Aleksandra Masłowska

**Quest for the best:
How to measure central bank
independence and show its
relation with inflation?**

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ABSTRACT

We use several numerical tests in order to receive answers to our three questions. First, this paper aims to indicate, which measure of central bank independence explains economic changes the most accurately, and hence gives the most exact guidance onto institutional design of monetary authorities. Second, our aim is to prove that differences in legal proxies matter as much as institutional development of countries. Finally, we show that results are vulnerable to data modification. This experiment is performed by an empirical verification of the quality of CBI indices, comparing several widely used measures for around 100 countries, using a panel data approach. After a brief description of imprecision in CBI measures methodology and their definitions, a comparison using OLS method is made. Additional tests of TSLS, PCA and stepwise selection are used, as well. In the final conclusion we are able to point the "winner" of this experiment but also we indicate that a minor modification of data can change the result.

Contact information

University of Turku, Department of Economics,
Assistentinkatu 7, FIN-20014 Turku.
E-mail: aleksandra.maslowska(at)utu.fi

1 Introduction

Early studies on central bank and its relations with the government and the public gave strict directions for central bankers: price stability as the goal and high personal independence, which effected with the flow of new central bank laws. Empirical studies, so often contradictory to each other, first brought the evidence for the CBI-inflation relation, only to criticize it later on. The central bank independence (CBI) measuring problem, compared by some to the discussion on the accuracy of openness definitions, is not simple. In both cases, the choice of definitions may influence empirical results. Defining the openness does not mean, however, influencing the institutions directly. It is otherwise in the case of CB independence, where the choice of central banks' attributes has the direct effect on the institutional design of central banks. The measure, constructed by a researcher, becomes the definition itself and can imply how the central bank law will be designed.

Running hundreds of regressions, while researching the topic on relations between central bank independence and inflation, brought us to an interesting conclusion that central bank independence may work as a placebo. Economists agree it is needed as one of the major instrument in achieving price stability but there is not a single study that would prove lower inflation is caused by CBI.

Moreover, despite many attempts, independence appears to be an unquantifiable phenomenon. We ask ourselves a question: what do these CBI measures really mean. First of all, the theoretical analysis of the true state of CBs showed that most of values do not represent the reality.[1] It is, perhaps, possible to believe that the National Bank of Poland is as independent as the European Central Bank (the former had adjusted its legal status prior the EU membership). We find difficult to trust in results stating that the Central Bank of Belarus is more independent than the Fed or Bank of England (according to the legal measure constructed by Cukierman, 1992).

After many critical studies on CBI, and having problems to receive any consistent results from empirical analysis, we have started to wonder, why so many countries decided to increase their degree of monetary authority's autonomy. The standard answer so far was to bring an example of the Bundesbank, its institutional design and successful period of disinflation since the World War II to the present day. However, due to the lack of causality, we ask again, do we really need central bank independence.

Despite problems with quantifying this institution, we believe that the basic, and perhaps the most accurate definition of CBI, provided by Debelle and Fischer (1994), justifies the need for CBI. Central banks need to be able to choose their monetary goals autonomously and fulfill these targets with

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[1] Fo the critical analysis of this topic see A. Maslowska, "Discussion on the Inconsistency of Central Bank Independence Measures", ACE *Discussion Paper*, No. 21, 2007.

the use of independently chosen instruments. Moreover, higher degree of CBI helps to improve degree of transparency and therefore helps to reveal "Secrets of the Temple" to the public.

The objective of this paper is to find the best among measures of CBI. We decide to perform empirical tests checking each measure's ability to explain changes in inflation. We are doing so keeping in mind that each institutional improvement of central banks always aims to obtain more efficient monetary policy. Thus, along with other studies, we assume that the main, and perhaps the only, reason of introducing higher degree of central bank independence is to help achieving price stability.

We have entitled this paper "Quest for the best" giving a hint, we are expecting to point the winner of this "competition" that is the most accurate measure. We perform several tests, some more, other less suitable (we are aware that all are vulnerable for criticism). First, we place all CBI measures in the test they were constructed for: analysis for inverse relation with inflation. We do not give a profound explanation, why such an association should exist. For there has been many studies, which presents theoretical explanation.[2] We simply verify their ability of explaining changes in inflation the way their authors aimed to do so while constructing their definitions. Our advantage lays in a fact that we have gathered several measures altogether and put them in one test. We have also longer time series and knowledge of results vulnerability based on bivariate examinations.

