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Ansgar Belke
Andreas Freytag
Jonas Keil
Friedrich Schneider

The Credibility of Monetary Policy Announcements

Empirical Evidence for OECD Countries since the 1960s

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Technische Universität Dortmund, Department of Economic and Social Sciences
Vogelpothsweg 87, 44227 Dortmund, Germany

Universität Duisburg-Essen, Department of Economics
Universitätsstr. 12, 45117 Essen, Germany

Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)
Hohenzollernstr. 1-3, 45128 Essen, Germany

Editors

Prof. Dr. Thomas K. Bauer
RUB, Department of Economics, Empirical Economics
Phone: +49 (0) 234/3 22 83 41, e-mail: thomas.bauer@rub.de

Prof. Dr. Wolfgang Leininger
Technische Universität Dortmund, Department of Economic and Social Sciences
Economics – Microeconomics
Phone: +49 (0) 231/7 55-3297, email: W.Leininger@wiso.uni-dortmund.de

Prof. Dr. Volker Clausen
University of Duisburg-Essen, Department of Economics
International Economics
Phone: +49 (0) 201/1 83-3655, e-mail: vclausen@vwl.uni-due.de

Prof. Dr. Christoph M. Schmidt
RWI, Phone: +49 (0) 201/81 49-227, e-mail: christoph.schmidt@rwi-essen.de

Editorial Office

Joachim Schmidt
RWI, Phone: +49 (0) 201/81 49-292, e-mail: joachim.schmidt@rwi-essen.de

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Ansgar Belke, Andreas Freytag, Jonas Keil,
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The Credibility of Monetary Policy Announcements – Empirical Evidence for OECD Countries since the 1960s

Abstract

Monetary policy rules have been considered as fundamental protection against inflation. However, empirical evidence for a correlation between rules and inflation is relatively weak. In this paper, we first discuss likely causes for this weak link and present the argument that monetary commitment is not credible in itself. It can grant price stability best if it is backed by an adequate assignment of economic policy. An empirical assessment based on panel data covering five decades and 22 OECD countries confirms the crucial role of a credibly backed monetary commitment to price stability.

JEL Classification: E31, E50, E52

Keywords: Credibility; central bank independence; price stability; monetary commitment

July 2012

1 Ansgar Belke, University of Duisburg-Essen and IZA Bonn; Andreas Freytag, Friedrich-Schiller-University Jena; Jonas Keil, University of Duisburg-Essen; Friedrich Schneider, Johannes-Kepler-University Linz. *– We gratefully acknowledge helpful comments by Sylvester Eijffinger, by seminar participants at CentER, Tilburg, in November 2009 and at University of Duisburg-Essen in July 2011 and by participants of the WEAI Annual Conference, San Francisco, in July 2012.* *– All correspondence to: Ansgar Belke, University of Duisburg-Essen, Faculty of Economics, Universitätsstr. 12, 45117 Essen, Germany, E-Mail: : ansgar.belke@uni-due.de.*

1. Introduction

In the last two decades, there has been low inflation in many countries and a widespread consensus among policymakers, central bankers as well as economists about the virtues of price stability and the need for the independence of central banks from daily politics. However, latest developments in the Eurozone have put this consensus into question and have casts doubt about future low inflation policies. Recent measures of the ECB to finance – albeit indirectly – public debt raise fears that price stability in the Eurozone is under threat which could have negative consequences for both growth and distribution. The history of central banking indeed shows that the political pressure on central banks to accommodate fiscal needs increases in times of fiscal problems. Wood (2005, p.6) has put it as follows: "In any case, monetary policy is at bottom a political decision."

Against this background, the question of what institutional arrangement is best equipped to prevent inflation, is again emerging; this time not only in the developing world, but also in Europe and the United States. To approach an answer to this question, it seems worth to take a look at the development of the inflation rate in OECD countries since the 1960s. The drivers of inflation in the developed world have to be identified. A focus will lie upon the institutional setting that governs the relation between central banks, governments and the public. In particular, it is necessary to inspect aspects of reputation and credibility more closely.

Why is the analysis of credibility so important? Despite the parallel developments of world-wide decreasing inflation and an increasing central bank independence (CBI), the direct statistical relationship between legal CBI and price stability is surprisingly weak, at least when calculated for both developing and developed countries (Klomp and de Haan 2010; Arnone et al. 2006a and 2006b). It is even more doubtful whether the observed correlation also reflects a causal relationship from high CBI to low inflation (e.g. Berger et al. 2001).

Recent contributions to the literature treat central bank independence as endogenous and the result of political interests (e.g. Crowe and Meade 2007). If this view is correct, the role of monetary policy rules has to be thought through

again. It seems insufficient and myopic to trace back inflation exclusively to political commitment to a certain monetary policy framework. Instead, the focus has to be shifted towards the question of what makes a monetary policy rule credible. Thus, we first discuss briefly several aspects of monetary commitment, including central bank independence, governance, transparency and accountability. We argue that none of these concepts is sufficient to explain the inflation rate. For this purpose, a workable enforcement mechanism must be established. We discuss the question how a central bank can build up reputation and make its announcements credible first theoretically before we test the evidence for OECD countries in five decades. We suggest that the price level and its developments are the result of monetary policy rules as well as of other relevant variables, both institutional and macroeconomic ones. Beside the important role of the institutional setting, fiscal stability seems relevant. Jointly, these variables determine the credibility of monetary policy and thereby have an influence on the performance, i.e. the inflation rate.

