Two Essays

on

Central Bank Independence Reforms

by

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Abstract

This thesis consists of two empirically oriented papers on Central Bank Independence (CBI) Reforms.

Paper [1] is an investigation of why politicians around the world have chosen to give up power to independent central banks, thereby reducing their ability to control the economy. A new data-set covering 132 countries, of which 89 had implemented CBI reforms during 1980-2005, was collected. Politicians in non-OECD countries were more likely to delegate power to independent central banks if their country had been characterized by high variability in inflation and if they faced a high probability of being replaced. No such effects were found for OECD countries.

Paper [2], using a difference-in-difference approach, studies whether CBI reform matters for inflation performance. The analysis is based on a dataset including the possible occurence of CBI reforms in 132 countries during the period 1980-2005. CBI reform is found to have contributed to bringing down inflation in high-inflation countries, but it seems unrelated to inflation performance in low-inflation countries**.**

This thesis consists of this summary and the following two papers:

[1] Why Do Politicians Implement Central Bank Independence Reforms? (co-authored with Sven-Olov Daunfeldt and Jörgen Hellström)

[2] Do Central Bank Independence Reforms Matter for Inflation Performance?

Summary

1 Introduction

Monetary policy theories concern the effects of monetary instruments on the growth and stability of macroeconomic variables. Recent theories on central banking, however, are also concerned with the institutional structure of the policy-making authority and how it affects the macroeconomy. An important trend in international economic politics during recent decades is the increase in central bank independence (CBI). Cukierman (2008, p. 723), for example, notes that *"most central banks in today's world enjoy substantially higher levels of both legal and actual independence than twenty years ago or earlier"*. At the same time there has emerged a large theoretical and empirical literature concerning CBI.

This thesis consists of two self-contained empirically oriented papers on CBI reform. Paper [1] tests empirically why politicians have chosen to delegate authority to central banks. Paper [2], using a difference-in-difference approach, investigates whether CBI reform matters for inflation performance.

The rest of this summary consists of an overview of the issues presented in the thesis. Section 2 discusses the theoretical background of the worldwide introduction of CBI reform. Section 3 presents the previous empirical research concerning the implications of CBI. Finally, Section 4 summarizes the two papers.

2 Theoretical Background

With few exceptions, countries all over the world have seen a remarkable improvement in inflation during the last three decades. This improvement

is seen in the recent lower prevalence both of hyperinflation in less developed countries, and of high inflation in the OECD countries, where double-digit inflation was not unusual three decades ago. How can this improvement be explained?

The relation between inflation and employment has always been of interest to macroeconomists. In a classic study using historical data from the UK, Phillips (1958) found a stable trade-off between wage changes and unemployment. Samuelson and Solow (1960) presented this trade-off as a menu for policymakers, suggesting that they could exploit it to lower unemployment at the expense of higher inflation.

However, there has emerged a consensus among macroeconomists, among other things due to pioneering work by Phelps (1967) and Friedman (1968), that the only goal that policymakers can successfully achieve with monetary policy in the long run is price stability. This is because in the long run the equilibrium unemployment rate, or natural rate, determines actual unemployment. In the short run, however, monetary policy is non-neutral, due to nominal rigidities (Galí 2008), and therefore there is a short run choice between targeting inflation and targeting unemployment. But, if the unemployment target of the policymakers is too ambitious, i.e. lower than the natural rate, so that the target for output is higher than its natural rate, then there will be an inflationary bias, a higher inflation in equilibrium than the inflation target, due to time-inconsistency of optimal monetary policy (Kydland and Prescott, 1977).[1] If a central bank has a credible commitment

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[1]It has been noted (Bofinger, 2001) that the first-best solution for policymakers to achieve an unemployment close to the target would be the removal of microeconomic distortions in the labor market. This issue is not investigated in this thesis.

to low inflation, it will be achieved at no cost. However, the mere announcement of a low-inflation goal is usually not enough to achieve credibility, if the public has reason to expect future expansionary monetary policy. If the public expected contractionary monetary policy, and hence lower inflation, and was expected to act on that belief, then monetary policymakers would have an incentive for expansionary monetary policy. A rational public will foresee this possibility and negotiate contracts under the expectation that monetary policy will in fact be expansionary.

Barro and Gordon (1983a,b) argued that the solution to this problem was to subject monetary policymakers to a strict low-inflation rule. But, of course, for this solution to work, following the rule must also be credible, and this is not the case if pure reputational forces are weak. Therefore, researchers have focused on designing institutional arrangements to make a low-inflation rule credible. This has usually meant some removal of monetary policymaking authority from elected politicians. Rogoff's (1985) solution involved the delegation of monetary policymaking to a conservative central banker, that is, one that would put a lower weight on the loss associated with unemployment than would society at large, resulting in lower inflation in equilibrium. Conservative might also mean taking a longer view, discounting the future less in a repeated policy-game context (Cukierman, 1992; Bofinger 2001). This might mean removing decisions about monetary policy from short-term policy pressures.[2]

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[2] There has also been research on performance contracts, beginning with Persson and Tabellini (1993) and Walsh (1995), concerned with subjecting central bankers to incentives so as to achieve optimal monetary policy and thus remove inflation bias, but this is perepheral to the issues discussed here.

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One such institutional design is for politicians to delegate monetary policy to an independent central bank, thus removing decisions about monetary policy from short term policy pressures. Giving more independence to a central bank can thus be seen as a commitment device for the government.

However, this can be questioned on various grounds. It has been suggested, for example, that time-inconsistency is not solved by CBI reform, but only relocated (McCallum, 1997), because politicians can always revoke their delegation of monetary policy. Thus, to solve the time-inconsistency problem, the costs of revocation must be high enough to make the delegation credible.

It has also been argued that low inflation does not depend on CBI. It might rather be that CBI and a commitment to low inflation are both determined by social attitudes. A statistical correlation between CBI and inflation then says nothing about causality (Forder 1996; Hayo, 1998). Thus, Blinder (1998, p. 41) claims that lower inflation "*came from determined, but discretionary, application of tight money. Rather than seeking short-term gains, central banks paid the price to disinflate. As in the Nike commercial, they just did it*".

In any case it is something of a puzzle that politicians choose to give up control over monetary policy when they know that, at least in the short run, it can influence unemployment and output levels. It is particularly surprising from a public choice perspective, since if it is possible to manipulate macroeconomic variables before an election, we would expect opportunistic politicians to do so. While not overwhelming, there seems to be some empirical evidence of this (Mueller, 2003, p. 446-7). Mueller argues that "*central*

bankers do not appear to be totally oblivious to the electoral fortunes of their governments".

In any case, theoretical explanations for why politicians may implement CBI reforms include: to reduce high and persistent inflation (Rogoff, 1985); to maintain price stability where it has already been achieved (Cukierman, 1994); to counteract high government debt (Maxfield, 1997). It may also occur: where the political system is highly competitive (Cukierman, 1994); where the financial sector is relatively influential (Posen, 1993); and there are more possibilities (Eijffinger and de Haan, 1996, ch. 5). However, why politicians have delegated authority to central banks has never been tested empirically.

3   Previous Empirical Research

Cukierman (2008) surveys empirical evidence that countries with independent central banks have lower inflation, usually derived using an index of degree of legal central bank independence (CBI). Cukierman (1992), Alesina and Summers (1993), and Grilli et al.(1991) found a negative correlation between average inflation and the degree of legal central bank independence, in cross-country regressions of industrial countries, suggesting that inflation might be brought down by CBI reform. On the other hand, for a group of less-developed countries, no relation was found (Cukierman et al., 1993). However, when other proxies for CBI were used, such as the actual turnover rate of central bank governors, a negative correlation was found between independence and inflation in these less-developed countries as well.

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More recently there have been numerous studies questioning these earlier results for various reasons. First, the validity of CBI indices is problematic, because researchers using them must choose which aspects of independence to include, and what weights to give to them. So, the indices differ a lot when it comes to ranking countries. Forder (1996, 1998) showed that the indices of CBI used were not robust, because small changes in them resulted in no correlation between CBI and inflation. The question of causality has also been raised, because statistical correlation says nothing about whether the level of CBI determines inflation, or whether causality might run in the other direction.

There have also been a few empirical studies which found that the degree of CBI did not determine inflation. For example, Hayo (1998) found that public attitudes determined a low-inflation culture, with the formal design of central bank institutions being only one aspect. Posen (1995) argues for the importance of societal support for CBI, and identifies in particular financial sector support for CBI as important for the achievement of price stability.

A study by Daunfeldt and de Luna (2008) of implementation dates of CBI-reforms in OECD countries shows that price stability was actually achieved prior of CBI reforms in most countries. Stabilization of inflation also preceded CBI reform in some Latin American countries (Jácome and Vasquez, 2008). Furthermore, the probability that a central bank governor would be replaced was positively related to inflation (Dreher et al., 2008), perhaps suggesting that causality ran from inflation to turnover. Campillo and Miron (1997) found evidence suggesting that formal institutional arrangements, such as CBI, also may be relatively unimportant

compared to less formal ones such as openness.

4   Summary of the Papers

4.1   Paper [1]: Why Do Politicians Implement Central Bank Independence Reforms?

Over the two last decades many countries, including New Zealand, Lesotho, England, Kazakhstan, Sweden and Chile, have implemented institutional reforms which granted their central banks more independence from the political process. It is something of a puzzle, however, that politicians have chosen to give up control over monetary policy when they knew that at least in the short run it could influence employment and production levels.

There are many possible theoretical explanations. It has been suggested, for example, that central bank independence (CBI) reforms occur in countries with high and persistent inflation (Rogoff, 1985); where price stability has already been achieved (Cukierman, 1994); where government debt is relatively high (Maxfield, 1997); where the political system is highly competitive (Cukierman, 1994); where the financial sector is relatively influential (Posen, 1993); and there are more possibilities (reviewed by Eijffinger and de Haan, 1996; ch. 5).

However, why politicians choose to delegate authority to central banks has (so far as we know) never been tested empirically. Previous empirical studies (de Haan and Van't Hag, 1995; Cukierman and Webb, 1995; de Haan and Siermann, 1996; Bagherei and Habib, 1998) used various CBI indices to investigate instead what determined a given level of independence (i.e., not

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a change). These studies could thus only explain cross-country differences, while the more interesting question, why politicians choose to implement CBI reform, remains unanswered.