Second, we refer to other methods that is a principal component analysis and regression based on a stepwise selection. We keep in mind the contribution made by Banaian, Burdekin and Willet (1998), who performed a PCA for a legal measure LVAU. We also remember that a stepwise selection attracts critical attention.

With this paper, we also want to challenge Cukierman's (1992, p. 425) conclusion that "any divergences in results between our full sample and that of the ATC [Alesina, and Grilli, Masciandaro and Tabellini studies] is due to differences in institutional features across the samples of countries rather than to differences in the legal proxies of CB independence". With this paper we want to show that measures can give contradictory results also within one sample. We are doing so by: (1) having a larger sample of legal measures used in a comparison that helps to analyze their construction in a broader way; (2) focusing on each group of countries separately; (3) and finally underlining that turnover of governors had been named the measure of "actual" independence and hence could be excluded from the study. However, we want to underline, we agree with Cukierman that institutional development of countries matters.

Furthermore, we also ask ourselves, if the idea of quantifying something that seems unquantifiable makes sense. Our aim is not to diminish the im-

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[2]Some references in the text.

portance of previous studies, for we acknowledge all courageous attempts of quantifying this phenomenon. We simply want to hint an idea that several other institutional solutions, inflation targeting for example, carry some elements of CBI as well.

This paper is organized as follows. Section 2 presents a brief theoretical background covering simple justification for central bank independence. We also show facts, which many other studies have pointed out: inconsistencies in constructions, and empirical investigation of CBI measures. We collect some of the strongest arguments against building indices the way they are now, and add our new inputs to this case. This illustration justifies further studies in this area. The description of the model and methodology can be found in section 3 of this paper, which is followed with results and comments (section 4). Additional information concerning CBI measures, as well as detailed estimation results are placed in Appendices.

2   Theoretical background

2.1   On the way to stable prices

Over the past 15 years, global inflation has dropped from 30% to 3%[3]. Has it been the result of effective monetary policy? Have central banks received any special incentive for working successfully? Both literature and experience give several explanations of this phenomenon, institutional changes and focus on independent monetary authority being one of them.

In order to explain decreasing trend of inflation, it is necessary to emphasize presence of many factors. Rogoff (2003) underlines importance of increased level of competitiveness, deregulation and a decreased role of governments in many economies. Surely, tighter fiscal policy played an important role as well. In European countries the drive towards common currency input discipline in many areas specified by the Maastricht Treaty.

An important post-Keynesian development in macroeconomics is the influence of the new classical economics: the rational expectations model proposed by Robert Lucas. According to rational expectations hypothesis, economic agents make rational expectations based on all available information to make best possible forecasts. As long as the government holds control over fiscal and monetary policies and supports expansionary policy with large deficits and increased money growth, rational agents would expect higher rates of inflation in the future. Hence, the delegation of monetary responsibilities to a central bank, which defines his inflation-aversion and obtains certain degree of independence sends information to agents. A case study on the relation between inflation expectations and institutional changes for Great Britan, performed by Spiegel (1998), provides the result

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[3]Based on data and projections of IMF's World Economic Outlook

that market perceived that enhanced CBI (announcement - May 6, 1997) would lead to lower average rates of future inflation. Despite the lack of proof for causality, Spiegel summarizes that announcements of institutional changes matter and in this case it has a significant impact on future expected inflation rates.

Further going in this line, the most prominent argument for central bank independence is the time-inconsistency problem, suggested by Kydland and Prescott (1977), developed later by Barro and Gordon (1983). Despite the asymmetry of information, private sector understands determinants of government policy and formulates its expectations based on this knowledge. However, a government that will attempt to re-optimize and change its plan later will suffer from a *credibility problem*.

2.2 On CBI definitions' imprecision

In this following section, we present brief summaries of empirical results on relationship between central bank independence and inflation, and we add our contribution into discussion on proxies of CBI imprecisions.