The remainder of this paper is organized as follows. In section 2, we present a discussion of different institutional aspects of monetary policy. Section 3 is dedicated to credibility of monetary policy rules. We derive hypotheses on the effects of monetary policy commitment and monetary policy credibility on inflation performance. In section 4, the variables and data are introduced. The empirical assessment of the hypotheses for two samples of OECD countries over five decades is presented and discussed in section 5. Conclusions in section 6 round off the paper.

2. Institutional set-up of monetary policy

Monetary policy rules and the position of the central bank in the policy assignment have been discussed in the literature extensively for about 50 years. Although a widespread common belief that monetary policy should be rule-bound and that central banks should be granted independence (CBI) has been developed over time, there is still controversy about details and about empirical evidence. Basic contributions to the field have been made by different schools of thought. Friedman (1969) suggested a strict *k*-rule for monetary policy. Brennan and Buchanan (1981) as well as Hetzel (1997) argue with multiple principal-agent

problems between the public as principal and the government as well as monetary policymakers as agents (McCallum 1997). This justifies defining monetary commitment as a constitutional decision. This view is strengthened by the neoclassical approach as put forward among others by Kydland and Prescott (1977) as well as Barro and Gordon (1983). The basic institutional setting to solve the principal agent problem is to grant the central bank political independence (CBI) from the government. CBI implies that the central bank is given a constitution defining goals (instrument independence, Debelle and Fischer 1995), giving the bank an organisational structure, restricting the influence of government and prohibiting credit from the central bank to the government. Thus defined CBI is measured as the simple sum or as a weighted or unweighted average respectively of the various properties of central bank legislation (e.g. Parkin and Bade 1977, Grilli, Masciandaro and Tabellini 1991, Cukierman 1992 respectively).

However, the literature on CBI does not prove a strong and robust relationship between CBI and price stability. First, the empirical evidence is not clear despite much evidence for a positive correlation between CBI sand price stability (Klomp and de Haan 2010; Arnone et al. 2006a). It seems that heterogeneity with respect to the development level of countries plays a major role. In those countries where the rule of law is generally accepted, the legal status of the central bank is decisive for the success of its policy. By contrast, for developing and transition countries, this relation is not that robust. Legal measures of CBI do not indicate a strong impact on inflation. The only significant negative correlation can be found between de-facto CBI measured as turnover rate of central banks' CEOs and inflation (Crowe and Meade 2007, Jácome and Vázquez 2008, Siklos 2008). This result cannot be satisfying, as both the turnover rate and inflation may be caused by the same exogenous variable.

Second, Forder (1996) argues that the concept of statute reading to identify the "true" independence of a central bank is methodologically flawed, as it gives no credit to informal rules and to actual behaviour. For instance, the central bank's ability to conduct monetary policy may be limited despite a high degree of CBI due to exchange rate regimes set up by the government. He also claims that the

statute of a central bank does not allow assessing the government's commitment to stability.

These criticisms triggered a number of attempts to broaden the analysis by highlighting the role of transparency and accountability of central banks (de Haan, Eijffinger and Waller 2005, chapter 4). In their analysis, they define transparency as the extent to which the central bank informs the public about their objectives (political disclosure), the economic data on which the bank bases its policy (economic disclosure), procedures within the bank (procedural disclosure), its decision (policy disclosure) and the implementation of policies (operational disclosure). These elements form the basis of an indicator of transparency, which raises the credibility of policy announcements. Similarly, de Haan, Eijffinger and Waller (2005, pp. 108ff.), connect the concept of accountability to responsibility. Is the central bank accountable to the public? How transparent is it? Who is finally responsible for the policy actions taken by the bank? Again, they suggest an indicator.

All indicators used in the literature are referring to the same observations. They just mix them differently, depending on the special question the respective authors want to answer. For our problem, we need a comprehensive indicator which tries to combine independence, accountability and transparency. Such an indicator has been constructed by Freytag (2001) with the indicator of monetary commitment (MOC).

Table 1: Elements of commitment to price stability

Criterion	CBI	Transparency	Accountability	MOC
Legal status				X
Policy objective	X	X	X	X
Policy explanation		X	X	X
Procedural disclosure		X	X	X
Economic disclosure		X	X	X
Operational disclosure		X	X	X
Policy formulation	X	X	X	X
Regulation/ supervision				X
Gov. competencies	X			X
CEO (App. and Diss.)	X		X	X
Lending to government	X		X	X
External pledge				X
Convertibility				X
Other currencies				X

Source: Own compilation based on Cukierman (1992), de Haan, Eijffinger and Waller (2005) and Freytag (2001).

The basic idea of this index is that only the government can commit to stability because as the agent of the voter it can solve the principal-agent problem by delegating the task to pursue monetary policy to a central bank. By doing so, it should make clear that the central bank is independent, accountable and transparent. Otherwise another principal-agent-problem between government and central bank evolves; which will of course be also one between central bank and public. A central bank constitution should clarify

- the objectives of central banking,
- the relation of the central bank to the government and other political actors,
- the relations of the central bank to the public, and
- the limits of power and the organizations the central bank is answerable to.