The purpose of this paper is to study the determinants of CBI reform using a new dataset covering its possible occurrence in 132 countries, of which 89 had implemented such a reform during 1980-2005. Thus, the literature on the time-inconsistency of monetary policy (Kydland and Prescott, 1977; Barro and Gordon, 1983a, b), and Rogoff's (1985) suggestion that politicians should delegate power to a more inflation-averse central bank, seem to have been very influential.

It was found in this study that non-OECD countries with a history of high variability in inflation were more likely to implement CBI reform, suggesting that politicians in those countries had become strongly averse to inflation and therefore implemented CBI reform to establish credibility for a price-stability rule. In addition, the likelihood of CBI reform seems to have increased when politicians in non-OECD countries faced a high probability of being replaced. No such effects were found for OECD countries, where politicians may not have felt a need to tie the hands of incoming governments, or that the credibility of a low-inflation goal could be achieved by other means. Finally, countries that were members of an economic cooperation organization (such as the EU) seem to have been more likely to implement CBI reform if other countries in the organization had recently done so.

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4.2 Paper [2]: Do Central Bank Independence Reforms Matter for Inflation Performance?

The purpose of this paper is to study, using a difference-in-difference approach, whether countries that implemented CBI reforms during the study period performed better in terms of inflation than those countries that did not. Legal changes considered CBI reform are those that formally decreased the influence of politicians on monetary policy. The analysis is based on a dataset compiled for the first paper in the thesis, covering the possible occurence of CBI reform in 132 countries during 1980-2005, more countries than in any previous study on CBI and inflation performance. Countries that implemented CBI reform are compared to those that did not.

The paper addresses problems in earlier empirical studies on CBI and inflation, regarding the scarcity of data, possible endogeniety, and subjectivity. As in the previous paper, focus is on possible changes in the legal independence of central banks, not on its level. As the reforms increased CBI by definition, the subjectivity that plagues the most commonly-used indices of CBI (see also Daunfeldt and de Luna, 2008) is reduced.

In accordance with Ball and Sheridan (2005), the statistical phenomenon of regression to the mean is controlled for. This is done by including inflation during the first year in the dataset as an explanatory variable. Also, to study whether the efficiency of CBI reform depends on previous inflation, countries are included or excluded from regressions, depending on its level in the pre-reform period. The difference-in-difference approach responds to possible endogeneity connected to unobservable time-invariant country-

specific effects on the level of inflation. That is, since differences are used, these effects are cancelled out.

It is found that countries that implemented CBI reform reduced inflation more than countries that did not. No such effect, however, is found for countries with previously low inflation. On the contrary, for some of those countries CBI reform seems to be associated with higher post-reform inflation. The overall results thus seem to be driven by countries with high pre-reform inflation, perhaps suggesting that the efficiency of CBI reform is related to recent experience with inflation.

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Why Do Politicians Implement Central Bank Independence Reforms?[*]

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Abstract

This paper is a first empirical attempt to investigate why politicians around the world have chosen to give up power to independent central banks, thereby reducing their ability to fine-tune the economy. A new data-set covering 132 countries, of which 89 countries had implemented such reforms, was collected. Politicians in non-OECD countries were more likely to delegate power to independent central banks if their country has been characterized by a high variability in historical inflation and if they faced a high probability of being replaced. No such effects were found for OECD-countries.

Keywords: inflation; institutional reforms; monetary policy; time-inconsistency

JEL-codes: E52; E58; P48

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1   Introduction

Over the two last decades many countries, including New Zealand, Lesotho, England, Kazakhstan, Sweden and Chile, have implemented institutional reforms which granted their central banks more independence from the political process. It is something of a puzzle, however, that politicians choose to give up control over monetary policy when they knew that (at least in the short run) it can influence employment and production levels.

There are many possible theoretical explanations. It has been suggested, for example, that central bank independence (CBI) reforms occur in countries with high and persistent inflation (Rogoff, 1985); where price stability has already been achieved (Cukierman, 1994); where government debt is relatively high (Maxfield, 1997); where the political system is highly competitive (Cukierman, 1994); where the financial sector is relatively influential (Posen, 1993); and there are more possibilities (Eijffinger and de Haan, 1996; ch. 5, provides an overview).

However, the question why political politicians choose to delegate authority to central banks has (as far as we know) never been tested empirically. Previous empirical studies (de Haan and Van't Hag, 1995; Cukierman and Webb, 1995; de Haan and Siermann, 1996; Bagherei and Habib, 1998) instead used various CBI-indices to investigate what determined a given level (i.e., not a change) of independence. These studies can thus only explain cross-country differences, while the more interesting question, why politicians choose to implement CBI-reforms, remains unanswered.

The purpose of this paper is to study the determinants of CBI-reform

using a new data set that covers its possible occurrence in 132 countries, of which 89 had implemented such a reform during 1980-2005. Thus, the literature on the time-inconsistency of monetary policy (Kydland and Prescott, 1977; Barro and Gordon, 1983), together with Rogoff's (1985) suggestion that politicians should delegate power to a more inflation-averse central bank, seem to have been very influential.

It was found in this study that non-OECD countries with a history of high variability in inflation were more likely to implement CBI-reforms, suggesting that politicians in those countries have received a strong aversion to inflation and therefore implement CBI-reforms to establish credibility for a price stability rule. In addition, the likelihood of a CBI-reform seems to have increased when politicians in non-OECD countries faced a high probability of being replaced. No such effects were found for OECD-countries, implying that politicians in more industrialized countries do not feel a need to tie the hands of incoming governments and that the credibility of a low inflation goal can be achieved with other means. Finally, countries that were members of an economic cooperation organization seem to have been more likely to implement CBI-reforms if other countries in the organization recently had recently done so.

In the next section, possible determinants of CBI-reform are discussed. The data used are described in Section 3. Section 4 then describes the econometric specification, while the results are presented in Section 5. Finally, section 6 summarizes and draws conclusions.

2 Determinants of central bank independence reforms

It is commonly believed that CBI-reforms will reduce the inflationary bias of policy and make a low inflation rule credible. Kydland and Prescott's (1977) and Barro and Gordon's (1983) work on time inconsistency in monetary policy, together with Rogoff's (1985) suggestion that a more inflation-averse central bank can make a low inflation policy credible, constitute the theoretical rationale for this belief.

Empirical studies have also found a negative correlation between an index reflecting the degree of CBI and average inflation (e.g., Alesina, 1988; Grilli et al., 1991; Cukierman et al., 1992; Alesina and Summers, 1993; Jonsson, 1995; and Eijffinger et al., 1998). Alesina and Summers (1993) could also not find any correlation between CBI and unemployment, real economic growth, or real interest rates. As a result, there is a broad consensus that CBI improves the likelihood of achieving low inflation at no real economic cost.

According to the time-inconsistency theory, achievement of price stability cannot be explained by a commitment to central bank autonomy. If announcement of a CBI-reform were sufficient for achieving low inflation, then it would be optimal for politicians to violate the commitment once price stability was achieved (McCallum, 1997). Thus, time-inconsistency theory suggest that irreversible CBI-reforms (or reversible only with great difficulty) are implemented because politicians want to achieve low and stable inflation.

Why Do Politicians Implement CBI-reforms?

On the other hand, Cukierman (1994) suggested that CBI-reforms might be implemented to maintain low inflation, i.e., as a commitment against future incautious politicians. This implies that politicians implement CBI-reforms only when they have already achieved low inflation. And in fact, by comparing the implementation dates of CBI-reforms with long-term inflation trends for 29 OECD-countries, Daunfeldt and de Luna (2008) found that price stability had been achieved in most countries before their central banks became more independent.

According to the time-inconsistency model of monetary policy, the benefit of surprise inflation is directly related to the gap between politicians desired unemployment rate and the natural rate of unemployment. Thus CBI-reform would be more valuable when the natural rate of unemployment is high (Cukeriman, 1994; Eijffinger and Schaling, 1995).

It has been suggested, moreover, that CBI-reforms have been implemented, especially in less-developed countries, to signal creditworthiness to foreign investors (Maxfield, 1997). Many less-developed countries have problems with high debt-ratios. Delegation of monetary policy to an independent central bank may then signal creditworthiness. The International Monetary Fund (IMF) can also demand more CBI as a prerequisite for obtaining funds. Maxfield (1997) presents some descriptive results indicating that CBI-reforms have in fact been implemented in developing countries to signal creditworthiness.

Political factors may also influence the decision to delegate power to independent central banks. According to Cukierman (1994), politically instable countries are less likely to implement CBI-reforms. When irregular changes

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of government due to revolution, coup d´etat, etc, occur often, politicians are mainly concerned with their own survival. On the other hand, when they fear that they might lose power in the next election, CBI-reforms might be implemented to limit the power of the incoming government. In addition, Moser (1994) presented some evidence that central banks in countries with extensive checks and balances were more independent.

Posen (1993) argued that the observed negative correlation between CBI-indices and inflation was not causal, because both were determined by financial opposition to inflation, suggesting that CBI-reforms had been implemented in countries where the financial sector was more influential. Similarly, CBI-reforms are more likely in countries where public opposition to inflation is strong. Posen (1993), Forder (1996), and Hayo (1998) have all argued that CBI and commitment to low inflation are jointly determined by social attitudes, i.e., that CBI is endogenous. This suggests that politicians in countries characterized by a high variability in historical inflation might have created a strong aversion against inflation (Hayo, 1998) and therefore implemented institutional reforms that delegates power to independent central bankers. Thus, independent central banks are successful in implementing low and stable inflation merely because their independence reflects a social attitude that supports low inflation.

3   Data

The dependent variable in our empirical analysis is a qualitative variable indicating whether a CBI-reform was implemented in a particular year. How-

ever, implementation years of CBI-reforms are not readily available any-where. Therefore, to obtain the dates, all (162) central banks listed in Morgan Stanley's *Central Bank Directory 2004* were asked by e-mail: (i) Has your country implemented any institutional reforms that grant your central bank more independence from elected policymakers? (ii) If yes, when? (iii) Where can we find more information about this?