2.2.1 Short results reminder of major studies on CBI

Political and economy independence Without any doubt, one of the major contributions in area of measuring CBI have been prepared by Grilli, Masciandaro and Tabellini (1991). Their work, for the first time, named in details institutional attributes of central bank autonomy, distinguishing between political aspects of this definition and economic ones. Degree of CBI has been calculated at the moment of the study (assumed year 1989), however this numerical representation is based on the data from the IMF monograph on central bank legislation, created in 1967, and national legislation.

Empirical examination relies on using the same value of CBI in the period 1950-1989, which is divided into 4 decades. The results show the effect of indicators (political and economic) on cross-country differences in inflation rates. As explanatory variables, authors have included participation in the EMS, as well as variables carrying political characteristics: (1) frequency (number of government changes for the decade); (2) significant (number of "significant" government changes for the decade); and (3) majority. Major findings, regression coefficients for decades and the whole period, show the expected (negative) sign for the indicator of central bank independence, with different significance depending on the type of autonomy and the level of average inflation in decades. The CBI measures also proved to be more significant in explaining degrees of inflation than political variables. Hence, all in all, measures constructed by Grilli, Masciandaro and Tabellini were able to prove negative relation between CBI and inflation.

The most widely used indicators The work performed simultanously to GMT, done by Cukierman (1992)[4], revolutionized the study on CBI. The author not only underlined the possibility of existing differences between the legal and actual degree of autonomy, but also created a detailed measure for a much larger sample of countries, giving this way material that has been often used in subsequent literature.

Cukierman's contribution emerged in creating a legal indicator LVAU (LVAW), measure of the "actual" independence TOR, as well as an index based on the questionnaire sent to central bankers, QVAU. Later, his further work on actual independence resulted with another measure, vulnerability (VUL), capturing aspects of government-CB governor instability (Cukiermand and Webb, 1995). Furthermore, on contrary to GMT, Cukierman calculated a value of CBI for each period separately. Considering that the period of analysis is similar as in GMT, 1950-1989, each measure has 4 different values for each decade, and the value depends on actual changes in central banks' legal statutes or frequency of governor changes within the subperiod.

The regression of inflation on the legal variables after the first aggregation shows insignificant results for the whole sample (developed and less developing countries). The individual contribution of each legal variable is mostly (not always) negative, hence as expected, and increases while including TOR to the regression; however, this effect is again not always significant. Dividing the sample into two groups dependent on development did not help to increase significance of coefficients. Measure of actual independence, TOR, is positive[5] and significant for the whole period, for less developed countries, whereas it has a negative sign for developed ones.

Resulted from second aggregation, one measure of legal independence, proves to show significant and expected results only for developed countries. Cukierman summarizes it indicating that measures of legal autonomy may be more adequate for developed countries.

2.2.2 Robustness of autonomy measures

Studies on the relationship between inflation and central bank independence brought a justification for the institutional change of central banks. They also started to ask questions concerning the substance of the CBI definition. Its construction and precision rely on proper understanding of CB laws and status, knowledge of a researcher, or how detailed CB attributes are being included in the measure. Thus, how 'independent' a central bank becomes does not only depend on its institutional design but also on researchers'

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[4]And Cukierman, Webb and Neyapti (1992)

[5]It is often wrongly analized that the negative sign of coefficients is also expected for TOR. It is important to remind after Cukierman that in case of this measure, higher values indicate lower independence, on contrary to the legal measure.

arbitrariness. According to Eijffinger and Schaling (1993) three types of subjective choice are involved while constructing CBI index: (1) which criteria should be included; (2) how should the legislation be interpreted, and (3) what weight should be attributed to each criterion.

The most common method, the 'statutes and law' reading, is criticized by Forder (2000), who names several 'traps'. He guesses, the designers of statute-reading measures postulate an opinion that a central bank always sets what they believe to be the best policy once given the power to do so. Similar opinion presents Woolley (1994) who remarks a lack of interest presented by measures in an area that should be of central importance, that is, whether, independent central banks actually are able to act contrary to the government wishes. As a comment, Forder (2000) brings an argument that the true power of an institution is determined rather by the actual practice in enforcing own decisions than the formal rules and 'the surface appearance'.