In summary, several strands of the literature discuss different aspects of central banking, which are independence from daily politics, accountability with the public, transparency with respect to actions and governance problems within central banks. The aspects covered by the different concepts are summarised in Table 1.

3. Commitment, reputation and credibility

There are several political economy arguments to assume that monetary commitment by the government may not be sufficient to guarantee price stability. The first one is based on the well-known rules versus discretion approach itself (basic: Kydland and Prescott 1977). They emphasize the importance of an enforcement mechanism to secure that an optimal policy announcement is realized because policymakers might be subject to time inconsistency. Once the public has adjusted to the announcement and concluded contracts, the optimal plan no longer may be optimal. If policymakers follow several goals simultaneously, a new mix is optimal. In the medium to long run, a new announcement is no longer credible. The government's reputation is foregone. In short: commitment without an enforcement mechanism is not sufficient meeting an objective.

For monetary policy, it is generally acknowledged that low inflation is an optimal policy even if the government can increase employment in the short run (and probably only in the short run). From a political perspective, the government may otherwise be tempted to create an upswing in the business cycle e.g. prior to elections (Hibbs 1977, Nordhaus 1975). The direct real effects of a political business cycle are zero. In the longer run, the increase in inflation even has negative consequences on growth (Barro 1995), which presents a strong economic rationale for separating the objective of price stability from other policy objectives. Therefore, it is sensible to enforce the commitment to stability.

A second argument is claiming that central bank independence itself is critically depending on the government's readiness to accept its political consequences. In other words it is endogenous in the long run. Wood (2005) has shown that both the Federal Reserve System and the Bank of England have experienced periods of high independence as well as times of higher dependence from the government, depending on the fiscal situation. Crowe and Meade (2007) argue that the call for transparency and accountability may well be interpreted as a public response to higher CBI. Besides the government, there may be other relevant actors. Posen (1993) argues that the financial sector is able to influence both the degree of central bank independence and inflation; its dislike of inflation causes both. Similarly, Hayo (1998) as well as de Jong (2002) argue that cultural aspects can exert pressure on the government to grant CBI and to keep inflation low.

One important conclusion of this reasoning is that monetary commitment by the government, whether measured as central bank independence, its accountability, transparency or even comprehensively must not be confused with credibility. Credibility of a policy is only given if the public has trust in the respective legislation, in other words if the problem of asymmetric information is minimized. Therefore, we first argue that governmental commitment to monetary stability can raise credibility of monetary policy and guarantee price stability only if it is interpreted as part of the policy assignment. This implies that the number of policy objectives equals the number of policy instruments (Tinbergen 1952) and that the single components of economic policy are compatible with each other, in other words that a consistent economic order exists (Eucken 1955). Only then, monetary policy can be pursued fully concentrated on the objective of price

stability. To ensure the adequate consideration of the policy assignment, not only formal economic policy rules are included, but also informal institutions, which exert influence on the outcome of monetary policy. Following this view, CBI is one of several important policy institutions necessary to secure price stability. The notion that institutional constraints are important for the effectiveness of policy rules has been increasingly considered in the literature in recent years (e.g. Keefer and Stasavage 2001, Freytag 2005[1]). In addition to this, the effects of a legal or constitutional policy rule are dependent on other macroeconomic factors. These have also to be taken into account.

Second and related, if monetary commitment is not compatible with the general institutional setting or governance structure, it cannot be expected that the government takes this commitment seriously and adheres to it. The government might rather deviate from its commitment due to short-term political necessities. If high CBI – on the other hand – is embedded in institutional constraints for the government, e.g. fiscal rules, economic freedom, freedom to export capital as well as to import goods and services and the like, the public can observe policies better. Thus, it may be more difficult for governments to give up monetary policy rules. They are more credible.

Third, credibility of a policy depends on the reputation of the responsible agency and thus needs a track record (Siklos 2008). A central bank that is granted CBI needs some time to prove the ability to perform monetary policy, the legal rule is not enough. After some time, the public has acquired experiences with the central bank and can judge the credibility of the policy announcements. The distribution of information is thus more symmetric. However, this form of reputation must not be mixed with credibility. The latter applies to an announcement whereas the former can be gained by an organisation. Both reputation and credibility are difficult to measure. Neither is just a look at past performance; this can only partly be used to judge announcements and policies directed into the future. Therefore, no indicator of a central bank's reputation exists,[2] and ex-post measures of

[1] The author shows for a sample of 29 countries, which pursued a monetary reform, that a high degree of monetary commitment is credible only jointly with an according policy assignment.

[2] The German Bundesbank had a high reputation. Monetary policy objectives were generally trusted despite the fact that in several years the Bundesbank missed the monetary objectives.

credibility, i.e. macroeconomic developments of the past as such are no good predictor of future performance (Mastroberardino 1994, pp. 72ff). In fact, they are no ideal indicators of credibility because they cannot predict a break.

Given these difficulties, we define credibility as a combination of monetary commitment, other institutional factors that constrain the discretionary power of governments and some experience with past performance of monetary policy. For the technical analysis, we further restrict ourselves to an interaction term of measures of CBI and MOC respectively and an indicator of institutions, which in this case is the index of economic freedom (Gwartney, Hall and Lawson 2011).

