

Central Bank Independence Reforms and Price Stability: The Role of Democracy and Political Stability

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Abstract

The purpose of this paper is to test whether the efficiency of central bank independence (CBI) reforms might depend on the interaction between the level of democracy and political stability. It was found that CBI-reforms, on average, lowered inflation rates with 3.95 to 4.68 percent. The reduction in inflation was 3.17 to 4.54 percentage larger in political unstable democracies than in other countries, supporting the claim that the benefit of implementing CBI-reforms is greatest in democracies characterized by a recent history of political instability.

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

JEL-codes: E52; E58; P48

1 Introduction

One of the most significant trends in international politics during the last decades is the dramatic increase in central bank independence (CBI) around the world. Daunfeldt et al. (2008) found that 89 of 132 studied countries had implemented a CBI-reform that delegated power from politicians to a central bank in recent years. The theoretical background behind this policy development is the literature on time-inconsistency in monetary policy (Kydland and Prescott, 1977; Barro and Gordon 1983; and Rogoff, 1985), suggesting that independent central banks are better in achieving low and stable inflation.

The empirical evidence whether CBI matter for inflation performance is rather mixed, however. Early cross-country studies (see e.g., Alesina, 1988; Grilli et al., 1991; Cukierman et al., 1992; Alesina and Summers, 1993; Jonsson, 1995; and Eijffinger et al., 1998) used correlation analysis to study the relationship between the level of CBI and average inflation, where the level of CBI was measured by a constructed CBI-index. In general, these studies found a negative correlation between average inflation and the level of CBI. Grilli et al. (1991, p. 375) concluded that: *"having an independent central bank is almost like having a free lunch, there are benefits, but no apparent costs in terms of economic performance"*.

This result has, however, been questioned in later studies. Cukierman (1994) argued that countries that have achieved low inflation could construct independent central banks to tie the hands of incoming governments, suggesting that the level of CBI might be an endogenously determined variable.

Posen (1998) and Hayo (1998) argued that a variable that influence both CBI and inflation might be omitted from the analysis (e.g., social attitudes), implying that independent central banks are successful in implementing low and stable inflation merely because their independence reflects a social attitude that supports low inflation. It has also been noted that CBI-indices are characterized by a large subjectivity bias (Forder, 1996, 1998; Mangano, 1998).

More recent empirical studies have tried to study the relationship between inflation performance and CBI from other methodological perspectives. Daunfeldt and de Luna (2008) focused on the change in CBI rather than the level of CBI using data from 29 OECD-countries.¹ Their results indicated that price stability had been achieved in most countries before their central banks did became more independent, suggesting that the credibility of a low inflation goal can be achieved without CBI-reforms. Campillo and Miron (1997) could not reject the null hypothesis that CBI has no influence on the inflation rate using multiple regression analysis; whereas Landström (2009), using a difference-in-difference methodology, indicated that CBI-reforms seem to have been efficient in bringing down inflation in high-inflation countries.

One drawback with almost all previous empirical studies is that they mainly use data from a small set of highly industrialized countries. One exception is Cukierman et al. (1992), who analyzed the correlation between

¹As the CBI-reforms by definition have increased the degree of independence of the central banks, their analysis did not suffer from the subjectivity problem that characterizes the construction of independence indices. There is still some subjectivity involved in dating the relevant CBI-reforms, however.

average inflation and the level of CBI in 72 countries. Their results indicated that more independent central banks contributed to lower inflation in industrialized countries, but not in developing countries. One possible explanation for the latter result is that the implementation of a CBI-reform is not sufficient for achieving a low-inflation goal in more developing countries because the political policymakers can violate this legal reform when price stability is achieved. As the public understands the policymakers' objective, CBI will not be effective in achieving low and stable inflation in developing countries (for a similar argument, see also McCallum, 1997).

The purpose of this paper is to study the effect of CBI-reforms on inflation rates, using a data-set compiled by Daunfeldt et al. (2008), covering the event of CBI-reforms in 132 countries during the period 1980-2005. In contrast to previous studies, a random effect and random coefficient model is used. This method has the advantage that it accounts for country specific unobserved heterogeneity in inflation levels, while also allowing for unobserved heterogeneity in the effects of CBI-reforms on inflation levels. The results indicate that CBI-reforms have contributed to lower inflation rates, but there is also considerable heterogeneity among countries when it comes to the effect of CBI-reforms.