Our study focused on a change towards more CBI, without regard to the magnitude of the reform. We consider all legal reforms that reduced the influence of politicians on monetary policy making as CBI-reforms, whereas a mere statement that price stability is the only goal of monetary policy was not regarded as sufficient. We included legal reforms that safe-guard the low inflation goal in the legislation; reduce the possibility for government to override central bank decisions on operating targets; reduce governments opportunities to use central bank credits to finance budget deficits; reduce the possibility of dismissing central bank governors or increasing their term in office or their numbers; and so on.

95 central banks (59%) finally answered the questionnaire. In a formal analysis of the response rate (with a simple probit model), the probability of response is increased in GDP and was lower for Asian, South American and African countries compared to Australian, European, and North American countries (statistically significant results at conventional levels). The country's inflation rate did not seem to affect the probability of response.[1]

Other sources (e.g., central bank publications, legislative acts, and sci-

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[1] The analysis was hampered by lack of data, especially for the countries that did not respond to the e-mail questionnaire.

entific articles) were used to validate the e-mail answers and to obtain the dates of CBI-reforms for countries that did not respond. The final sample consists of 132 countries (81% of those initially contacted), of which 89 had implemented CBI-reforms. Table A1 (in the Appendix) lists the countries for which information on CBI-reforms is still missing; whereas Table A2 (in the Appendix) lists the dates when CBI-reforms occurred and sources that were used to verify them.

Figure 1 shows the time trend of adoption of CBI-reforms around the world during 1980-2005. New Zealand is often considered the first country to implement CBI-reform with its 1989 Reserve Bank Act, which substantially reduced politicians ability to produce surprise inflation.[2] New Zealand was soon followed by Belize, El Salvador, Hungary and Uganda in 1991. The peak of the movement was perhaps in 1998 when eleven countries launched CBI-reforms.
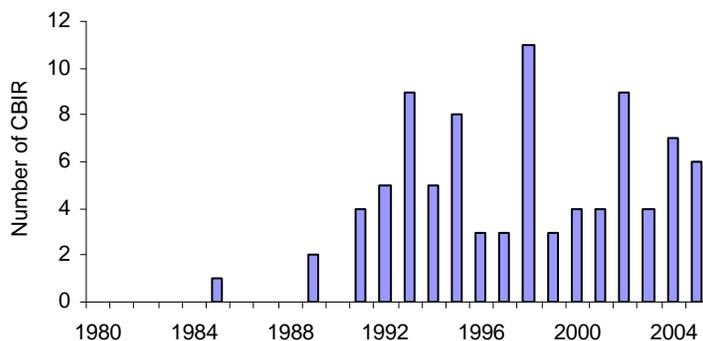

Figure 1: Number of central bank independence reforms for the full sample.

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[2]Evans et al. (1996), Silverstone et al. (1996), and Daunfeldt and de Luna (2001) provide more information on the regime shift in New Zealand.

Figures 2 and 3 show the frequencies of CBI-reform for OECD and non-OECD countries. In the OECD countries, CBI-reforms started in 1989 (New Zealand) and peaked in 1998, with reforms in nine European countries. Most were prospective members of the ESCB (European System of Central Banks), for whom the Maastricht Treaty required their central banks to be independent before the ESCB's establishment date. Other more recent prospective members of the European Monetary Union (e.g., Czech Republic and Poland) have also implemented CBI-reforms.
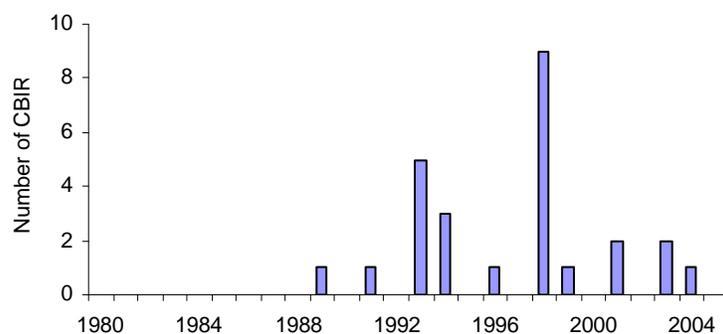
Figure 2: Number of central bank independence reforms in OECD countries.

Non-OECD countries (Figure 3) were the first to implement CBI-reforms, with many in the early 1990s, mostly in South-America, peaking in 1995, with five there, one in Asia, one in Africa and one in Europe. A second-wave of non-OECD CBI-reforms started in 2002, mostly in Asia and Africa.

In the empirical study the reform year is indicated by one, when that series was terminated, and all previous years are indicated with zeros. This is done in order to avoid explaining the period after the CBI reform. Table

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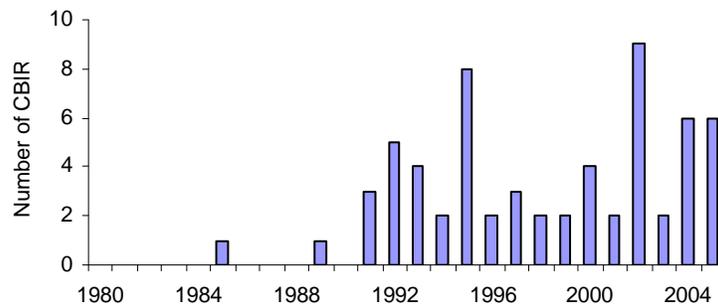
Figure 3: Number of central bank independence reforms in non-OECD countries.

1 shows the frequency of CBI-reform and non-reform for the full, OECD, and non-OECD samples.

We control for both economic characteristics, political factors, and geographical determinants in the analysis.

Economic characteristics are the level and variability of inflation, measured by the annualized percentage change in consumer prices, from *IMF Financial Statistics*; unemployment rates, obtained from the *International Labor Organization (ILO)*; gross domestic product per capita (GDP) in US dollars and the use of fund and credits from the International Monetary Fund, both from the World Bank's *World Development Indicators*; and total debt services (%)[3], from the World Bank's *Global Development Finance.* In addition, the strength of the financial sector is measured by liquid liabilities as a percentage of GDP, using data from the *World Bank* (Beck

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[3]The sum of principal repayments and interest actually paid in foreign currency, goods, or services on long-term debt, interest paid on short-term debt, and repayments (repurchases and charges) to the IMF, as a percentage of exports of goods services and income. The variable is obtained from the Quality of Government Dataset (Teorell et al., 2009).

et al., 1999).[4] All the economic variables are lagged one period to avoid endogeniety problems.[5]

Table 1: Frequencies of dependent variable for 132 countires, 1980-2005.

	Full sample	OECD	Non-OECD
No CBI-reform in observation year	2719	554	2165
CBI-reform in observation year	89	26	63
Total	2808	580	2228

Political factors used in the analysis are political fragmentation in the parliament and whether the country is a federation or not, both from Lundell and Karvonen's (2003) *Comparative Data Set on Political Institutions*[6], and the number of coups in previous periods from the *Coup Data Codebook* (Marshall and Marshall, 2007).

The simple use of implementation dates for CBI-reforms neglects the degree of previous CBI. For example, CBI-reforms in some countries might predate the study period. Therefore, the CBI-index developed by Cukierman et al. (1992) is used to analyze whether CBI-reform (or not) depends on the initial level of CBI. Finally, geographical determinants used are the number of CBI-reforms in the previous period in the same economic cooperation organization: the European Union (EU), the African Economic Community (AEC), the Asia-Pacific Economic Cooperation (APEC), or the

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[4] Liquid liabilities include currency as well as demand and interest-bearing accounts of banks and other financial intermediaries.

[5] We also tried lagging all the economic variables two or three periods, but all qualitative results remained the same. The results are available from the authors upon request.

[6] The purpose of the data set is to gather information on political institutions around the world since 1960. The data is compiled at the Department of Political Science, Åbo Akademi, in collaboration with Professor Torsten Persson at the Institute of International Economic Studies, Stockholm University.

Latin American Free Trade Association (LAFTA).

Table 2: Number of missing observations for independent variables, 1980-2005.

	Full sample		OECD		Non-OECD	
	Missing	%	Missing	%	Missing	%
Inflation	331	12%	14	2%	317	14%
GDP per capita	387	14%	33	6%	354	16%
Unemployment	1608	57%	99	17%	1509	68%
Liquid assets	962	34%	261	45%	701	31%
Total debt	1302	46%	519	89%	783	35%
Use of funds and credits	283	10%	0	0%	283	13%
Political fragmentation	1121	40%	50	9%	1071	48%
Federation	1154	41%	0	0%	1154	52%
Coups	1000	36%	43	7%	957	43%

A problem when working with macro-data for the many countries considered here is missing data. Table 2 shows the number of missing observations in the full, OECD, and non-OECD samples. The problem is largest for the non-OECD sample, especially for unemployment, political fragmentation, federation, and the presence of coups. For the OECD sample the problem is largest for liquid assets and total debt, and for the full sample for unemployment and total debt.

Since missing data (if not random) can obscure the results, multiple imputation (see e.g., Graham et al., 2003) is used as replacement method. Multiple imputation has been shown to produce unbiased parameter estimates which reflect the uncertainty associated with the missing observations. The method has further been shown to provide adequate results in presence of high rates of missing data (Schafer and Graham, 2002). An iterative Markov chain Monte Carlo method is used to impute missing observations

and 5 data sets are created. The empirical analysis is then performed on each of the data sets and the estimation results for each are later combined, using the rules established by Rubin (1987), to produce one set of estimation results. The means and standard deviations for all variables (with imputed values) averaged over the 5 data sets are shown in Table 3. The variables are further discussed in the next section.