The theoretical considerations suggest the following two hypotheses with respect to the correlation of central bank independence and inflation:

Hypothesis 1: In OECD countries inflation is the lower, the higher the degree of monetary commitment, the degree of fiscal stability, the degree of openness, the flexibility of labour markets and the inflation culture.

Hypothesis 1 refers to the economic rationality of economic policymaking. An adequate neo-classical policy assignment allows for price stability as other objectives are assigned own instruments.

Hypothesis 2: In OECD countries inflation is negatively correlated with the degree of credibility, defined as an interaction between institutional constraints and the index of monetary commitment.

Hypothesis 2 is directed at the political rationality of economic policymaking. If the public – having rational expectations – is convinced about the adequacy of the assignment and the sincerity of the government's announcements, its plans will give reasons for time consistent policy.

4. Data and econometric method

A crucial topic is the measurement of commitment. In general, it is measured as the weighted average of criteria assessing the relation between government and central bank with respect to monetary policy. Throughout this paper, we use both

Its reputation caused the public to accept all explanations for any deviations from the announced and planned figures. For a general judgement of the Bundesbank, its reputation and the drivers of the latter see Marsh (1992).

the indicator of central bank independence LVAU constructed by Cukierman (1992) and a comprehensive concept of monetary commitment (MOC) which includes all components of conventional measures of CBI (in particular: Cukierman 1992, pp. 371-378), the central bank's accountability as well as external aspects of commitment, namely the exchange rate regime, convertibility restrictions, completive elements in monetary policy and the question of who decides on exchange rate policy (Freytag 2001).[3] For both indicators, the coding is restricted between 0 and 1, with higher values referring to a higher degree of CBI or commitment, respectively.

Next, we need to identify those (formal and informal) components of economic order that contribute to the credibility of monetary policy commitment and the discussion of the way in which these components are connected to monetary policy. We argue that these institutions are well covered by the index of economic freedom (EF) (Gwartney, Hall and Lawson 2011). This index consists of 5 groups:

(1) Size of government, including information about government consumption, subsidies and taxes.

(2) Legal system, consisting of information about property rights, judiciary independence, impartial courts, intellectual property rights, the role of military in politics and general acceptance of the law.

(3) Monetary soundness. This group is disregarded in our analysis as our aim is to capture the effect of economic freedom on monetary soundness, i.e. inflation.

(4) Freedom to trade with foreigners, including information about barriers to trade and capital restrictions.

(5) Regulation, including banking regulation, labour market regulation, business regulation and corruption.

The index covers almost all important institutional aspects and is based on *de jure* and *de facto* institutions. The value of the index is the higher, the smaller the

[3] See Table A1 in appendix for details regarding the components of the indicator of monetary commitment (MOC).

government (including taxes levied), the better legally protected the citizens, the higher freedom to trade and the less regulated the labour market. To make it useful for our purpose, the index is adjusted by normalising its values between 0 and 1 and by omitting monetary soundness; the expected correlation with inflation is negative. It can reasonably be argued that in order to be successful, a strong monetary commitment requires a high degree of fiscal stability, a high degree of openness and a flexible labour market. High economic freedom exerts pressure on governments to stick to their policy announcements, as it leaves more options for the citizens. Costs of reneging are high.

In a final step, we combine by multiplication the LVAU and MOC variables, respectively, with the EF variable in order to construct a proxy variable for ex-ante credibility designed to analyse whether or not the public trusts an announcement in advance. Theoretically, the credibility of a monetary regime is the higher, the higher cost a deviation from a commitment causes for the government. Therefore, the product of LVAU and MOC with EF is expected to be negatively correlated with inflation, as both variables are expected to be negatively correlated with inflation.

In addition, we employ several control variables to estimate the determinants of inflation. Among the most important control variables is money growth which interestingly has often been neglected in models that test the influence of CBI on inflation. Based on so-called *p-star* models (Tödter 2002), we incorporate the growth rate of the monetary aggregate M2 as a control variable. We expect a positive correlation between money growth and inflation. Moreover, a high GDP growth rate could be positively correlated with inflation in less developed countries. However, in our sample of 22 developed OECD countries, high GDP growth might also imply an efficient allocation of resources, efficient government activities and low distortions, in which case there might be no need for the government to abuse monetary policy. Put differently, in low growth countries, inflation may be higher (stagflation). We therefore expect a negative correlation. These control variables are included in our baseline model.

As additional variables used for further robustness checks of our model, we include trade openness and fiscal stability. Foreign trade can have contradictory

effects on inflation. On the one hand, foreign trade causes intensive competition and better allocation of resources and factors implying a lower inflation rate (Romer 1993). On the other hand, higher demand for domestic goods can increase their prices contributing to higher inflation. The indicator of fiscal stability and

We employ these variables in estimating several variants of the panel model

$$\pi_{it} = \alpha_i + \beta_1 C_{it} + \beta_2 EF_{it} + \beta_3 C_{it} EF_{it} + \beta_4 M_{it} + \beta_5 Y_{it} + \epsilon_{it},$$

where π_{it} is the average inflation rate, C_{it} refers to one of the two monetary policy commitment measures LVAU or MOC, EF_{it} is the economic freedom index, M_{it} is the average money (M2) growth rate, Y_{it} is the average GDP growth rate and ϵ_{it} is the idiosyncratic error term. The subscript $i = 1, \dots, N$ refers to the countries in our sample and the subscript $t = 1, \dots, T$ refers the decades covered.