It is argued in the paper that the interaction between the degree of democracy and political stability might influence whether CBI-reforms are efficient in reducing inflation, a relationship that previously has not been investigated in the empirical literature. In highly democratic countries characterized by a high degree of political stability, the public might consider a low inflation policy rule as credible; thereby reducing the need for a CBI-reform

to achieve low and stable inflation. In totalitarian countries (regardless of the degree of political stability), CBI-reforms might not matter as laws are not fulfilled. Democratic countries that have a recent history of political instability might, on the other hand, need to implement CBI-reforms to achieve credibility for a price stability rule. This hypothesis is supported by the empirical analysis, suggesting that it is of great importance to consider the political situation when studying the influence of CBI.

In the next section, the relationship between inflation performance, degree of democracy and political stability is discussed. The data and the descriptive statistics are presented in Section 3. In Section 4, the econometric models are specified, while the results are presented in Section 5. Finally, Section 6 summarizes and draws conclusions.

2 Inflation performance and political stability

It is commonly believed that CBI-reforms will reduce the inflationary bias of monetary 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.

In this paper it is argued that the interaction between the level of democracy and the degree of political stability might determine whether a CBI-reform is successful in bringing down inflation. A number of previous studies (Cukierman, 1994; Cukierman and Webb, 1995; de Haan and Siermann,

1996) have argued that the efficiency of CBI-reforms might be determined by the degree of political stability. However, only a small number of studies have suggested that the level of democracy also will influence the efficacy of a CBI-reform. Bagheri and Habib (1998) is a notable exception. This paper is focused on analysing whether it is the interaction between democracy and political stability that influence the efficiency of CBI-reforms in reducing inflation. No empirical paper has (as far as we know) addressed this question previously.

In countries characterized by a low level of democracy, CBI-reforms might not be successful in bringing down inflation regardless of the the level of political stability. The reason is that formal CBI does not matter if laws are not fulfilled, i.e., the public will not trust any price stability rule when it exist a big difference between formal and informal CBI. Cukierman et al. (1993) showed, for example, that average inflation and the level of CBI was negatively correlated in a sample of industrialized countries, whereas inflation seemed unrelated to the level of CBI in more developing countries. Their interpretation was that the level of CBI in more developing countries did not reflect actual independence. On the other hand, when the turnover rate of central bank governors (Cukeriman et al., 1993) or the political vulnerability of the central bank (Cukeriman and Webb, 1995) was used as a proxy for CBI in these countries, the level of CBI seem significantly negatively related to inflation.

CBI-reforms might not either be correlated with better inflation performance in democratic countries that have a history of political stability. A low-inflation goal can be made credible in these countries without

CBI-reforms since the public tend to trust announcements of price stability targets. The influence of reputation in achieving and maintaining price stability is, for example, emphasized by Barro and Gordon (1983). As Blinder (1997, p. 14) notes, governments in these countries seem to have *"brought inflation down dramatically by purely discretionary policy decisions. As in the Nike commercial, they just did it"*. Note that this reasoning contradicts the time-inconsistency theory of monetary policy. 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) must be implemented to achieve low and stable inflation. However, 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.

On the other hand, CBI-reforms might be successful in lowering inflation in democratic countries characterized by a recent history of political instability. In these countries, a price stability rule might not be regarded as credible since the public does not trust the politicians. An institutional reform that delegates power from politicians to independent central bankers might therefore be necessary for establishing credibility for a low inflation goal.

Figure 1 About Here

The relationship between the degree of democracy and political stability in achieving low inflation is illustrated in Figure 1. To summarize, in democratic countries characterized by a history of political stability (e.g., Sweden), announcement of a price stability target might be sufficient to reduce inflation. This means that CBI-reforms are not necessary in order to achieve low and stable inflation. CBI-reforms are not efficient in less democratic countries (e.g., China and Zimbabwe) either since institutional reforms does not matter if laws are not fulfilled. However, in democratic countries characterized by a history of political instability (e.g., Brazil), CBI-reforms might be needed in order to establish credibility for a low-inflation rule. The hypothesis to be tested in the empirical section is thus whether CBI-reforms are most efficient in bringing down inflation in countries that can be characterized as democracies, but have a recent history of political instability.

3 Data and descriptive statistics

To investigate whether the level of democracy and history of political instability matter for the efficiency of CBI-reforms, information on the dates of when more independence formally was granted to the central banks is necessary. This information is available in the dataset obtained and previously used by Daunfeldt et al. (2008). To obtain the dates, Daunfeldt et al. (2008) sent an e-mail questionnaire to all (162) central banks listed in Morgan Stanley's *Central Bank Directory 2004*. The following questions were asked: (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 means that all legal reforms that reduced the influence of politicians on monetary policy making were defined as CBI-reforms, whereas a mere statement that price stability is the only goal of monetary policy was not regarded as sufficient. Thus, included in the definition were legal reforms that safe-guarded the low inflation goal in the legislation; reduced the possibility for government to override central bank decisions on operating targets; reduced governments opportunities to use central bank credits to finance budget deficits; reduced the possibility of dismissing central bank governors or increasing their term in office or their numbers; and so on.