Table 3: Descriptive statistics, 1980-2005

	Full sample		OECD		Non-OECD	
Variable	Mean	s.d.	Mean	s.d.	Mean	s.d.
Inflation	25.91	73.84	12.32	33.20	29.44	80.77
GDP per capita	6465	8188	17310	9275	3642	4851
Unemployment	8.27	4.84	7.24	4.26	8.54	4.95
Liquid assets	0.47	0.31	0.60	0.35	0.43	0.29
Total debt	18.83	13.86	21.09	12.42	18.24	14.14
Pol fragmentation	5591	2176	5316	2256	6651	1399
Federation	0.21	0.32	0.27	0.44	0.20	0.23
Coups	0.25	0.57	0.10	0.36	0.29	0.61
CBI index	35.39	8.19	36.92	15.11	34.99	4.95
Number CBI-reforms	0.18	0.62	0.25	0.80	0.16	0.56
Number of obs.		2808		580		2228
Number of countries		132		30		102

4   Empirical model

To investigate why politicians choose to implement CBI-reforms, we define the unobserved latent reform pressure in country $i = 1, 2, ..., n$ in year $t = 1, 2, ..., T$ as

$$y_{it}^* = \boldsymbol{\theta}_j' \mathbf{X}_{it} + \boldsymbol{\lambda}_k' \mathbf{Z}_{it} + \varepsilon_{it},$$

where $\mathbf{X}_{it}$ and $\mathbf{Z}_{it}$ are vectors of economic and political variables, respectively, assumed to affect reform pressure, while $\boldsymbol{\theta}'_j$ and $\boldsymbol{\lambda}'_k$ are the corresponding parameter vectors. The error term is specified as $\varepsilon_{it} = \mu_i + \eta_{it}$, where μ_i denotes country specific unobservable effects and η_{it} is a random error. In the specification of a probit random-effects model, as here, it is assumed that $\eta_{it} \sim IN(0, \sigma_\eta^2)$.[7] Reform pressure can only be observed in dichotomous form, i.e., via the observed reform decision

$$y_{it} = \begin{cases} 1, \ y_{it}^* \geq 0 \ (if \ reform) \\ 0, \ y_{it}^* < 0 \ (if \ no \ reform) \end{cases}$$

The parameters of the model are estimated by noting that the distribution of y_{it}^* conditional on μ_i is independent normal (Heckman, 1981). Thus

$$\Pr(y_{it} = 1 | \mu_i, \mathbf{X}_{it}, \mathbf{Z}_{it}) = \Pr(\frac{\eta_{it}}{\sigma_\eta} > \frac{-\boldsymbol{\theta}'_j \mathbf{X}_{it} - \boldsymbol{\lambda}'_k \mathbf{Z}_{it} - \mu_i}{\sigma_\eta}) = \Phi(z_{it}),$$

where

$$z_{it} = -(\boldsymbol{\theta}'_j \mathbf{X}_{it} + \boldsymbol{\lambda}'_k \mathbf{Z}_{it} + \mu_i)/\sigma_\eta,$$

and Φ is the distribution function for a standard normal variate.

Domestic inflation is included in the vector of economic explanatory variables, $\mathbf{X}_{it}$, to study whether CBI-reforms are more likely in countries with high inflation (Kydland and Prescott, 1977; Barro and Gordon, 1983; Rogoff, 1985), in which case we expect a positive effect; or in countries that have already achieved low inflation (Cukierman, 1994), in which case we

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[7]Fixed and random-effects Logit models, as well as linear probability models with random effects, gave similar results.

expect a negative effect.

In addition to the level of previous inflation, a history of high inflation variability might lead to an anti-inflation culture that induces the politicians to implement CBI-reforms (Hayo, 1998). To account for historical volatility in inflation in country i, without loosing too many observations, the historical variance at time t is calculated as $\sigma_{it}^2 = 1/(t-1)\sum_{j=2}^{t}(Inflation_{ij-1} - \overline{Inflation_{ij-1}})^2$. Thus, the number of observations used in the calculation of the mean inflation, $\overline{Inflation_{ij-1}}$, and the variance, σ_{it}^2, increases for each successive observation, i.e. $\sigma_{i,1985}^2$ is based on the observations from 1980-1984 while $\sigma_{i,1990}^2$ is based on the observations from 1980-1989.

Unemployment is included to study whether a high natural rate of unemployment makes surprise inflation more beneficial and thereby reduces the likelihood of a CBI-reform, or whether it instead strengthens the need for a CBI-reform.[8]

Total debt services and the use of funds and credits from the IMF are use to study whether countries with high debt-ratio might be "forced" to implement CBI-reforms in order to signal creditworthiness to foreign investors.

Political instability is assumed to reduce the probability of CBI-reform, and is therefore proxied with an exponential weighted moving average (EWMA, 20 years) of the number of coups in the country. The weights for successive past observations in the moving average were calculated as $(1 - \lambda)\lambda^0$, $(1 - \lambda)\lambda^1, (1 - \lambda)\lambda^2, ...$, where λ is 0.75.[9]

Political fragmentation, measured by Rae's index of party fractionaliza-

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[8] Actual unemployment tends to follow the natural rate of unemployment (Elmeskov, 1994) and is, therefore, used as a proxy.

[9] The values $\lambda = 0.94$, and $\lambda = 0.5$ gave similar results.

tion in the parliament, is also included in the vector of political variables, $\mathbf{Z}_{it}$, to study whether more fragmented countries are more likely to implement CBI-reform. A value of zero would indicate that one party had all seats in parliament, whereas a value of 10,000 would indicate that each party had only one seat.

Federation, a dummy variable taking the values one or zero, is included to study whether countries practicing fiscal federalism are more likely to implement CBI-reform. Liquid assets, a proxy for the strength of the financial sector, is included to study whether countries with a strong financial sector are more likely to implement CBI-reform. The CBI-index, a measure of pre-existing CBI, is included to study whether countries with high independence were less likely to implement further CBI-reform.

Finally, in order to control for geographical effects, the number of CBI-reforms in period $t-1$ in the same economic cooperation organization was included.

5   Results

The combined estimation results (combined over the 5 imputed data sets) for the random-effects probit models are displayed in Table 4. In the full sample, countries with a historically high inflation variability and a high degree of political fragmentation in the parliament were more likely than others to implement CBI-reforms, at 5% levels of significance. However, when the sample was divided into OECD and non-OECD countries, these results seem driven by the later group of countries.

Table 4: Probit estimates regarding the determinants of CBI-reform, 1980-2005

Variable	All countries			OECD			Non-OECD		
	Estimate	z-value	%	Estimate	z-value	%	Estimate	z-value	%
Constant	-2.28	-6.86	15	-2.16	-2.80	1	-2.76	-5.47	9
Inflation (L)	-0.012	-1.19	24	-0.067	-0.94	22	-0.012	-1.08	27
Inflation variability	0.002	2.34	7	0.001	0.31	1	0.001	2.12	2
GDP per capita (L)	0.005	0.73	15	-0.007	-0.42	11	-0.006	-0.31	39
Unemployment (L)	0.006	0.50	17	0.010	0.37	6	0.004	0.32	25
Liquid assets (L)	0.013	0.06	25	0.26	0.70	23	-0.082	-0.26	43
Total debt (L)	0.010	0.27	24	-0.009	-0.085	32	0.011	0.28	14
Fund and credits (L)	0.36	1.58	33	11.86	1.68	5	0.35	1.57	30
Pol fragmentation	0.062	2.39	8	0.11	1.21	4	0.055	1.90	12
Federation (D)	-0.25	-1.36	10	-0.29	-0.83	1	-0.18	-0.80	14
Coups	-0.068	-0.67	1	-2.58	-1.48	1	-0.051	-0.58	2
CBI index	-0.002	-0.26	1	-0.008	-0.87	1	0.015	1.25	0
Nr. CBI-reforms (L)	0.20	3.83	0	0.16	1.78	0	0.22	3.31	0
Log L	-367.8			-95.2			-265.8		
Number of obs.	2669			545			2124		
Number of countries	132			30			102		

Note: (L) = lagged one period, (D) = dummy variable, % = percentage of total variation due to variation in point estimate between the 5 samples.

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Why Do Politicians Implement CBI-reforms?

The results indicate that politicians in non-OECD countries implement CBI-reforms when their country has a history of high variable inflation. This supports Hayo's (1998) claim that CBI is related to an historical feedback process, suggesting that CBI-reforms are implemented because a high historical inflation variability creates stronger preferences for lower inflation. No such effect was present for OECD-countries. This might indicate that the credibility of a low inflation goal can be achieved without CBI-reforms in more industrialized countries, thereby reducing the need for a CBI-reform to achieve stable inflation.

Contrary to prevailing theories of the effect of inflation on CBI-reforms, the estimated inflation level parameter is not statistically significant for any of the samples.[10] In fact, no other economic variable is statistically significant at any conventional significance level for the full sample. Note, however, that CBI-reforms might be implemented when inflation is high in order to achieve price stability or when inflation is low to maintain price stability. The likelihood of implementing a CBI-reforms can thus be influenced by both hypotheses, thereby canceling out any significant effects of inflation on the decision to implement CBI-reforms.

Highly political fragmented non-OECD countries (but not OECD countries) were more likely to implement CBI-reforms, perhaps by politicians afraid that they will be replaced, and eager to tie the hands of incoming governments. The frequency of coups did not seem to influence the occurrence of CBI-reforms. However, the number of CBI-reforms in the same

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[10]Different lag structures for the inflation variable (2 to 5 periods) were also tested, but rendered insignificant results.

economic cooperation organization in the previous period seemed to increase the likelihood of reform, generating geographical clustering in time.

A likelihood ratio test for the models, estimated on each of the samples, was used to assess overall performance (against a constant only specification). The LR-statistics (with 12 d.f.) averaged over the 5 imputed samples were 37.20, 15.19 and 27.95 for the full, OECD, and non-OECD samples, respectively, indicating that the estimated models are significant at conventional levels for the full sample and the non-OECD sample. Analysis of the generalized residuals (based on Gourieroux et al., 1987) for each model showed no residual autocorrelation. The total variance of the point estimates is composed of two components; the natural variability in the data (the within-imputation variability) and the uncertainty introduced by missing data (the between-imputation variability). The second component reflects how the point estimates vary between the 5 imputed samples. On average the missing data contributed to the total variance of the point estimates with 14, 8, and 17 percent for the full, OECD, and non-OECD samples. Table 4 reports the contribution to the total variance for the point estimates due to missing data for each of the variables.

