shakes it? what shapes it? *American Economic Review* 95(1), 66–88.
- Acemoglu, D., S. Johnson, P. Querubin, and J. A. Robinson (2008). When does policy reform work? the case of central bank independence. NBER Working Papers 14033, National Bureau of Economic Research, Inc.
- Aghion, P., A. Alesina, and F. Trebbi (2004). Endogenous political institutions. *The Quarterly Journal of Economics* 119(2), 565–611.
- Alesina, A. (1988). Macroeconomics and politics. *NBER Macroeconomics Annual* 3, 13–52.
- Alesina, A., S. Ardagna, and F. Trebbi (2006). Who adjusts and when? on the political economy of reforms. Working Paper 12049, National Bureau of Economic Research.
- Alesina, A. and A. Drazen (1991). Why are stabilizations delayed? *The American Economic Review* 81(5), 1170–1188.
- Alesina, A. and N. Roubini (1992). Political cycles in oecd economies. *The Review of Economic Studies* 59(4), 663–688.
- Alesina, A. and A. Stella (2010). The politics of monetary policy. In B. M. Friedman and M. Woodford (Eds.), *Handbook of Monetary Economics*, Volume 3 of *Handbook of Monetary Economics*, Chapter 18, pp. 1001–1054. Elsevier.
- Alesina, A. and L. H. Summers (1993). Central bank independence and macroeconomic performance: Some comparative evidence. *Journal of Money, Credit and Banking* 25(2), 151–162.
- Antenbrink, F. (2010). Securing financial independence in the legal basis of a central bank. In *The capital needs of central banks*, Chapter 5. Routledge.
- Arnone, M., B. J. Laurens, and J.-F. Segalotto (2006). The measurement of central bank autonomy: Survey of models, indicators, and empirical evidence. IMF Working Papers 06/227.
- Arnone, M., B. J. Laurens, J.-F. Segalotto, and M. Sommer (2009). Central bank autonomy: Lessons from global trends. *Imf Staff Papers* 56(2), 263–296.
- Bade, R. and M. Parkin (1982). Central bank law and monetary policy. Technical report, Department of Economics University of Western Ontario.

- Bai, J. and P. Perron (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics* 18(1), 1–22.
- Ball, L. and N. Sheridan (2003). Does inflation targeting matter? NBER Working Papers 9577, National Bureau of Economic Research, Inc.
- Baltagi, B. H. (2005). *Econometric Analysis of Panel Data*, Volume 13. Wiley.
- Banerjee, A., R. L. Lumsdaine, and J. H. Stock (1992). Recursive and sequential tests of the unit-root and trend-break hypotheses: Theory and international evidence. *Journal of Business & Economic Statistics* 10(3), 271–287.
- Bank for International Settlements (2009). Issues in the governance of central banks: A report from the central bank governance group. Technical report, Bank for International Settlements.
- Beck, N. and J. N. Katz (1995). What to do (and not to do) with time-series cross-section data. *American Political Science Review* 89(3), 634–647.
- Beck, T., G. Clarke, A. Groff, P. Keefer, and P. Walsh (2001). New tools in comparative political economy: The database of political institutions. *The World Bank Economic Review* 15(1), 165–176.
- Berggren, N., S.-O. Daunfelt, and J. Hellström (2015). Does social trust speed up reforms? the case of central-bank independence. Working Paper Series 1053, Research Institute of Industrial Economics.
- Blinder, A. S. (2004). *The quiet revolution: central banking goes modern*. Yale University Press, New Haven.
- Bodea, C. and R. Hicks (2015). International finance and central bank independence: Institutional diffusion and the flow and cost of capital. *The Journal of Politics* 77(1), pp. 268–284.
- Boyer, P. C. and J. Ponce (2012). Regulatory capture and banking supervision reform. *Journal of Financial Stability* 8(3), 206–217. The Financial Crisis of 2008, Credit Markets and Effects on Developed and Emerging Economies.
- Braun, M. and B. Larrain (2005). Finance and the business cycle: international, inter-industry evidence. *The Journal of Finance* 60(3), 1097–1128.
- Breitung, J. and S. Das (2008). Testing for unit roots in panels with a factor structure. *Econometric Theory* 24(01), 88–108.