Ninty-five central banks (59%) finally answered the questionnaire. Other sources (e.g., central bank publications, legislative acts, and scientific articles) were used to validate the e-mail answers and to obtain the years of CBI-reforms for countries that did not respond. The data on implementation years of CBI-reforms were then used to create a dummy variable ($DCBI$) that takes the value one if country i had implemented a CBI-reform. The final sample consists of 132 countries (81% of those initially contacted), of which 89 had implemented CBI-reforms. This shows that CBI-reforms have been one of the most significant trends in international politics during the last decades. The countries for which information on CBI-reforms is still missing, years when CBI-reforms occurred, and sources that were used to verify them can be found in Daunfeldt (2008, Table A1 and Table A2).

In this paper, we investigate the effect of CBI-reforms on inflation performance and whether CBI-reforms are more efficient in bringing down inflation in democratic countries characterized by a history of political instability.

Inflation (π) is measured by the annualized percentage change in consumer prices, from *IMF Financial Statistics*. In accordance with Campillo and Miron (1997), periods of hyperinflation was handled by omitting observations with yearly inflation in excess of 100%.²

To study whether the level of democracy and political stability is important for the efficacy of CBI-reform, countries are classified into a case and control group; where the former group (*DUNSTABLE_{it}*) consists of democratic countries that have a history of political instability. In our simplest definition (Model 8), our case group consist of countries that are classified as transition economies (*DTRANS*) according to IMF. Transition economies refers to all countries that change from a centrally planned economy towards a free market. Transition economies are often newly formed democracies that have a recent history of political instability. However, less democratic countries such as China is also included in this group.

Our other definitions of the case group are based on an interaction term between a democracy indicator and a political stability indicator.³ The interaction term takes the value one for countries that can be classified as democracies, but have a history of political instability. To create a dummy for countries that can be characterized as democracies, we use the democracy indices published by Freedom house (*DEMFH*) and Polity IV (*DEMPIV*). The scale for both indices ranges from 0-10, where 0 is least democratic and

²We have also tried to exclude observations with a yearly inflation in excess of 50%, 500%, and 1000%. All the results remain qualitively the same.

³All variables on the level of democracy and political stability that are used to create an indicator of political unstable democracies are obtained from the *Quality of Government Dataset* (Teorell et al., 2009). The reader is refered to this source for complete definitions of these variables.

10 most democratic. We use the imputed version of the Freedom House measure, which has imputed values for missing data (Hadenius and Teorell, 2005).

Political terror scales, published by Amnesty International (*TERROAI*) and the US State Department (*TERRORUS*)⁴, are used as measures of political stability in the empirical analysis. The terror scale ranges from 1-5, where 1 refers to countries under a secure rule of law (and 5 the opposite). The most recent regime change or the end of transition period defined by the lack of stable political institutions obtained from Polity IV (*REGDUR*) and the Hobbes index (*HOBBS*) are other measures that are used in the analysis to create indicators of political stability. The Hobbes index reflects an attempt to measure how far nations have come from the state of nature, i.e., a state where life is short, nasty, solitary, poor and brutish. The Hobbes index ranges from 0 to 100, where higher values indicate a longer distance from the state of nature. Note that the Hobbes index only exist until 1997 and that most CBI-reforms happened after that year.

The use of two indices of democracy and four measures of political stability in the empirical analysis, as well as our dummy for transition economies, makes it possible to test whether our results are sensitive for the choice of indicators. Definitions of all the variables included in the empirical analysis, as well as means and standard deviations, are given in Table 1.

Table 1 About here

In order to create an indicator variable that takes the value on if a cer-

⁴The data-set on political terror scale has been gathered by Gibney and Dalton (1996). See also: <http://www.politicalterroryscale.org>.

tain country can be classified as a political instable democracy, we need to define a cut-off point for what is considered to be a democratic and historically political unstable country. To identify whether a country can be regarded as democratic or not, we create two dummy variables (*DDEMPIV* and *DEMFH*) that takes the value one if the value for *DEMPIV* and *DEMFH* is above the mean. Countries that have values over 2 on the political terror scale indices are classified as political instable, i.e, these indicators (*DTERROAI*, and *DTERRORUS*) takes the value one if *TERROAI* and *TERRORUS* are equal or larger than 3. Countries that have a significant regime change in the last five years according to *REGDUR* are classified as political unstable, i.e., *DREGDUR* takes the value one in these cases, and zero otherwise. Finally, a dummy variable (*DHOBES*) for political instability is created by assigning a value of one when *HOBES* is lower than the mean.