6 Summary and conclusions

It is something of a puzzle that politicians in many countries have recently implemented CBI-reforms, thereby reducing their ability to fine-tune the economy. This paper is a first empirical attempt to investigate why they would do so.

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Why Do Politicians Implement CBI-reforms?

The lack of compiled data on the occurrence of CBI-reforms is probably why no previous study has investigated this question. Therefore, we collected and analyzed data on the possible occurrence of CBI-reform during 1980-2005 in 132 countries, 89 of which (67%) had implemented such a reform. Hence, CBI-reform seems to be a major recent trend, illustrating the influence of the time-inconsistency literature on policy outcomes around the world.

To investigate why politicians implement CBI-reforms, a random-effects probit regression model was estimated. It was found that politicians in non-OECD countries were more likely to formally grant their central bank greater independence if their country had a history of high inflation variability. This might indicate that politicians aversion against inflation have increased during the periods of high inflation variability and that CBI-reforms are implemented as a consequence of changed preferences. No such effect was found for OECD-countries, implying that they might be able to establish credibility for a price stability rule with other means.

It was also found that politically fragmented non-OECD countries were more likely to implement CBI-reforms. This could indicate that the fear of losing power induced politicians to delegate power to independent central banks.

Finally, the likelihood of CBI-reform increased if other countries in the same economic cooperation organization had recently implemented such reform.

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Appendix

Table A1: Countries for which no information on CBI reforms was available

Country	Country	Country
Algeria	Liberia	Qatar
Angola	Libya	Rwanda
Armenia	Malawi	São Tomé and Príncipe
Congo	Mauritania	Saudi Arabia
Eritrea	Moldova	Senegal
Guinea	Morocco	Sierra Leone
Haiti	Mozambique	Taiwan
Hong Kong	Myanmar	Tajikistan
Kyrgyz Republic	Netherlands Antilles	Tonga
Lebanon	Panama	United Arab Emirates

Table A2: Year and sources of CBI-reform in 132 countries, 1980-2005

Country	Year	Sources
Afganisthan	2003	Law Da Afganisthan Bank (www.centralbank.gov.af), and e-mail correspondence
Albania	1998	Constitution of the Republic of Albania (Article 161), (www.bankofalbania.org)
Argentina	1992	BCAR's chapter reform, law 24.144 (www.bcar.gov.ar), and e-mail correspondence
Australia	1996	Statement on the conduct of monetary policy (www.rba.gov.au), Polillo and Gillen (2005), Acemoglu et al. (2008), Daunfeldt and de Luna (2008), and e-mail correspondence
Austria	1998	Nationalbankgesetz-Federal Law Gazette Part I No.161/2004 (www.oenb.at), and e-mail correspondence.
Azerbaijan	2004	Law of the Republic of Azerbaijan on the National Bank of the Republic of Azerbaijan (www.nba.az)
Bahamas	2000	Central Bank Act of the Bahamas 2000 (www.centralbankbahamas.com), and e-mail correspondence
Bahrain	None	e-mail correspondence
Bangladesh	None	www.bangladesh-bank.org
Barbados	None	www.centralbank.org.bb
Belarus	None	www.nbrb.by, and e-mail correspondence
Belgium	1999	Polillo and Gillen (2005), Acemoglu et al. (2008), and Daunfeldt and de Luna (2008)
Belize	None	www.centralbank.org.bz
Bhutan	None	www.rma.org.bt

Table A2 (Cont): Year and sources of possible CBI-reform in 132 countries, 1980-2005

Country	Year	Sources
Bolivia	1995	Jácome and Vazques (2005)
Bosnia	1997	Dvorsky (2004), cbbh.ba, and e-mail correspondence
Botswana	None	Bank of Botswana Act (www.bankofbotswana.bw)
Brazil	None	Ribeiro (2002)
Brunei	None	www.finance.gov.bn/bcb/bcb_index.htm, and e-mail correspondence.
Bulgaria	2005	Law on the Bulgarian National Bank (www.bnb.bg), and e-mail correspondence
Burundi	None	e-mail correspondence
Cambodia	None	www.imf.org/external/np/ms/2004/071504.htm
Canada	None	www.bankofcanada.ca/en/about/act_loi_boc_bdc.pdf, and e-mail correspondence
Cap Verde	None	www.bcv.cv
Cent. Af. States	None	www.beac.int
Chad	None	www.beac.int
Chile	1989	www.bcentral.cl/eng/funorg/organiclaw/, Jácome and Vazques (2005), and e-mail correspondence
China	None	Law of the People´s Bank of China (www.pbc.gov.cn/english)
Colombia	1992	www.banrep.gov.co/board_directors/bd_mission.htm, Jácome and Vazques (2005), and e-mail correspondence
Comoros	None	www.bancecom.com/bcc_home.php
Costa Rica	1995	Law No. 7558, Act of the Central Bank of Costa Rica (www.bccr.fi.cr), e-mail correspondence, and Jácome and Vazques (2005)
Croatia	2001	Dvorsky (2004), Law of the Croatian National Bank (www.hnb.hr), and e-mail correspondence

Table A2 (Cont): Year and sources of possible CBI-reform in 132 countries, 1980-2005

Country	Year	Sources
Cyprus	2002	Central Bank of Cyprus Law L138(I)/2002 (www.mof.gov.cy), and e-mail correspondence
Czech Republic	1993	Constitutional Court of the Czech Republic, Decision No. 278/2001 (www.cnb.cz), and e-mail correspondence
Denmark	None	www.nationalbanken.dk, and e-mail correspondence
Djibouti	2005	e-mail correspondence
Dominican Rep	2002	Jácome and Vázquez (2005)
Ecuador	1992	Jácome and Vázquez (2005)
Egypt	None	www.cbe.org.eg
El Salvador	1991	Organic Law of the Central Reserve Bank of El Salvador www.bcr.gob.sv/ingles/acerca/resenia.html), e-mail correspondence, and Jácome and Vázquez (2005)
Estonia	2004	Eesti Pank Act (www.legaltext.ee/text/en/X70022.htm), and e-mail correspondence
Ethiopia	None	www.nbe.gov.et
Fiji	None	www.reservebank.gov.fj, and e-mail correspondence
Finland	1998	The Act on the Bank of Finland (www.bof.fi), and e-mail correspondence
France	1993	www.banque-france.fr/gb/instit/histoire/histor5.htm, and e-mail correspondence
Gambia	2005	www.cbg.gm/pdf/strategic%20plan.pdf
Georgia	1995	Organic Law of Georgia on the National Bank of Georgia (www.nbg.gov.ge/nbg_new/about_the_bank/nbg_history.htm)
Germany	None	www.bundesbank.de, and e-mail correspondence
Ghana	None	www.bog.gov.gh/privatecontent/File/Secretarys/bog-act.pdf

Table A2 (Cont): Year and sources of possible CBI-reform in 132 countries, 1980-2005

Country	Year	Sources
Greece	1994	Law 2275, Articles 45 and 46 (www.bankofgreece.gr/en), Maxfield (1997), Panagioditis and Triampella (2006), and Acemoglu et al. (2008)
Guatemala	2002	Principales Leyes Bancarias y Financieras (www.banguat.gob.gt), and e-mail correspondence
Guyana	1998	The Bank of Guyana Act (www.bankofguyana.org.gy/legalregframewk.htm), and Jácome and Vázquez (2005)
Honduras	1996	Jácome and Vázquez (2005)
Hungary	1991	Act of the Magyar Nemzeti Bank (english.mnb.hu)
Iceland	2001	www.sedlabanki.is, and e-mail correspondence
India	None	Polillo and Guillen (2005), and Acemoglu et al. (2008)
Indonesia	1999	Central Bank Act, UU No. 23, 1999 (www.bi.go.id), Polillo and Guillen (2005), and Acemoglu et al. (2008)
Iran	2005	www.cbi.ir/default_en.aspx
Ireland	1998	Central Bank Act 1998 and convergence report (www.ecb.int/pub/pdf/conrep/cr1998en.pdf)
Israel	None	e-mail correspondence
Italy	1993	Legislative Decree 385, 1993 (www.bancaditalia.it), Polillo and Guillen (2005), and Acemoglu et al. (2008)
Jamaica	None	www.boj.org.jm/uploads/pdf/qmp_report/fqmp_report_october_december2003.pd, and Nelson-Fouglas (2004)
Japan	1998	www.boj.or.jp/en/type/exp/about/foboj.htm, and Werner (2003: ch 18)
Jordan	None	www.cbj.gov.jo/pages.php
Kazakhstan	2005	www.nationalbank.kz/cont/publish626681_1720.doc, and e-mail correspondence

Table A2 (Cont): Year and sources of possible CBI-reform in 132 countries, 1980-2005

Country	Year	Sources
Kenya	None	e-mail correspondence
Korea	1997	Polillo and Guillen (2005), and Acemoglu et al. (2008)
Kuwait	None	www.cbk.gov.kw/WWW/index.html
Lao	None	www.bol.gov.la/bollaw1.html, and e-mail correspondence
Latvia	2002	www.bank.lv/eng/main/lvbank/llb/), convergence report (www.ecb.int/pub/pdf/conrep/cr2004en.pdf), and e-mail correspondence
Lesotho	2000	www.centralbank.org.ls/about/default.htm), and e-mail correspondence
Lithuania	2001	Morgan Stanley (2004)
Luxemburg	1998	www.bcl.lu/en/bcl/index.html
Macedonia	2002	Dvorsky (2004)
Madagascar	1994	e-mail correspondence
Malaysia	1994	Arnone et al. (2007)
Maldives	None	e-mail correspondence
Malta	2002	www.centralbankmalta.com/site/about4a.html), and e-mail correspondence
Mauritius	2004	e-mail correspondence
Mexico	1994	Jácome and Vázquez (2005), and e-mail correspondence
Mongolia	1995	Slok (2002), and Polillo and Guillen (2005)
Namibia	2004	e-mail correspondence
Nepal	2002	www.nrb.org.np/index.htm, and e-mail correspondence
Netherlands	1998	www.dnb.nl/dnb/home/file/bankact1998_tcm13-36143.pdf, and e-mail correspondence

Table A2 (Cont): Year and sources of possible CBI-reform in 132 countries, 1980-2005