- Brumm, H. J. (2000). Inflation and central bank independence: Conventional wisdom redux. *Journal of Money, Credit and Banking* 32(4), 807–819.
- Brunnermeier, M. K. and Y. Sannikov (2012). Redistributive monetary policy. In *Policy Forum of the Federal Reserve Bank of Kansas City in Jackson Hole*.
- Campillo, M. and J. A. Miron (1997). Why does inflation differ across countries? In *Reducing Inflation: Motivation and Strategy*, NBER Chapters, pp. 335–362. National Bureau of Economic Research, Inc.

- Cargill, T. (1995). The statistical association between central bank independence and inflation. *Banca Nazionale del Lavoro Quarterly Review* 48(193), 159–172.
- Clarida, R. H. and M. Gertler (1997). How the bundesbank conducts monetary policy. In *Reducing Inflation: Motivation and Strategy*, NBER Chapters, pp. 363–412. National Bureau of Economic Research, Inc.
- Clemente, J., A. Montanes, and M. Reyes (1998). Testing for a unit root in variables with a double change in the mean. *Economics Letters* 59(2), 175–182.
- Crowe, C. and E. E. Meade (2007). The evolution of central bank governance around the world. *Journal of Economic Perspectives* 21(4), 69–90.
- Crowe, C. and E. E. Meade (2008). Central bank independence and transparency: Evolution and effectiveness. *European Journal of Political Economy* 24(4), 763–777.
- Cukierman, A. (1992). *Central Bank Strategy, Credibility, and Independence: Theory and Evidence* (1 ed.), Volume 1. The MIT Press.
- Cukierman, A. (2008). Central bank independence and monetary policymaking institutions – past, present and future. *European Journal of Political Economy* 24(4), 722–736.
- Cukierman, A. (2011). Reflections on the crisis and on its lessons for regulatory reform and for central bank policies. *Journal of Financial Stability* 7(1), 26–37.
- Cukierman, A. (2013). *Regulatory Reforms and the Independence of Central Banks and Financial Supervisors*, Chapter 8, pp. 121–134. SUERF - The European Money and Finance Forum.
- Cukierman, A., G. P. Miller, and B. Neyapti (2002). Central bank reform, liberalization and inflation in transition economies—an international perspective. *Journal of Monetary Economics* 49(2), 237–264.
- Cukierman, A. and S. B. Webb (1995). Political influence on the central bank: International evidence. *The World Bank Economic Review* 9(3), 397–423.
- Cukierman, A., S. B. Webb, and B. Neyapti (1992). Measuring the independence of central banks and its effect on policy outcomes. *The World Bank Economic Review* 6(3), 353–398.
- de Haan, J., D. Masciandaro, and M. Quintyn (2008). Does central bank independence still matter? *European Journal of Political Economy* 24(4), 717–721.
- de Haan, J. and G. van't Hag (1995). Variation in central bank independence across countries: Some provisional empirical evidence. *Public Choice* 85(3-4), 335–351.
- de Jong, E. (2002). Why are price stability and statutory independence of central banks negatively correlated? the role of culture. *European Journal of Political Economy* 18(4), 675–694.
- Dickey, D. A. and W. A. Fuller (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association* 74(366), 427–431.

- Dincer, N. N. and B. Eichengreen (2014). Central Bank Transparency and Independence: Updates and New Measures. *International Journal of Central Banking* 10(1), 189–259.
- Drazen, A. (2000). *Political economy in macro economics*. Princeton University Press.
- Dreher, A. (2006a). Does globalization affect growth? evidence from a new index of globalization. *Applied Economics* 38(10), 1091–1110.
- Dreher, A. (2006b). Imf and economic growth: The effects of programs, loans, and compliance with conditionality. *World Development* 34(5), 769–788.
- Eijffinger, S. and J. de Haan (1996). The political economy of central-bank independence. *International Finance* 19(19), 1–92.
- Eijffinger, S. and E. Schaling (1995). The ultimate determinants of central bank independence. Discussion Paper 1995-5, Tilburg University, Center for Economic Research.
- Fernandez, R. and D. Rodrik (1991). Resistance to reform: Status quo bias in the presence of individual- specific uncertainty. *The American Economic Review* 81(5), 1146–1155.