The indicator variables for democracy and political stability are then interacted with each other to identify our case groups (Model 1-7) that consist of democratic countries with a recent history of political instability. Descriptive statistics for the eight case groups used in the analysis to identify political unstable democracies are presented in Table 2.

Table 2 About here

4 Empirical Model and Estimation Results

Mainly two approaches have been used to study the effects of CBI on inflation. The first approach has been to create indices reflecting the degree of

CBI, which then are used to study the relationship between inflation and the level of CBI (e.g. Alesina, 1988; Grilli et al., 1991; Cukierman et al., 1992; Alesina and Summers, 1993; Campillo and Miron, 1997; and Eijffinger et al., 1998). These indices of CBI have, however, been criticized for being arbitrarily constructed (e.g. Forder, 1996, 1998; Mangano, 1998). The second approach has been to assign a value of one to an indicator variable when a country has made a sufficiently large CBI-reform (e.g. Daunfeldt and de Luna, 2008; Landström, 2009). This approach has the drawback, however, that two very different reforms could both be assigned the value one, and thus treated as being equal in the estimations. To account for the heterogeneity in the effects of CBI-reforms on inflation levels, we use an alternative estimation strategy in this paper.

The following equation will be estimated:

$$\begin{aligned} \pi_{it} = & \beta_0 + \beta_1 DCBI_{it} + \beta_2 DUNSTABLE_{it} \\ & + \beta_3 (DCBI_{it} * DUNSTABLE_{it}) + \sum_{t=4}^{26} \beta_t t + u_{it}, \end{aligned} \quad (1)$$

where π_{it} represents the inflation rate in country i at time t ⁵, $DCBI_{it}$ is a indicator variable taking the value one after a central bank independence reform has been implemented, $DUNSTABLE_{it}$ is an indicator variable equal

⁵As commonly done in studies of how central bank independence reforms have affected inflation (e.g. Campillo and Miron, 1997), we use a cut-off point to avoid including hyperinflations in the dataset. The results presented in the paper uses a cut-off of 100 percent inflation per year. However, cut-off points equal to 50, 250 and 1000 percent have also been tested. All results remain qualitative the same. The results from these estimations are available from the authors upon request.

to one if country i can be classified as a political unstable democracy. An interaction term between these two variables, $DCBI_{it} * DUNSTABLE_{it}$, has been included to investigate if CBI-reforms are more efficient in bringing down inflation, as expected, in democracies characterized by a recent history of political instability.⁶ Finally, t are time specific fixed effects, and u_{it} is the residual term. The time specific fixed effects are included to capture time-variant heterogeneity in inflation rates (due to, for example, business-cycle movements, time-trends in inflation levels, etc.).⁷

The residual (or heterogeneity) term is specified as

$$u_{it} = v_i + \gamma_i DCBI_{it} + \varepsilon_{it} \quad (2)$$

where $v_i \sim iid N(0, \sigma_v^2)$ is a country specific random effect, $\gamma_i \sim iid N(0, \sigma_\gamma^2)$ is a country specific random coefficient term related to the indicator variable for CBI-reforms, and $\varepsilon_{it} \sim iid N(0, \sigma_\varepsilon^2)$ is the within country residual.⁸ The specific random effects are assumed independent of each other, and the model to be estimated can thus be written

⁶We treat the indicator variable for the introduction of central bank independence reforms as exogenous, as we also do with the indicator variable for unstable democracies. For a discussion regarding the effects of potential endogeneity on the results presented in the paper, see appendix 2.

⁷One could consider other potential covariates such as money supply, GDP, unemployment, etc. However, using these variables introduces econometric problems. First, these variables are plagued by measurement errors and missing data, which is especially apparent when studying developing economies. Second, these variables are endogenous in the sense that they will be correlated with the error term of the regression. Instead of including these problematic covariates, we opt for using a random effects, random coefficient model to account for heterogeneity between countries in both average inflation levels and the effects of CBI-reforms on inflation

⁸Tests for autocorrelation and groupwise heteroskedasticity have been performed (for a discussion, see appendix 1). These tests did not reveal any serious problems with either autocorrelation or heteroskedasticity.

$$\begin{aligned} \pi_{it} = & \beta_0 + v_i + (\gamma_i + \beta_1)DCBI + \beta_2DUNSTABLE_{it} & (3) \\ & + \beta_3(DCBI_{it} * DUNSTABLE_{it}) + \sum_{t=4}^{26} \beta_t t + \varepsilon_{it} \end{aligned}$$

The main advantages of this type of model is that it accounts for country specific unobserved heterogeneity in inflation levels, while also allowing for unobserved heterogeneity in the effects of CBI-reforms on inflation levels. Such heterogeneity in the effects of CBI-reforms on inflation levels could for example be due to differences in the design and the magnitude of the reform, the competence of the board of directors in the central banks, external shocks to the economy, etc. This estimation strategy thus addresses the potential problems with the estimation strategies previously used when studying the effects of CBI-reforms.