Country	Year	Sources
New Zealand	1989	Evans et al. (1996), Silverstone et al. (1996), Daunfeldt and de Luna (2001), and e-mail correspondence
Nicaragua	1992	www.bcn.gob.ni/english/about/origin_bank.htm, and Jácome and Vázquez (2005)
Nigeria	1999	e-mail correspondence
Norway	2003	www.regjeringen.no/Rpub/OTP/20022003/081/PDFS/ OTP200220030081000DDDPDFS.pdf), and e-mail correspondence
Oman	None	www.cbo-oman.org/BankingLaw/BankingLaw.pdf
Pakistan	1997	Morgan Stanley (2004)
New Guinea	2000	www.imf.org/external/pubs/ft/scr/2000/cr00137.pdf), and e-mail correspondence
Paraguay	1995	Jácome and Vázquez (2005)
Peru	1993	Jácome and Vázquez (2005)
Philippines	1993	www.bsp.gov.ph/about/history_cbp.asp
Poland	1998	www.nbp.pl/en/publikacje/integracja/role_nbp_en.pdf, and e-mail correspondence
Portugal	1998	www.bportugal.pt/default_e.htm, ECB (1998), and e-mail correspondence
Romania	2004	Dvorsky (2004), www.bnro.ro/def_en.htm, and e-mail correspondence
Russia	1995	www.cbr.ru/eng/today/history/central_bank.asp
Samoa	None	e-mail correspondence
Serbia	2003	Dvorsky (2004)
Seychelles	2004	www.cbs.sc/acro/QuarterlyReviewQ22005.pdf, and e-mail correspondence

Table A2 (Cont): Year and sources of possible CBI-reform in 133 countries, 1980-2005

Country	Year	Sources
Singapore	None	Polillo and Guillen (2005)
Slovak Rep	1993	www.nbs.sk/INDEXA.HTM, and e-mail correspondence
Slovenia	2002	ECB (2004)
Solomon Isl	None	www.cbsi.com.sb/CBSI%20ACT.pdf
South Africa	1996	www.reservebank.co.za/internet/Publication.nsf/LADV /700A8754AC98C40242257037003CAB4C/$File/Factsheet1.pdf
Spain	1994	www.bde.es/normativa/be/leyautone.pdf, and e-mail correspondence.
Sri Lanka	2002	e-mail correspondence
Sudan	None	(http://www.bankofsudan.org/)
Suriname	2005	e-mail correspondence
Swaziland	None	(http://www.centralbank.org.sz/history.php)
Sweden	1999	www.riksbank.com/templates/Page.aspx?id=9173, Daunfeldt and de Luna (2008), and e-mail correspondence.
Switzerland	2004	www.snb.ch/e/snb/index.html?file=recht/content_recht.html, and e-mail correspondence
Syrian	None	www.banquecentrale.gov.sy/eg-laws/law23-eg.htm, and e-mail correspondence.
Tanzania	1995	www.bot-tz.org/AboutBOT/BOT_Function.htm
Thailand	None	www.bot.or.th/bothomepage/BankAtWork/AboutBOT /Response/History/Response_E.pdf)
Trinidad	None	www.central-bank.org.tt/the_bank/1041.pdf), and e-mail correspondence.
Tunisia	None	(http://www.bct.gov.tn/bct/siteprod/english/presentation/historique.jsp)

Table A2 (Cont): Year and sources of possible CBI-reform in 133 countries, 1980-2005

Country	Year	Sources
Turkey	2001	www.tcmb.gov.tr/yeni/banka/law.html, and e-mail correspondence
Turkmenistan	None	www.heritage.org/Index/country.cfm?id=Turkmenistan
Uganda	1993	e-mail correspondence
Ukraine	1999	Schwödiauer et al (2006)
United Kingdom	1998	www.bankofengland.co.uk/about/legislation/legis.htm, Morgan Stanley (2004), and e-mail correspondence
United States	None	e-mail correspondence
Uruguay	1995	Jácome and Vázquez (2005)
Uzbekistan	1995	Jácome and Vázquez (2005)
Vanuatu	None	e-mail correspondence
Venezuela	1992	Jácome and Vázquez (2005)
Vietnam	1997	e-mail correspondence
Yemen	2000	Central Bank Law No. 14 (www.buyusa.gov/yemen/en/yemen2008.pdf)
Zambia	None	e-mail correspondence
Zimbabwe	None	www.rbz.co.zw/about/about.asp

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Do Central Bank Independence Reforms Matter

for Inflation Performance?[*]

Mats Landström[†]

Abstract

A difference-in-difference approach was used to investigate whether Central Bank Indepencence (CBI) reforms matter for inflation, based on a novel data set including the possible occurence of such reforms in 132 countries during the period 1980-2005. CBI-reforms are found to have contributed to bringing down high inflation rates where those existed, but they seem unrelated to performance in low-inflation countries.

1   Introduction

In recent years many countries have implemented institutional reforms that formally established the independence of central banks from elected policy-makers (Daunfeldt et al., 2008). The reason for this might be that independent central banks are widely believed to perform better at achieving low inflation than central banks controlled by politicians. The theoretical background of this belief is the literature on time-inconsistency in monetery policy (Kydland and Prescott, 1977; Barro and Gordon, 1983; Rogoff, 1985).

There is some empirical evidence that countries with independent central banks have lower inflation (Cukierman, 2008). For example, Cukierman et al. (1992) and Alesina and Summers (1993) found a negative correlation between average inflation and the degree of central bank independence (CBI), suggesting that inflation might be reduced via CBI-reforms.

However, these studies used data from only a small set of mostly highly industrialized countries. Cukierman et al (2002), on the other hand, studied the relation between CBI and inflation in 26 former socialist countries during their transition to market economies, but found no correlation, at least in the early stages of economic liberalization. Cukierman et al (1993) also found no correlation between CBI and inflation in up to 70 less-developed countries. Thus the importance of CBI might differ across countries at different levels of development. Therefore it might be helpful to increase the number of countries under study.

In addition, previous studies have not addressed the question of endogeniety, since correlation analysis is not sufficient for establishing a causal

relationship between variables. It might be that low inflation leads to more CBI, rather than the other way around. Or there might have been a variable omitted from the models that caused both CBI and low inflation, for example social attitudes (Posen, 1993; Hayo, 1998). The construction of CBI indices is also somewhat subjective, potentially leading to bias (Forder, 1996, 1998; Mangano, 1998).[1]

This paper thus studies whether countries that implemented CBI reforms performed better in terms of inflation than those that did not, while expanding the dataset and taking into account possible endogeniety and subjectivity, during the study period, 1980-2005. Legal changes considered CBI reforms are those reforms that formally decreased the influence of elected politicians on monetary policy.

The focus is thus on changes in the legal independence of central banks, instead on the level of CBI. As all the reforms increased CBI, the subjectivity that plagues most commonly used CBI indices (Daunfeldt and de Luna, 2008) is reduced. However, focusing on changes rather than level does not totally eliminate bias as there is still some subjectivity in interpreting what constitutes a change. For example, it might be argued that a change was too small to be considered a real change, or that it was in a dimension not relevant for CBI. However, small changes are usually amendments of earlier larger changes, usually involving multiple dimensions, including CBI.[2]

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[1] For example, one country might be ranked higher than another according to one criterion for CBI, but lower according to another criterion. Clearly, how the two countries are ranked according to an aggregate CBI index depends on the weights given to the two criteria. It follows that different CBI indices might rank the countries differently.

[2] Basically, a CBI index should be monoton and continuous in the mapping from the relevant dimensions, but it does not have meaningful cardinal interpretation. See also previous footnote.

Do CBI-reforms Matter for Inflation Performance?

The analysis is based on a novel dataset compiled by Daunfeldt et al. (2008), covering the possible occurence of CBI reforms in 132 countries during the period 1980-2005. This means that the study includes more countries than any previous study on CBI and inflation.

The study, closely related to one by Ball and Sheridan (2005), is based on a difference-in-difference method, previously also used to identify the effect of a change in institutional (e.g., legal) factors (Meyer, 1995). Ball and Sheridan (2005) used it to study whether inflation-targeting reduced inflation in 20 OECD countries, finding that it did, but not when regression to the mean was controlled for. Instead of comparing targeters and non-targeters, countries that implemented CBI reforms during the study period are here compared to those that did not. Following Ball and Sheridan (2005), regression to the mean, the tendency of large (or small) measures to be followed by measures closer to the average[3], since transitory factors tend to disappear over the long run, was controlled for by including inflation in the first year in the dataset as an explanatory variable.

In an alternative analysis, to study whether the efficiency of CBI reform depended on previous inflation rates, countries were included or excluded, depending on their level of pre-reform inflation. The difference-in-difference method eliminates endogeneity due to unobservable time-invariant country-specific effects connected to the level of inflation. Since differences are used, these effects are cancelled out, as are any time-variant symmetric effects.

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[3]A well-known example of this is that athletes who have been extremely successful in their rookie year in team sports, often find it almost impossible to live up to expectations during their sophomore year. More generally, an athlete's superior performance is likely to be followed by poorer performance, due to regression alone (Gilovich, 1991).

Countries that implemented CBI reforms during the study period are found to have reduced inflation more than those that did not, though no such effect was found for countries with previous low inflation. The results thus seems to be driven by countries that had high pre-reform inflation, perhaps suggesting that the efficiency of CBI reform is related to recent inflation experience.

The next section presents the data and sample of countries, while section 3 presents and discusses the empirical method. Section 4 presents and discusses the results. Section 5 summarizes and draws conclusions.

2   The Data and Descriptive Statistics

2.1   The data

To investigate whether countries with CBI reforms perform better than others, dates of implementation are needed. This information is available in the dataset obtained and previously used by Daunfeldt et al. (2008).

The dates of CBI reforms were obtained by contacting, by e-mail, all central banks listed in Morgan Stanley's *Central Bank Directory 2004,* asking the following questions: (i) Has your country implemented any institutional reforms that grant your central bank more independence from elected policymakers? (ii) If yes, when? (iii) Where can we find more information about this?