- Gengenbach, C., F. Palm, and J.-P. Urbain (2008). Panel unit root tests in the presence of cross-sectional dependencies: Comparison and implications for modelling. *Business* 29(2), 111–145.
- Giavazzi, F. and G. Tabellini (2005). Economic and political liberalizations. *Journal of Monetary Economics* 52(7), 1297 – 1330.
- Giuliano, P., P. Mishra, and A. Spilimbergo (2013). Democracy and Reforms: Evidence from a New Dataset. *American Economic Journal: Macroeconomics* 5(4), 179–204.
- Grilli, V., D. Masciandaro, and G. Tabellini (1991). Political and monetary institutions and public financial policies in the industrial countries. *Economic Policy* 6(13), 342–392.
- Gutierrez, E. (2003). Inflation performance and constitutional central bank independence. IMF Working Papers 03/53.
- Hansen, B. E. (1997). Approximate asymptotic p values for structural-change tests. *Journal of Business & Economic Statistics* 15(1), 60–67.
- Hayo, B. (1998). Inflation culture, central bank independence and price stability. *European Journal of Political Economy* 14(2), 241–263.
- Hayo, B. and C. Hefeker (2002). Reconsidering central bank independence. *European Journal of Political Economy* 18(4), 653–674.
- Issing, O. (2013). A new paradigm for monetary policy? *International Finance* 16(2), 273–288.
- Jacome, L. and F. Vazquez (2008). Is there any link between legal central bank independence and inflation? evidence from latin america and the caribbean. *European Journal of Political Economy* 24(4), 788–801.

- Keefer, P. and D. Stasavage (2003). The limits of delegation: Veto players, central bank independence, and the credibility of monetary policy. *American political science review* 97(03), 407–423.
- Klomp, J. and J. de Haan (2010). Inflation and central bank independence: a meta-regression analysis. *Journal of Economic Surveys* 24(4), 593–621.
- Kydland, F. E. and E. C. Prescott (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy* 85(3), 473.
- La Porta, R., F. Lopez-de Silanes, A. Shleifer, and R. Vishny (1999). The quality of government. *Journal of Law, Economics, and organization* 15(1), 222–279.
- Laeven, L. and F. Valencia (2013). Systemic banking crises database. *IMF Economic Review* 61(2), 225–270.
- Laurens, B. J., M. Arnone, and J.-F. Segalotto (2009). *Central bank independence, accountability, and transparency: a global perspective*. Palgrave Macmillan/International Monetary Fund, Basingstoke [England] ; New York.
- Lin, S. and H. Ye (2007). Does inflation targeting really make a difference? evaluating the treatment effect of inflation targeting in seven industrial countries. *Journal of Monetary Economics* 54(8), 2521 – 2533.
- Lybek, T. (1999). Central bank autonomy, and inflation and output performance in the baltic states, russia, and other countries of the former soviet union, 1995-1997. IMF Working Papers 99/4.
- Mangano, G. (1998). Measuring central bank independence: a tale of subjectivity and of its consequences. *Oxford Economic Papers* 50(3), 468–492.
- Masciandaro, D. (2009). Politicians and financial supervision unification outside the central bank: Why do they do it? *Journal of Financial Stability* 5(2), 124 – 146.
- Masciandaro, D. (2012). Central banking and supervision: The political cycle. Paolo Baffi Centre Research Paper 2012-131, Paolo Baffi Centre Research.
- Masciandaro, D. and F. Passarelli (2013). Banking bailouts and distributive monetary policy: Voting on central bank independence. *Baffi Center Research Paper* (146).
- Masciandaro, D., M. Quintyn, and M. W. Taylor (2008). Inside and outside the central bank: Independence and accountability in financial supervision: Trends and determinants. *European Journal of Political Economy* 24(4), 833 – 848. Does central bank independence still matter?
- Masciandaro, D. and D. Romelli (2015a). Central bankers as supervisors: Do crises matter? BAFFI CAREFIN Centre Research Paper 2015-4, BAFFI CAREFIN Centre.
- Masciandaro, D. and D. Romelli (2015b). Ups and downs. central bank independence from the great inflation to the great recession: Theory, institutions and empirics. *Financial History Review Forthcoming*.