In addition to these regressors, the model contains country-specific fixed effects α_i. Fixed effects panel models are less restrictive than random effects panel models in the assumptions regarding the covariance of the fixed effects and the error terms. Furthermore, it seems reasonable to include country-specific fixed effects in order to account for time-invariant unobserved heterogeneous characteristics across the countries which might be of relevance for inflation performance but cannot be captured explicitly by the variables in our model. While the choice of preferring the fixed effects model over the random effects model is mainly motivated by this argument, it can also be justified on purely econometric grounds by means of a Hausman test. In nearly all the model specifications reported below, the Hausman test rejects the random effects model which is more efficient under its restrictive assumptions but not consistent when these assumptions are violated. We estimate the fixed effects panel model using the within estimator which accounts for the group-fixed effects by applying the within transformation.

Our proposed model is a static panel model. At first glance it might seem appropriate to estimate a dynamic version of this model adding lagged observations of the endogenous variable. However, as we analyse average inflation over whole decades, we argue that average inflation of the past decade has at most only a very modest influence on the current decade's average inflation. Each decade is characterized by concurrent policies and shocks which

have a larger influence than past events. For the same reason, autocorrelation can reasonably be expected not to be a prevalent problem in the data. Moreover, dynamic estimation would further constrain the number of degrees of freedom which is already limited due to limitations in data availability.

Details and data sources regarding the variables are as follows (see Table 2 for descriptive statistics of the variables):

- The dependent variable is the log of average consumer price inflation of each decade. The decade averages of annual consumer price inflation are calculated on the basis of IFS statistics (IMF).
- Data for the indicator of central bank independence (LVAU) is taken from Cukierman (1992) and Cukierman et al. (2002). It is available from the 1960s to the 2000s. The variable is restricted between 0 and 1, with a higher value implying a higher degree of central bank independence and thus monetary commitment.
- Monetary commitment (MOC) is generally measured by assessing the central bank law with respect to the ability of the central bankers to pursue a stability oriented monetary policy free of political influence. Thus ten criteria (see Table A1 in appendix for details)[4] are introduced and given numerical values, which are averaged either weighted or unweighted. The data is available from the 1960s to the 2000s. The information for MOC for the 1990s and 2000s is taken from Cukierman (1992), Freytag (2001), central bank websites (IWP 2003) and IMF. The variable is restricted between 0 and 1, with a higher value implying a higher degree of monetary commitment.
- In order to measure the institutional setting, we use all sections of the index of economic freedom (EF) by Gwartney, Hall and Lawson (2011) apart from its third section (access to sound money), which in our analysis is captured by the other variables. The economic freedom index is restricted between 0 and 1, with a higher value implying a higher degree of freedom. The variable is available for the years 1970, 1975, 1980, 1985, 1990, 1995, 2000 and 2005. As the index in each year reflects past developments, we argue that the 1970

[4] See also the studies by Grilli, Masciandaro and Tabellini (1991), Parkin and Bade (1977), Cukierman (1992) and Cukierman et al. (2002).

value represents the institutional setting of the 1960s and that the average of the values for 1975 and 1980 represent the 1970s and so forth. Thus, we obtain the required five observations per country.

- In hypothesis 2, we argue that the public is able to assess the economic order. The compatibility of the monetary regime with other policy areas is important for its credibility. This hypothesis demands for an ex-ante proxy of credibility, which we proxy by the product of LVAU or MOC, respectively, and EF. If both monetary commitment and economic freedom are high (close to one), credibility also is high (close to one). If both indicators are low (close to zero), credibility is also low (close to zero). The expected impact of our indicators of monetary policy credibility is negative.
- Data on average growth of the monetary aggregate M2 is taken from the IMF and available for the whole sample period. This variable is included in logarithmic terms.
- Data on average real GDP growth on inflation is taken from Heston, Summers and Aten (2011) and available for the whole sample period. This variable is included in logarithmic terms.
- Trade openness is calculated as the sum of exports and imports divided by GDP and multiplied with 2. The data is taken from Heston, Summers and Aten (2011) and is available for the whole sample period.
- Fiscal stability refers to the average government budget deficit (or surplus) divided by GDP. It is calculated from the OECD and is available for the whole sample period.

On the time dimension, our sample covers five periods: the five decades from the 1960s to the 2000s. On the cross-sectional dimension, the sample comprises the following 22 OECD countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, South Korea, Spain, Sweden, Switzerland, United Kingdom and USA. In order to control for international spill-overs, we also estimate the model for a subsample of 16 small open economies (excluding France, Germany, Italy, Japan, UK and USA from the country sample). If our

results were mainly driven by the large economies exerting influence on the smaller ones, the results of the small sample estimations should differ from the large sample estimations.