This method of obtaining information was convenient, and had the added benefit of treating all the countries equally, at least initially, without regard

to whether or not their central bank has posted information on a website. Of the 162 central banks contacted, 95 (59%) answered the questionnaire. For the banks that did not, the dates of any CBI reforms were obtained from central bank acts, central bank publications, and scientific articles. These sources were also used to validate the answers obtained by e-mail.

Of interest here are reforms that established CBI in dimensions possibly relevant for inflation-bias in monetary policy, due to time-inconsistency, by naming the low inflation goal in the legislation; reducing the possibility for the government to override central bank decisions; restricting governments' opportunities to use central bank credits to finance budget deficits; reducing the power to dismiss central bank governors; increasing their terms in office and number; and so on. But, besides a clear change towards more CBI, the magnitude of change is undetermined.

The dataset consists of a panel of 132 countries over 1980-2005 (81% of the countries that were initially contacted by e-mail), of which 89 had implemented CBI reforms during the period. The dates, as well as countries with no information on CBI reform, are presented in Daunfeldt et al. (2008), Table A1 and A2. Inflation data is missing for four countries, Afganisthan, Bosnia and Herzegovina, Georgia, and Slovak Republic, reducing the panel to 128 countries.

The countries in the dataset are classified as either reform- or non-reform countries. For countries that implemented CBI reforms, time is partitioned into pre-reform period and a post-reform periods, with the break defined as beginning of the year when the reform was implemented. To use the difference-in-difference method, a break-point between pre-reform and post-

reform periods also needs to be defined for the countries that did not implement any CBI reforms. Following Ball and Sheridan (2005), it is defined as the unweighted average of the reform years of the reform countries. This year is 1998, which is also the median year for reform.[4] Next, average inflation was calculated for both the pre-reform and post-reform periods, for all the countries in the sample, using inflation measures from *IMF Financial Statistics*.

2.2 Descriptive statistics

The time series for median and mean inflation for reform and non-reform countries from 1980 to 2005 are presented in Figure 1 and 2, respectively. For both reform and non-reform countries, mean inflation rates were much lower during the end of the study period, as were also the median rates. Only eight countries experienced higher inflation in the post-reform period. The mean inflation rates are somewhat lower for reform countries in the post-period, compared to non-reform countries, although it was higher in the pre-reform period, giving the impression that CBI-reforms are important for improving inflation performance. Although the vertical scales are different on the two figures, the strikingly different patterns of mean and median inflation rates, may indicate problems with extreme values in the dataset, which might distort the results.

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[4]A sensitivity analysis was performed using different years depending on which economic cooperation area (e.g. EU) the countries belong to, as a break between pre- and post-reform. These analyses did not generate qualitatively different results.

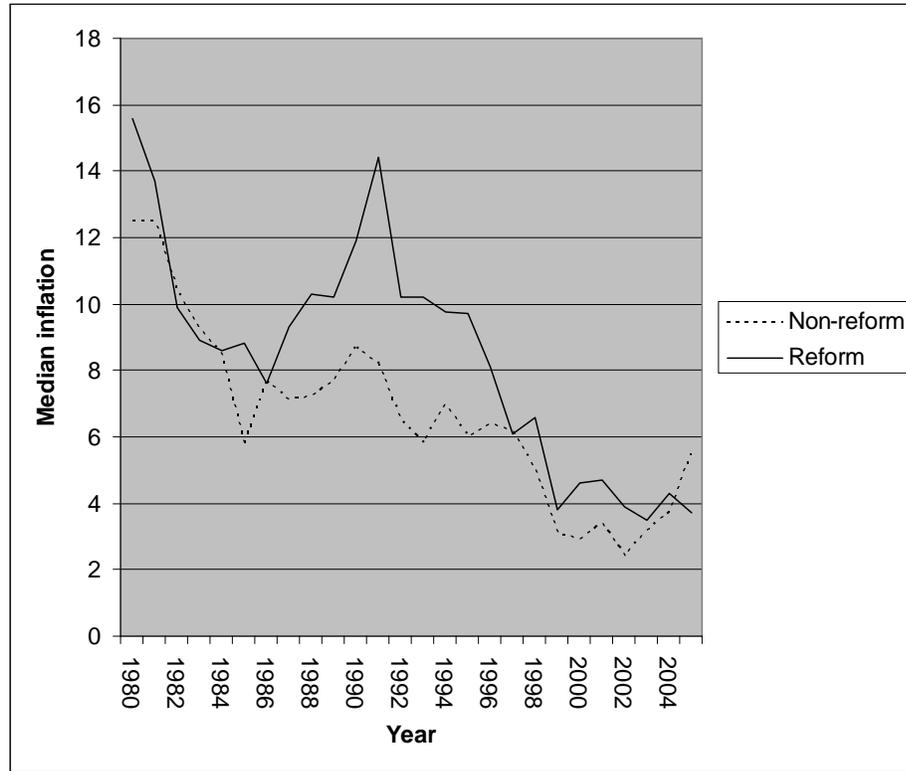*Do CBI-reforms Matter for Inflation Performance?*

Figure 1: Median inflation in reform and non-reform countries, 1980-2005
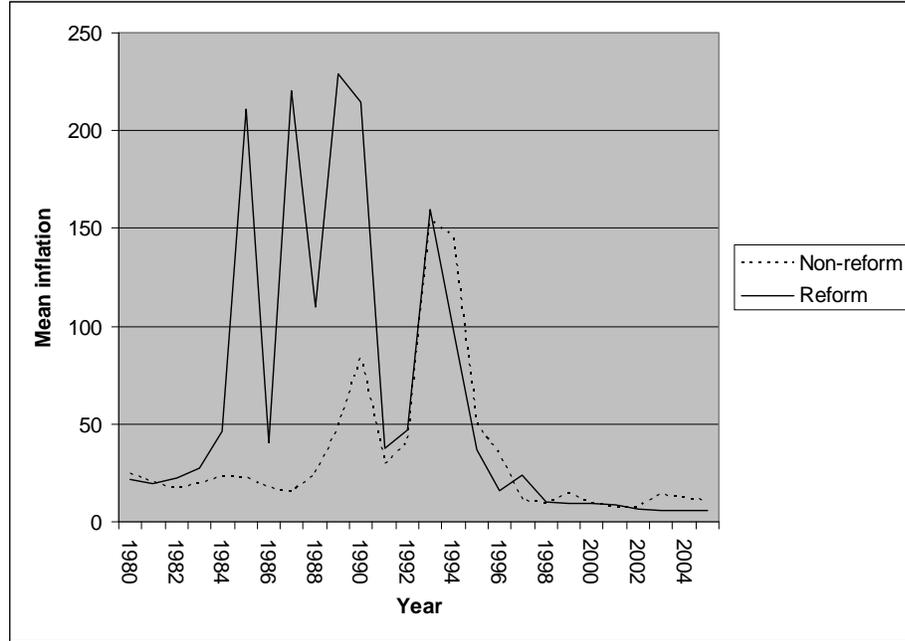
Figure 2: Mean inflation in reform and non-reform countries, 1980-2005

Plotting the change in inflation against the average level of inflation in the pre-reform period (Figure 3), makes regression to the mean effect clearly visible, i.e., inflation fell more in countries that experienced higher inflation, in the pre-reform period, with no clear difference between reform and non-reform countries. The methods used for controlling for regression to the mean are discussed in the next section.
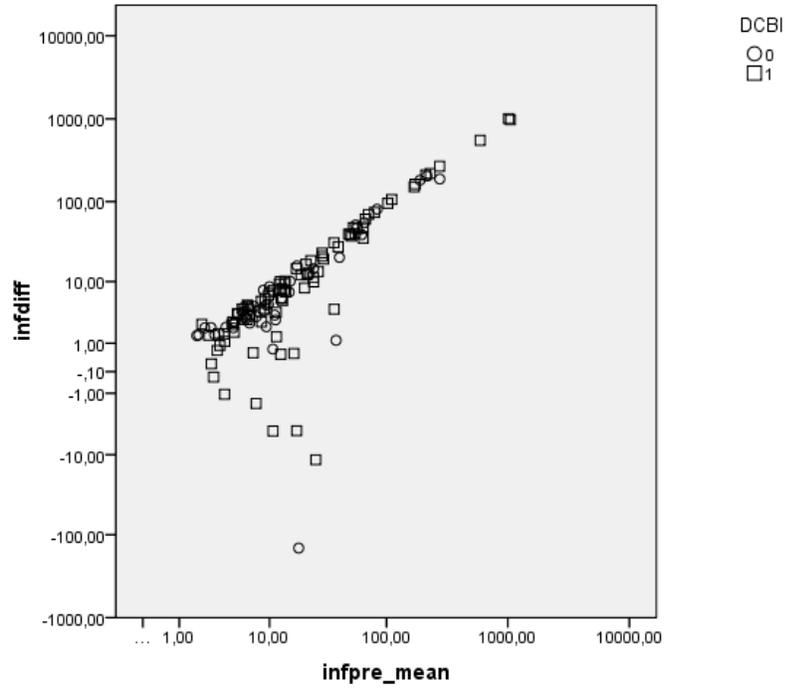
Figure 3: Change in inflation (infdiff) against the level of average inflation in the pre-reform period (infpre_mean), of reform (1) and non-reform (0) countries.