Note that there is still some subjectivity involved in defining which countries should be included in our case group ($DUNSTABLE_{it}$) of political unstable democracies. We therefore use eight different (Model I - Model VIII) definitions (for a detailed description of the different definitions, see Section 3) and the results from the estimations are presented in Table 3.⁹

Table 3 About Here

In seven out of eight estimated model specifications, the parameter es-

⁹Since the results presented in this paper could be due to the use of the different indexes when creating the dummy variables for political unstable democracies, extensive sensitivity testing has been performed. In the sensitivity tests, the chosen cut-off points in the democracy and stability indexes have been increased/decreased by one standard deviation and the regressions estimated with these new variables. The results show that... These estimations are available from the authors upon request.

timate for the introduction of CBI-reforms, β_1 , is negative and statistically significant at the five percent level. This suggests that the introduction of CBI-reforms does lower average inflation in the affected countries, something that has been debated in previous literature (for overviews, see e.g., Berger et al., 2001; Hayo and Hefeker, 2002). The reduction in inflation due to the CBI-reforms lies between 3.95 and 4.68 percent. However, the estimated random coefficient term also show that there is considerable heterogeneity among countries when it comes to the effect of CBI-reforms (this will be discussed more in detail below). Finally, the time specific fixed effects show a clear trend of reduced inflation during the study period. The results should thus be interpreted as the effects of the CBI-reforms, while holding the apparent time trend in inflation rates constant.

Turning to the results for the political unstable democratic countries, the parameter estimate for $DUNSTABLE_{it}$, β_2 , show that these countries, on average, have higher inflation rates than other countries during the study period. In six out of eight estimated specifications, the parameter estimate for β_2 is significant on the 5 percent level, and in one specification it is significant on the 10 percent level. The size of the effect varies somewhat depending on specification, but lies between 1.90 and 7.02 percent.

Finally, the parameter estimate for the interaction term between CBI-reforms and political unstable democracies show that CBI-reforms have, in four out of eight estimated specifications, a negative and statistically significant correlation with the level of inflation. In all other specifications the sign of the effects of the reform is negative, but not significant at conventional levels. The size of the effect of the introduction of a CBI-reform is, on

average, between 3.17 and 4.54 percent higher in political unstable democracies as compared to other countries, suggesting that the greatest gain of CBI-reform is in democratic countries characterized by a recent history of political instability.

It should also be noted that the variance components for both random effects and random coefficients are statistically significant in all estimated models, indicating that not including these in the estimations would lead to biased parameter estimates. Using the estimates of the random effects and random coefficient terms, we can also calculate an interval within which 95% of the estimated coefficients related to the introduction of CBI-reforms in different countries, $(\gamma_i + \beta_2)$, are expected to lie (Rabe-Hesketh and Skrondal, 2008, p. 159). This will be useful in order to investigate if there are countries where CBI-reforms have actually been correlated with an increase in inflation rates. The results from these calculations for the eight different specifications are presented in Table 4.

Table 4 About Here

The results show that a CBI-reform, on average, corresponds to a reduction in inflation with between 3.95 and 4.68 percentage points, but also that several examples can be found in our data where the introduction of a CBI-reform has been correlated to an increase in inflation, *cet par*. This result could have a number of explanations, for example that the reform is correlated in time with some exogenous inflation shock. It could also be that the reform (or the management of the reform) was insufficient to affect the underlying problems causing inflation such as, for example, budget deficit

spending of the government.

5 Conclusions

One of most significant trends in international politics during the last decades is the dramatic increase in CBI. The underlying idea behind this policy development is that CBI-reforms are believed to solve the time-inconsistency problem of monetary policy (Kydland and Prescott, 1977; Barro and Gordon, 1983), and thereby contribute to lower inflation rates (Rogoff, 1985). A number of previous empirical studies (Alesina, 1988; Grilli et al., 1991; Cukierman et al., 1992; Alesina and Summers, 1993; Jonsson, 1995; and Eijffinger et al., 1998) have supported this hypothesis. These empirical studies have, however, been criticized since correlation analysis is not sufficient for establishing a causal relationship between variables and that a variable that is omitted from the model can cause both CBI and low inflation (Posen, 1993; Campillo and Miron, 1997; Hayo, 1998). Forder (1996, 1998) and Mangano (1998) have also showed that a lot of subjectivity is involved in interpreting the level of CBI, and that the results seem sensitive for small and plausible changes in the CBI-indicies.