Table 2: Descriptive statistics

Variable	obs.	minimum	mean	median	maximum	st. dev.
log inflation	109	-0.916	1.430	1.278	3.570	0.762
LVAU	110	0.070	0.426	0.395	0.920	0.207
MOC	110	0.180	0.525	0.525	0.800	0.183
EF	110	0.490	0.651	0.640	0.820	0.075
LVAU · EF	110	0.042	0.282	0.259	0.676	0.147
MOC · EF	110	0.094	0.347	0.355	0.593	0.138
log money growth	97	-4.605	-2.406	-2.526	-0.010	0.770
log GDP growth	110	-2.040	0.879	0.896	2.236	0.628
trade openness	110	0.040	0.249	0.230	0.680	0.125
fiscal stability	110	-0.120	-0.017	-0.020	0.370	0.078

5. Empirical results

The main empirical results of our econometric analysis are presented in Table 3. This table reports the results of six different specifications of our panel model, estimated using the full country sample. In the first two specifications (1) and (2) we estimate the effect of the two monetary policy commitment measures LVAU and MOC, respectively. These results can be used to test our first hypothesis. Specifications (3) to (6) deal with the interaction of the commitment measures with the economic freedom index, i.e. our proxy for monetary policy credibility. These results can be used to test our second hypothesis.

Specifications (1) and (2) of Table 3 show that both commitment measures LVAU and MOC respectively are negatively correlated with inflation performance in the full sample, both coefficients being highly statistically significant. These results strongly support the first hypothesis, namely that inflation is lower the higher the degree of monetary policy commitment. Furthermore, among the two control variables the money growth rate stands out as another important determinant of inflation, the two variables being positively related in a robust fashion. This gives credence to the view that inflation is a monetary phenomenon. The results regarding GDP growth are less conclusive. While the coefficient for GDP growth is negative as expected, it is only significant in specification (2). These results

underline the importance of monetary policy commitment and money growth as determinants of inflation.

Table 3: Inflation, monetary commitment and monetary credibility: Fixed effects regression, 1960s to 2000s, large country sample

	(1)	(2)	(3)	(4)	(5)	(6)
LVAU	-2.762***		6.205		-1.135	
	(0.002)		(0.168)		(0.104)	
MOC		-3.172***		5.364		-1.561***
		(0.000)		(0.128)		(0.005)
EF			-2.757	0.079	-6.912***	-5.801***
			(0.304)	(0.980)	(0.000)	(0.000)
LVAU · EF			-11.671*			
			(0.010)			
MOC · EF				-11.235**		
				(0.048)		
Money	0.446***	0.302***	0.378***	0.301***	0.370***	0.312***
	(0.000)	(0.006)	(0.000)	(0.001)	(0.000)	(0.001)
GDP	-0.087	-0.262**	-0.019	-0.147	-0.009	-0.108
	(0.504)	(0.030)	(0.848)	(0.155)	(0.927)	(0.297)
N	96	96	96	96	96	96
R^2 (within)	0.277	0.444	0.602	0.639	0.586	0.617
F-statistic	9.05	18.88	20.90	24.38	24.80	28.23
Hausman	0.144	0.001	0.000	0.000	0.001	0.000
Marg. eff.	---	---	-1.393	-1.950	---	---

Notes: Fixed effects panel model estimated using within-estimator. Fixed effects coefficients are not reported here. Dependent variable is the average log inflation rate. For each estimated coefficient, the respective p-value is reported in parentheses with significance levels marked by *** <0.01, ** <0.05 and * <0.1. The large country sample consists of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, South Korea, Spain, Sweden, Switzerland, UK and USA.

Specifications (3) and (4) report the core results of our paper. These two model specifications are designed to capture the effect of monetary policy credibility on inflation performance. As described above, we use the product of either the central bank independence measure LVAU or the monetary commitment measure MOC on the one hand and the economic freedom index EF on the other hand as our proxy for credibility of monetary policy. In these two specifications, the two underlying variables (also referred to as "main terms") LVAU resp. MOC and EF are included as regressors even though we are mainly interested in the effect of the interaction terms which capture monetary credibility. However, leaving out these variables underlying the interaction terms could otherwise lead to a bias in the estimated coefficients of the interaction terms and hamper the proper interpretation of the coefficients (cf. Ozer-Balli and Sorensen 2010). Both interaction terms are significant and negatively correlated with inflation. On top of that, both estimation fit and joint significance as judged by the within-R^2 and the F-statistic seem to be better than in the first two specifications. This strongly

corroborates our second hypothesis which states that monetary policy credibility leads to better inflation performance.

Table 4: Inflation, monetary commitment and monetary credibility: Fixed effects regression, 1960s to 2000s, large country sample, robustness analysis

	(1)	(2)	(3)	(4)	(5)	(6)
LVAU	7.781*		6.019		7.721	
	(0.098)		(0.185)		(0.102)	
MOC		6.206*		5.580		6.262*
		(0.086)		(0.121)		(0.088)
EF	-2.031	0.626	-2.806	0.297	-1.993	0.692
	(0.459)	(0.842)	(0.299)	(0.926)	(0.469)	(0.829)
LVAU ·	-14.381*		-11.356		-14.287*	
EF	(0.054)		(0.113)		(0.057)	
MOC · EF		-12.672**		-11.665**		-12.791**
		(0.031)		(0.046)		(0.032)
Money	0.383***	0.302***	0.386***	0.291***	0.400***	0.298***
	(0.000)	(0.001)	(0.000)	(0.002)	(0.000)	(0.002)
GDP	-0.04	-0.139	-0.024	-0.147	-0.010	-0.139
	(0.968)	(0.178)	(0.813)	(0.156)	(0.922)	(0.180)
Trade	1.502	1.271			1.762	1.230
openness	(0.244)	(0.286)			(0.188)	(0.318)
Fiscal			0.524	-0.453	0.936	-0.173
stability			(0.659)	(0.701)	(0.444)	(0.886)
N	96	96	96	96	96	96
R^2	0.610	0.645	0.603	0.639	0.614	0.645
(within)						
F-statistic	17.74	20.55	17.25	20.09	15.20	17.37
Hausman	0.000	0.000	0.003	0.000	0.004	0.000
Marg. eff.	-1.581	-2.044	-1.374	-2.014	-1.580	-2.065