- Masciandaro, D. and F. Spinelli (1994). Central banks' independence: Institutional determinants, rankings and central bankers' views. *Scottish Journal of Political Economy* 41(4), 434–443.
- Milton, S. and P. Sinclair (2010). *The capital needs of central banks*. Routledge.
- Moser, P. (1999). Checks and balances, and the supply of central bank independence. *European Economic Review* 43(8), 1569–1593.
- Oatley, T. (1999). Central bank independence and inflation: Corporatism, partisanship, and alternative indices of central bank independence. *Public Choice* 98(3/4), pp. 399–413.
- Perera, A., D. Ralston, and J. Wickramanayake (2013). Central bank financial strength and inflation: Is there a robust link? *Journal of Financial Stability* 9(3), 399–414.
- Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica* 57(6), 1361–1401.
- Perron, P. and T. J. Vogelsang (1992). Testing for a unit root in a time series with a changing mean: Corrections and extensions. *Journal of Business & Economic Statistics* 10(4), 467–470.
- Polillo, S. and M. F. Guillén (2005). Globalization pressures and the state: The worldwide spread of central bank independence. *American Journal of Sociology* 110(6), 1764–1802.
- PolityIV (2014). Polity iv project: Political regime characteristics and transitions, 1800–2014. On-line (<http://www.systemicpeace.org/inscrdata.html>).
- Posen, A. S. (1995). Declarations are not enough: Financial sector sources of central bank independence. In *NBER Macroeconomics Annual 1995, Volume 10*, NBER Chapters, pp. 253–274. National Bureau of Economic Research, Inc.
- Reinhart, C. M. and K. S. Rogoff (2004). The modern history of exchange rate arrangements: A reinterpretation. *The Quarterly Journal of Economics* 119(1), 1–48.
- Reis, R. (2013). Central bank design. *Journal of Economic Perspectives* 27(4), 17–44.
- Rodrik, D. and W. Bank (2006). Goodbye washington consensus, hello washington confusion? a review of the world bank's "economic growth in the 1990s: Learning from a decade of reform". *Journal of Economic Literature* 44(4), 973–987.
- Roger, S. (2009). Inflation targeting at 20: Achievements and challenges. IMF Working Papers 09/236, International Monetary Fund.
- Rogoff, K. (1985). The optimal degree of commitment to an intermediate monetary target. *Quarterly Journal of Economics* 100(4), 1169–1189.
- Siklos, P. L. (2008). No single definition of central bank independence is right for all countries. *European Journal of Political Economy* 24(4), 802–816.
- Smets, F. (2014). Financial stability and monetary policy: How closely interlinked? *International Journal of Central Banking* 10(2), 263–300.

- Stella, P. (2010). Central bank financial strenght and macroeconomics policy performance. In *The capital needs of central banks*. Routledge.
- Sul, D. (2009). Panel Unit Root Tests Under Cross Section Dependence with Recursive Mean Adjustment. *Economics Letters* 105(1), 123–126.
- Taylor, J. B. (2013). The effectiveness of central bank independence vs. policy rules. *Business Economics* 48(3), 155–162.
- Terra, C. (1998). Openness and inflation: A new assessment. *Quarterly Journal of Economics* 113(2), 641–648.
- Ueda, K. and F. Valencia (2014). Central bank independence and macro-prudential regulation. *Economics Letters* 125(2), 327–330.
- Vuletin, G. and L. Zhu (2011). Replacing a disobedient central bank governor with a docile? one: A novel measure of central bank independence and its effect on inflation. *Journal of Money, Credit and Banking* 43(6), 1185–1215.
- Wooldridge, J. M. (2001). *Econometric Analysis of Cross Section and Panel Data*, Volume 1 of *MIT Press Books*. The MIT Press.
- World Bank (2014). World development indicators 2014. Technical report, World Bank Publications.
- Zeileis, A., C. Kleiber, W. Kramer, and K. Hornik (2003). Testing and dating of structural changes in practice. *Computational Statistics & Data Analysis* 44(1-2), 109–123.
- Zivot, E. and D. W. K. Andrews (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics* 10(3), 251–270.