Daunfeldt and de Luna (2008) and Landström (2009) focused on possible changes in the legal independence of the central banks, instead on the level of CBI. This approach has the advantage, as the reforms by definition have increased CBI, that the subjectivity that plagues the most commonly used indicies of CBI is reduced. One problem, however, is that two very different CBI-reforms will be treated equally in the empirical analysis.

The purpose of this paper has been to study whether CBI-reforms have reduced inflation rates using a random effect and random coefficient model that accounts for country specific unobserved heterogeneity in inflation levels, as well as unobserved heterogeneity in the effects of CBI-reforms on inflation levels. The analysis is based on a novel data-set compiled by Daunfeldt et al. (2008), covering the possible occurrence of CBI-reforms in 132 countries. The study should be seen as the first attempt to empirically test whether the efficiency of CBI-reforms in achieving low inflation might depend on the interplay between the level of democracy and political stability

It is argued that CBI-reforms will not matter in totalitarian countries, regardless of the level of political stability, since the reforms does not reflect actual independence. On the other hand, in democratic countries characterized by a high degree of political stability, politicians might not need to implement CBI-reforms. The reason is that the public trust the politicians, implying that a mere statement that price stability is the only goal for the monetary policy might be sufficient in order to establish credibility for a low inflation goal. Politicians in these countries might instead implement CBI-reforms when price stability is achieved to tie the hands of incoming governments that might have different preferences regarding the inflation-unemployment trade-off (Cukierman, 1994). Thus, the greatest gains of CBI-reforms might be in democracies characterized by a recent history of political stability because these countries need to implement institutional reforms that delegates power from politicians in order to establish credibility for a low inflation goal.

The results presented in the paper indicated that CBI-reforms, on av-

erage, have been efficient in bringing down inflation, supporting the implications of the time-inconsistency theory of monetary policy. The reduction in inflation due to the CBI-reforms ranges between 3.95 and 4.68 percent. Note, however, that the results also indicated that there was considerable heterogeneity among countries when it comes to the effect of CBI-reforms. The hypothesis that CBI-reforms are more efficient in bringing down inflation rates in political unstable democracies was also supported by the data. The results indicated that CBI-reforms, on average, reduced inflation with 3.17 to 4.54 percentage more in political unstable democracies compared to other countries.

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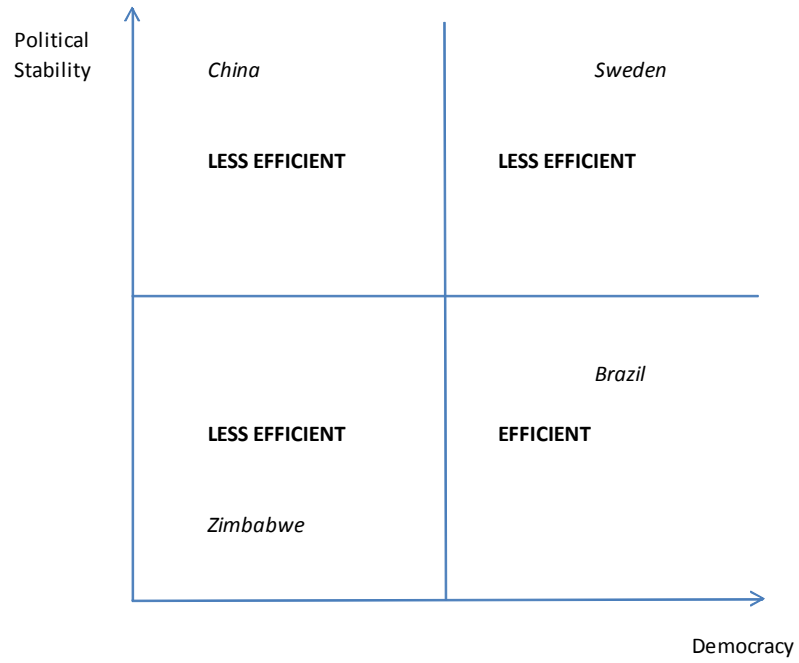