Figure 3 also shows the extreme observations that can distort the results. Therefore a boxplot analysis was performed on pre-reform inflation to exclude such outliers (Figure 4). A country was considered an outlier if the pre-reform inflation was more than two standard deviation above the mean, or above 55.19%. This excluded a further 23 countries, leaving 105 in the dataset.
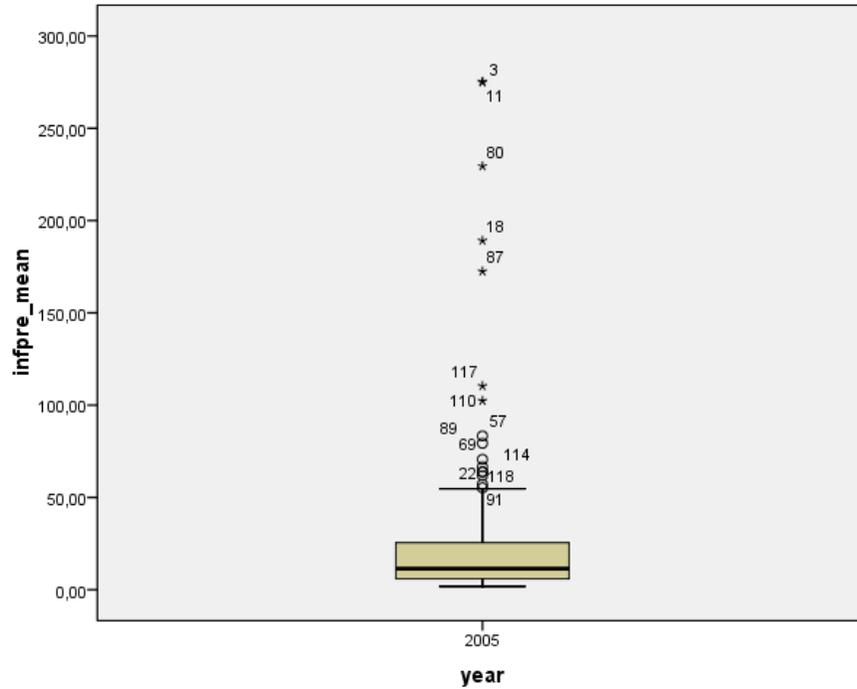
Figure 4: Boxplot of level of average inflation in the pre-reform period (infpre_mean).

Mean and standard deviations of the variables used in the empirical analysis are presented in Table 1. Note that the descriptive statistics supports the impression that CBI-reforms were important for reducing inflation performance. The variables are further explained in the next section.

3   Empirical Model

To investigate whether CBI reforms improved inflation performance, we distinguish between reform and non-reform countries, with a dummy variable,

Table 1: Means and standard deviations of variables

	All		Reform		Non-Reform	
Variable	Mean	s.d.	Mean	s.d.	Mean	s.d.
Pre-reform inflation	13.79	12.30	15.86	13.53	9.98	8.61
Post-reform inflation	7.75	16.44	6.95	6.73	9.29	26.79
Inflation reduction	6.07	17.93	8.98	11.80	0.75	24.98
Initial Inflation	58.4	237.2	78.7	289.7	18.7	30.1
CBI dummy	0.66	0.47				
Number of countries	105		71		34	

using a difference-in-difference, as noted. The following regression (Model I) was first estimated, using ordinary least-squares (OLS):

$$\pi_i^{pre} - \pi_i^{post} = \alpha_0 + \alpha_1 D_i + \epsilon_i \tag{1}$$

where π_i^{pre} is average pre-reform inflation in country i; π_i^{post} is its average post-reform inflation; D_i is a dummy variable equal to one if country i implemented CBI reform during the study period, otherwise zero; and ϵ is an error-term. The parameter α_1 then measures the impact of CBI reform on inflation. The hypothesis that CBI reform did not matter can be rejected if the estimate of α_1 (expected to be positive) is significantly different from zero.

However, Model I might produce biased parameter estimates, since it does not control for regression to the mean. High-inflation countries, which are likely to reduce their inflation more than other countries regardless of their monetary regime, might thus distort the results.

To control for this, Ball and Sheridan (2005) added average pre-reform inflation (π_i^{pre}) as an independent (as well as dependent) variable, thereby perhaps causing endogeneity, i.e., that π_i^{pre} might be correlated with the

error-term (Kennedy, 2003). To reduce this possible endogeniety country *i's* inflation in the first year in the dataset, π_i^0, is here used instead. Model II is then:

$$\pi_i^{pre} - \pi_i^{post} = \alpha_0 + \alpha_1 D_i + \alpha_2 \pi_i^0 + \epsilon_i \tag{2}$$

In this case the parameter for the CBI dummy (α_1) indicates whether CBI reform affected inflation, given first year inflation.

First year inflation (π_i^0) might be a poor proxy for regression to the mean, however, since some countries might have been able to reduce initial high inflation already in the later years of the pre-period. To control for the effect of regression to the mean in some other way, the sample was thus split into low- and high-inflation groups, according to a criteria explained below.

First, all countries were ranked according to pre-period inflation, outliers excluded. The difference between pre- and post-reform inflation was then regressed against the reform dummy, first for only the 25% with lowest pre-reform inflation, 5.6% or lower. Then a corresponding regression was run for all other countries. Next, a regression was run for half the countries, those with pre-reform inflation lower than 9.8 %, and another regression for the rest, and so on. The equations estimated were:

$$\pi_{iL}^{pre} - \pi_{iL}^{post} = \alpha_0 + \alpha_1 D_{iL} + \epsilon_i \tag{3a}$$

$$\pi_{iH}^{pre} - \pi_{iH}^{post} = \alpha_0 + \alpha_1 D_{iH} + \epsilon_i \tag{3b}$$

where $\pi_{iL}^{pre} - \pi_{iL}^{post}$ is the inflation difference between pre- and post-reform periods for low-inflation countries; and $\pi_{iH}^{pre} - \pi_{iH}^{post}$ is for high-inflation countries.

The CBI dummy D_i might itself also be endogenous, due to a time-variant country-specific effect. For example, the probability of a CBI reform might increase with pre-reform inflation (and thus with positive transitory shocks), and thus be positively correlated with the error term. If the CBI dummy is endogenous in this way, then we would expect estimators related to it to be positively biased, attributing some of the reduction of inflation due to the passing of the transitory inflation to the reform.[5]

4 Results

The aim of the empirical part of the paper was to investigate whether countries that have implemented CBI-reforms, that is countries in the dataset with a dummy value of 1, have improved their of inflation performance relative to those countries that have not implemented such institutional reforms. The results from estimating equations (1)-(2) are presented in Table 2.

Table 2: Determinants of inflation performance, 1980-2005

Variable (parameter)	Model I		Model II	
	Est.	t-value	Est.	t-value
Constant (α_0)	0.74	0.26	0.52	0.18
CBI dummy (α_1)	8.24	2.30	7.54	2.10
First-year inflation (α_2)			0.01	1.60

[5]Angrist and Pischke (2009) discuss problems with using standard instrumental-variable techniques when the instrumented variable is dichotomous. No instrument highly correlated with the reform dummy was found.

Do CBI-reforms Matter for Inflation Performance?

The null hypothesis that CBI reform did not matter for inflation performance can be rejected at all conventional significance levels in Model I. In Model II, when first year inflation is included to control for the possibility of regression to the mean, CBI reform was still statistically significant. Reform countries thus improved inflation performance on the average more than non-reform countries, supporting the belief that CBI-reforms are helpful in achieving price stability.

Table 3: Inflation reduction, due to CBI reform, for different partitions of data, 1980-2005

Inflation break point	Low-inflation countries			High-inflation countries		
	Est.	t-value	n	Est.	t-value	n
5.6% (25% of sample)	-0.39	-0.85	27	11.17	2.34	78
9.8% (50% of sample)	-0.91	-1.96	53	18.11	2.28	52
17.7% (75% of sample)	-0.46	-0.58	80	48.00	2.78	25

The results from the estimations of equations 3a and 3b, for different partitions of the data, are presented in Table 3. For low-inflation countries CBI reforms seems to have had no or little influence on inflation performance. The only statistically significant effect of CBI reform is actually negative in one case, implying that countries that did not implement CBI reforms reduced inflation more than those that did. A possible explanation is that the low-inflation group includes many countries with stable political systems that had already been able to achive low inflation earlier by other means (for a similar explanation, see Daunfeldt and de Luna, 2008). CBI reforms were, with low inflation already achieved, perhaps only adopted as part of a package of reforms aimed at transition towards a market economy or towards joining a political union. When all countries were included in the group,

there was a positive significant correlation. The results then, seems to be sensitive to which countries are included in the regression.

For the high-inflation countries, the CBI dummy is positive and statistically significant at the 10% level, for all regressions. Thus, CBI reforms seems to have contributed to reducing inflation in high inflation countries, beyond the reduction due to regression to the mean. A separate regression run for the high-inflation countries excluded from the main analysis, as outliers, produced no statistically significant results, perhaps due to high variability of inflation. It also may point towards a heterogenous effect of CBI reforms, hump-shaped in pre-reform inflation. To sum up, while CBI reforms seems to matter for inflation performance in general, it matters little for countries that already have achieved low inflation by other means.

5   Summary and Conclusions

One of the most important recent macroeconomic findings is the strong negative correlation between average inflation and the degree of central bank independence (CBI) (see e.g., Cukierman et al., 1992; Alesina and Summers, 1993), which suggest that inflation might be brought down with CBI reform. In recent years many countries have implemented such reforms. Using a difference-in-difference method (Ball and Sheridan, 2005), it was studied here whether countries that implemented CBI reform performed better in terms of inflation than countries that did not. The empirical analysis was based on a dataset covering the possible occurence of CBI reforms in 132 countries during 1980-2005.

Do CBI-reforms Matter for Inflation Performance?

CBI reform was found to be positively related to inflation performance, meaning that countries that implemented CBI reform brought down inflation more than countries that did not.

Countries were then ranked according to the level of pre-reform inflation, and partitioned into quartiles. The difference in inflation between the pre- and post-reform periods was then regressed against the reform dummy for the first quartile, as well as for the other three quartiles together; then for the lower half and the upper half; finally for the lower three quartiles as well as the upper quartile. CBI reform seem to have been more efficient in reducing inflation in countries with high previous inflation, while the effect was not statistically significant (or even negative) in countries with low previous inflation.

Thus, the popular view that CBI reform is important for improving a country's inflation performance, is not fully supported. The efficacy of CBI reform seems instead to depend on past inflation.

In low-inflation countries it might be that politicians' unemployment-targets coincide with the natural rate of unemployment, eliminating any need for CBI reform. In high inflation countries, on the other hand, CBI reform might be needed in order to achieve credibility for a low-inflation rule.

The results here raise the question whether there are perhaps other conditions that, together with formal legal independence of the central bank, are important for improving inflation performance. For example, the effectiveness of CBI reform might be influenced by the level of political stability in the countries. Or, the choice of nominal inflation target might matter,

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perhaps together with how transparent the responsibilities and actions of the central bank are to the public. These questions might be fruitful for future research.

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