Notes: Fixed effects panel model estimated using within-estimator. Fixed effects coefficients are not reported here. Dependent variable is the average log inflation rate. For each estimated coefficient, the respective p-value is reported in parentheses with significance levels marked by *** <0.01, ** <0.05 and * <0.1. The large country sample consists of Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, South Korea, Spain, Sweden, Switzerland, UK and USA.

At first glance, it might seem odd that in these specifications the estimated coefficients for LVAU and MOC, respectively, are positive rather than negative. However, due to the interaction terms, the respective marginal effect of the two variables is calculated as

$$\beta_1 + \beta_3 \cdot EF_{it}$$

which yields marginal effects of LVAU and MOC (averaged across all observations in the sample) of -1.393 and -1.950, respectively. These are smaller in absolute value than the estimates of the first two specifications, which shows the importance of the differential effect of our proxy of credibility. In the two supporting specifications (5) and (6), only the main terms and not the interaction terms are included. Here, again significant negative coefficients emerge. Judging from the results of specifications (3) and (4) as well as the supporting

specifications (5) and (6), our overall concept of monetary credibility and the proxy used to capture it empirically seems to be supported well by empirical evidence. For each specification, the p-value of a Hausman test of random effects vs. fixed effects model is reported. In five out of six specifications, the Hausman test rejects the null hypothesis of validity of the random effects model, which supports our choice of the fixed effects model. Summing up, we conclude from these estimations that monetary policy credibility on top of monetary policy commitment does explain well differences in inflation performance. Furthermore, in all of these four specifications, money growth again is a robust negative determinant.

In Table 4, our main model equation (the third and fourth specification in Table 3) is estimated again, this time including either one or both of the additional control variables trade openness and fiscal stability. However, including these potentially relevant determinants of inflation does not change the above results: trade openness and fiscal stability turn out to be insignificant, while our credibility measures (especially the one based on the commitment indicator MOC) largely remain robust determinants of inflation.

Table 5: Inflation, monetary commitment and monetary credibility in small open economies: Fixed effects regression, 1960s to 2000s, small country sample

	(1)	(2)	(3)	(4)	(5)	(6)
LVAU	-2.811**		10.047**		-0.764	
	(0.012)		(0.031)		(0.296)	
MOC		-3.079***		9.451***		-1.068**
		(0.000)		(0.006)		(0.046)
EF			-2.270	0.902	-8.084***	-7.355***
			(0.379)	(0.742)	(0.000)	(0.000)
LVAU · EF			-16.708**			
			(0.019)			
MOC · EF				-16.64***		
				(0.002)		
Money	0.3787***	0.294**	0.341***	0.301***	0.320***	0.293***
	(0.004)	(0.016)	(0.000)	(0.000)	(0.000)	(0.001)
GDP	-0.211	-0.330**	-0.128	-0.213**	-0.118	-0.168*
	(0.135)	(0.011)	(0.140)	(0.015)	(0.191)	(0.070)
N	72	72	72	72	72	72
R^2 (within)	0.280	0.435	0.742	0.774	0.713	0.728
F-statistic	6.87	13.62	29.36	34.96	32.23	34.86
Marg. eff.	---	---	-0.830	-1.379	---	---

Notes: Fixed effects panel model estimated using within-estimator. Fixed effects coefficients are not reported here. Dependent variable is the average log inflation rate. For each estimated coefficient, the respective p-value is reported in parentheses with significance levels marked by *** <0.01, ** <0.05 and * <0.1. The small country sample consists of Australia, Austria, Belgium, Canada, Denmark, Finland, Greece, Iceland, Ireland, Netherlands, New Zealand, Norway, South Korea, Spain, Sweden and Switzerland.

Table 5 reports the same estimations of Table 3, this time based on the reduced country sample of 16 smaller open economies which excludes France, Germany, Italy, Japan, UK and USA from the full sample. On the whole, the small sample estimation results largely support the conclusions drawn from the full sample. Again, both the commitment measures as our credibility measures turn out to have significant negative coefficients, further supporting the conclusions from above. The effects of credible monetary policy thus also carry over to smaller open economies and not just large economies. In this small sample, higher money growth again is robustly linked to higher inflation. Additionally, in this sample there is evidence for a negative link between GDP growth and inflation which tentatively supports our expectation regarding this variable.