Figure 1: The efficiency of CBI-reforms in bringing down inflation

Table 1: Means, standard deviations, definitions and sources of variables

Variable	Mean (SD)	Definition
π	11.55 (15.34)	Annual percentage change in consumer prices. Source: IMF Financial Statistics
<i>DCBI</i>	0.23 (0.42)	Dummy, equal to one if country i has implemented a CBI-reform. Source: Daunfeldt et al. (2008)
<i>DTRANS</i>	0.12 (0.33)	Dummy, equal to one if country i is classified as a transition economy. Source: IMF
<i>TERRORAI</i>	2.61 (1.10)	A five grade schale where 1 indicates that the country has a secure rule of law, whereas 5 indicates the opposite. Source: Amnesty International.
<i>TERRORUS</i>	2.21 (1.12)	A five grade schale where 1 indicates that the country has a secure rule of law, whereas 5 indicates the opposite. Source: US State Department.
<i>REGDUR</i>	26.45 (32.48)	The number of years since the most recent regime change or the end of transition period defined by the lack of stable instiutions. Source: Polity IV.
<i>DEMPIV</i>	5.66 (4.10)	An additive eleven-point scale (0-10), where 0 indicates a low level of democracy. Source: Polity IV.
<i>DEMFH</i>	6.50 (3.25)	An additive eleven-point scale (0-10), where 0 indicates a low level of democracy. Source: Freedom house
<i>HOBBS</i>	68.21 19.44	Ranges from 0 to 100, where 100 is the longest distance from the state of nature. Source: Bueno de Mesquita et al., 2003

Table 2: Descriptive statistics for the different case groups. The terms takes the value one when countries can be classified as political unstable democracies.

Model	Variable	Mean	s.d.	N
1	<i>DDEMFH * DTERRORUS</i>	0.15	0.36	2821
2	<i>DDEMFH * DTERRORAI</i>	0.26	0.44	2292
3	<i>DDEMFH * DREGDUR</i>	0.12	0.32	2533
4	<i>DDEMPIV * DREGDUR</i>	0.11	0.31	2664
5	<i>DDEMPIV * DTERRORAI</i>	0.19	0.39	2345
6	<i>DDEMPIV * DTERRORUS</i>	0.15	0.35	2853
7	<i>DDEMFH * DHOBBS</i>			1823
8	<i>DTRANS</i>	0.12	0.33	2965

Table 3: Estimation results.

Parameter	Model 1		Model 2		Model 3		Model 4	
	Estimate	S.e.	Estimate	S.e.	Estimate	S.e.	Estimate	S.e.
β_0	19.57**	1.59	18.53**	1.85	18.95**	1.71	19.18**	1.62
β_1	-3.95**	1.53	-4.07**	1.70	-4.17**	1.58	-4.25**	1.58
β_2	4.09**	1.11	2.85**	1.15	4.12**	0.96	4.03**	0.93
β_3	-3.67**	1.84	-4.54**	1.84	-4.30**	1.90	-3.17**	1.95
Random effect/random coefficient parameters (variable)								
v_i	12.48**	0.87	12.98**	0.93	12.70**	0.94	12.60**	0.90
γ_i	11.22**	1.13	11.60**	1.24	11.34**	1.19	11.38**	1.19
Log-likelihood		-11011		-9041		-9899		-10394
Observations		2821		2292		2533		2664
Countries		130		129		117		124
Parameter (variables)	Model 5		Model 6		Model 7		Model 8	
	Estimate	S.e.	Estimate	S.e.	Estimate	S.e.	Estimate	S.e.
β_0	18.98**	1.77	19.70**	1.58	19.35**	1.65	18.46**	1.60
β_1	-4.68**	1.69	-4.41**	1.53	-2.73	2.31	-4.20**	1.58
β_2	1.04	1.08	1.90*	1.04	5.89**	1.48	7.02**	2.96
β_3	-2.35	1.84	-1.36	1.85	-6.62	4.49	-2.85	3.51
Random effect/random coefficient parameters (variable)								
v_i	13.05**	0.93	12.65**	0.88	12.07**	0.88	12.34**	0.86
γ_i	11.60**	1.25	11.31**	1.14	12.26**	1.79	11.11**	1.12
Log-likelihood		-9241		-11129		-7242		-11554
Observations		2345		2853		1823		2965
Countries		130		130		124		131

** Significant at the 5 percent level. * Significant at the 10 percent level. Time specific fixed effects left out in order to save space.

Table 4: Confidence interval, $\gamma_i + \beta_1$

Model	β_1	95% C.I.	
Model 1	-3.95**	-25.94	18.04
Model 2	-4.07**	-26.81	18.67
Model 3	-4.17**	-26.40	18.06
Model 4	-4.25**	-26.55	18.05
Model 5	-4.68**	-27.42	18.06
Model 6	-4.41**	-26.58	17.76
Model 7	-2.73	-26.76	21.30
Model 8	-4.20**	-25.98	17.58

Appendix 1. Autocorrelation and heteroskedasticity tests

We test for autocorrelation by regressing the residual on lagged values of the residual (4 lags) and all other independent variables used in the original estimations. The results show that there is a statistically significant parameter estimate for the first lag of the residual for all eight specifications, but also that the parameter estimates of the autocorrelation coefficient lie between 0.0023 and 0.15. As such, no adjustment for autocorrelation has been made in the specifications estimated and presented in this paper, although we have also tried estimating the model including the one year lag of the inflation rate. This removes the statistically significant autocorrelation without changing any of the results presented in this paper.

We test for groupwise heteroskedasticity by regressing the residual on fixed effects for the different nations and test the significance of the overall equation using an F-test. The test suggest that there is remaining heteroskedasticity, but a closer inspection show that this is related to significant parameter estimates of the fixed effects for three countries (Bolivia, Nicaragua and Peru). Removing these countries from the estimations does not affect the results presented in this paper except for model 1 where the interaction term became significant on the 10 percent level instead of the 5 percent level, and thus we choose to keep them in the dataset used in the estimations. The estimation results from these tests are available from the authors upon request.

Appendix 2. Potential endogeneity in the indicator variables

As mentioned in the paper, we treat the indicator variables for the introduction of CBI-reforms, unstable democracies and the interaction term between these two variables as exogenous in the estimations performed in the paper. The reason for this is twofold. First, we have not been able to find any instruments that we consider to be highly correlated to the potentially endogenous variables but uncorrelated with the error term of the regression equation. Second, using instrumental variable techniques when the variables to be instrumented are dichotomous variables is not straight forward (for a thorough discussion about this see Heckman et al., 2006) Angrist and XX, 2009, p XXX). **Vi kan även referera till följande artikel: .**

Instead we choose to discuss how potential endogeneity would affect the estimation results presented in the paper. First, if the indicator variable for the introduction of CBI-reforms is endogenous, we would expect the estimators related to this variable to be positively biased. That is, we expect the estimates related to this variable to be less negative than the true values. The reason is that, since we have included country specific effects, the parameter estimates for β_1 measures how CBI-reforms have affected the inflation development within countries. As such, if countries that introduced reforms otherwise would have had a higher increase (or a lower decrease) in inflation than other counties, the expected bias for β_1 is positive, that is, the true effect of the reforms are likely more negative than those reported in the paper.

The indicator variable for unstable democracies are created using indices that do not directly depend on inflation, so there is no direct source for reversed causality for this variable. Still, the indices are based on variables such as politicians ability to create seignorage which might depend on expected inflation development. Thus, the estimators for β_2 might suffer from some endogeneity bias and the estimates for β_2 should therefore be interpreted with some caution.

Potential bias in the estimators for the indicator variables for CBI-reforms and unstable democracies, do not cause bias in the estimator for the interaction term between these two (β_3), given that there is no interaction effect between the sources of biases for these two variables. This follows from the Frisch-Waugh Theorem which in this context means that the same estimate for β_3 obtained by estimating equation (3) or by regressing π_{it}^* on $(DCBI_{it} * DUNSTABLE_{it})^*$, where π_{it}^* and $(DCBI_{it} * DUNSTABLE_{it})^*$ are residual vectors from regressing π_{it} and $(DCBI_{it} * DUNSTABLE_{it})$ on all explanatory variables of equation (3) except $(DCBI_{it} * DUNSTABLE_{it})$ (Greene, 2003, Chapter 3; Frisch and Waugh, 1933). π_{it}^* will equal a function of $(DCBI_{it} * DUNSTABLE_{it})$ plus an error term, which by construction will be uncorrelated with both $DCBI$ and $DUNSTABLE$. Therefore, regressing π_{it}^* on $(DCBI_{it} * DUNSTABLE_{it})^*$ or estimating equation (3) will both provide us with the same unbiased estimate of β_3 , given that there is no interaction effect between the sources of biases. If there are interaction effects between the sources of biases, that is, if the indices used when creating the indicator for unstable democracies systematically are more or less endogenous for countries introducing CBI-reforms or if the introduc-

tions of CBI-reforms systematically are more or less endogenous for unstable democracies, the estimators for β_3 could be biased. We see no reason for such interactions between the sources of biases and therefore argue that the expected bias for β_3 is zero.