In general, the empirical evidence of our econometric analysis is encouraging and confirms our two major hypotheses to a considerable degree. Monetary commitment in conjunction with the institutional setting can explain the development of inflation very well. Following our first hypothesis, inflation is indeed decreasing the higher the degree of monetary commitment. The empirical results also make evident that central bank independence (LVAU) and monetary commitment (MOC) respectively are well suited to empirically capture the theoretically proposed relation between commitment and inflation. As the main contribution of our paper, the empirical analysis also strongly confirms our second hypothesis. Thereby, we can show that monetary commitment can gain credibility and thus facilitate price stability if it is compatible with the economic order.

6. Summary and policy conclusions

This paper aims at giving an explanation for the missing link between *de jure* measures of monetary commitment and the inflation performance. For this purpose, we define a proxy variable capturing monetary credibility based on the notion that monetary policy is part of a principal-agent problem. We formulate two hypotheses: first, in OECD countries inflation is negatively correlated with the degree of monetary commitment, and second, inflation is negatively correlated with the degree of monetary credibility, defined as an interaction between an indicator of institutional constraints and an indicator of monetary commitment. In order to test these hypotheses, we look at the long run perspective of monetary

policy by estimating variants of a fixed effects panel model based on data of 22 OECD countries since the 1960s. Both hypotheses are strongly confirmed by our panel regressions. Our proxy variable seems to be an adequate way of empirically capturing monetary credibility and its additional effect on top of monetary commitment alone, which by itself is not necessarily credible.

Indeed, these extensions to the empirical analysis help understanding how monetary commitment can be made credible within the economic policy assignment. The obvious and expected outcome is that monetary commitment is important for the success of monetary policy. This has already been shown in theoretical literature and partly in previous empirical literature. However, our main contribution reveals that commitment is at best a necessary condition. The sufficient condition seems to be an appropriate mechanism enforcing actual policy that is complying with the commitment. However, this mechanism cannot be modelled explicitly in empirical analyses. In order to be able to incorporate this enforcement mechanism in our analysis, we define our proxy variable based on institutional constraints. A higher degree of economic freedom for citizens leads to less incentives for politicians to weaken stability oriented monetary policy. These results suggest that the public very well perceives the credibility of policy rules by relating the degree of monetary commitment with other policy areas. This relation can be (and obviously is) used as a concept to assess credibility of policy rules ex-ante. In the long run, the credibility of policy rules has an impact on the behaviour of the public with respect to contracts.

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Appendix

Table A1: Components of the index of monetary commitment (MOC)

Criterion	Component	Explanation	Coding
Stated objectives of monetary policy	*obj*	1. Price stability only goal	1.00
		2. Other objectives mentioned	0.66
		3. Other objectives equally important	0.33
		4. No goals for monetary policy	0.00
Locus of legal commitment	*const*	1. Constitution	1.00
		2. Central bank law	0.66
		3. Decree	0.33
		4. Not fixed at all	0.00
Discretionary power belonging to the government	*gov*	1. No power left to the government	1.00
		2. Exchange rate only issue to be consulted between government and monetary authority	0.66
		3. Exchange rate regime completely left to government	0.33
		4. Government may override central bank as regards monetary policy	0.00
Conditions of appointment and dismissal of monetary CEO	*ceo*	1. CEO must be a reputed expert	1.00
		2. No expertise demanded	0.00
	diss	1. Appointment with fixed term and dismissal only after criminal offenses and bad performance	1.00
		2. No rules for dismissal	0.50
		3. Dismissal unconditioned or linked to resignation of governments and ministers	0.00
Conditions of lending to the government	*limcred*	1. No central bank credit allowed	1.00
		2. Central bank credit allowed conditionally	0.50
		3. Central bank credit allowed unconditionally	0.00
	limprim	1. Central bank is not allowed to purchase public bonds on the primary market	1.00
		2. Central bank is allowed to purchase public bonds in hard currency on the primary market	0.66
		3. Central bank is allowed to purchase public bonds in any currency on the primary market	0.33
		4. No limitations on credit activities	0.00

Table A1 (continued): Components of the index of monetary commitment (MOC)

Criterion	Component	Explanation	Coding
Supervision and regulation of the financial system by the central bank	*reg*	1. Supervision and regulation is assigned to a separated body	1.00
		2. Supervision and regulation is assigned to central bank	0.50
		3. No supervision and regulation	0.00
Accountability of the central bank	*acc*	1. Obligation to inform the public	1.00
		2. Obligation to inform the parliament in public hearings	0.66
		3 Obligation to inform the government without publicity	0.33
		4. No accountability	0.00
External pledges of the government	*extern*	1. Exchange rate fixed to a hard currency and money base fully backed with foreign reserves	1.00
		2. Exchange rate fixed	0.75
		3. Crawling peg	0.50
		4. Managed floating	0.25
		5. Free floating	0.00
Convertibility restrictions	*conv*	1. Full convertibility	1.00
		2. Partial convertibility	0.75
		3. Convertibility for current account transactions only	0.50
		4. Convertibility for capital account transactions only	0.25
		5. No convertibility	0.00
	mult	1. One exchange rate	1.00
		2. Multiple exchange rate	0.00
Interactions with other currencies	*comp*	1. A hard currency can be used for all transactions	1.00
		2. A hard currency can be used for some transactions, others excluded	0.66
		3. A hard currency may be held	0.33
		4. No holdings or transactions in hard currencies allowed	0.00

Source: Freytag (2001, p. 198-199)