Considering the fact that Cukierman (1992) is focusing on 'legal' independence as opposite to 'actual' and tests done by Banaian et al. (1998) proving insignificance of Cukierman choice of attributes, index of 'legal' central bank independence seems to be informative only in a limited area. Banaian et al. (1995), although acknowledge the contribution of Cukierman's indices, argue it is not sufficient to read central bank laws on the financial relationship between central bank and government. Such a method is not explaining the pressures on central banks when open market operations are concerned. Further, authors continue, the turnover rate reveals little information about government influence on central banks, and what effect the degree of TOR will have on inflation in industrial countries. Moreover, it is possible, that a low degree of turnover means no more but an 'accommodative' governor, who is unlikely to be replaced.

A collection of CB characteristics included in the measure is a decision aiming to choose the most important attributes, in respect of the general CBI definition. Eijffinger and Schaling (1993) decide to call a 'decisive' attribute the one concerning final policy authority. It results with asymmetry in favour of this matter, giving lower importance to questions concerning the presence of a government official in the board or the board appointments procedure. Similarly, Banaian et al. (1995, 1998) argue, that basic theoretical principles contribute the priority to attributes concerning the formal ability of the central bank to set monetary policy autonomously. Hence, they assign lesser importance to the central bank as an interventionist in the market for government securities. All attributes, including the procedure of appointment or financial relationship with government are informative when the political pressure placed on monetary authorities is concerned. However, "where the government makes the basic policy decisions and the role of the central bank is limited to simply implementing the government's instructions, the effects of these other attributes are likely to be severely compromised" (Banaian et

Table 1: Subjectivity and arbitrariness of selected CBI attributes

Attribute	Cukierman	Maliszewski (based on GMT)	Loungani and Sheets	Rank (Fry et al.)
CEO	20	31.25	46	2
Policy Formulation	30	37.5	38.5	1
Lending Restrictions	50	31.25	15.5	3

Notes: Values for three first measures represent the percentage of focus put on certain attribute compared to the total number of CB factors.
Based on the data from: Cukierman, A. (1992), Maliszewski W. (2000), Loungani, P. and N. Sheets, (1997).

al., 1998).

Further, it is possible that CBI measures simply do not consider the amount of disagreement that has arisen as to the relative importance of the different institutional features that may be significant for central bank independence. Table 1 presents a comparison between three measures: Cukierman's 'legal index' (1992), modification of the Grilli, Masciandaro and Tabellini index (GMT hereafter) done by Maliszewski (2000) and index constructed by Loungani and Sheets (1997) especially for transition economies. Numbers in relating to these measures columns represent the percentage share of the total number of CB attributes in the measure. For example, Cukierman focuses in 50% on lending restrictions, when Maliszewski (GMT) spreads his interest almost equally into three clusters of attributes. The last column shows rankings according to central bankers, who were asked to name the most and least important central bank attribute, when CB independence is concerned.

A list of detailed CB attributes can be found in table 3 in Appendix. This composition presents additionally, which attribute has been included in the construction of chosen measures. Again, last column represents subjective opinion of bankers, who indicate the importance of CBI elements.

3 Empirical examination of models

Keeping in mind theoretical justification for CBI, previous studies proving a negative relation between autonomy and inflation, as well as critical examination of CBI measures, we have decided to perform an empirical study verifying which CBI definition among many has a capability of explaining changes in inflation the most. We have collected the data on CBI from their original studies. Below, we present a description of data, models and results.

3.1 Selection of country samples

Our major intention has been to include to the analysis as many countries as possible, in order to be able for a profound comparison between various

groups of economies. Hence, we have collected the data for the following groups of countries (size of samples in brackets): industrialized countries (23); emerging economies (19); transition economies (21); developing countries (62). In total, we have gathered the data for 126 countries. The missing countries, for example for developing ones, are due to the lack of data for central bank independence measures.

3.2 Data

CBI measures The literature presents several measures of central bank independence; many of them consider legal aspects of independence, others measure the "actual" degree of CB autonomy. The most interesting, however, are those bringing new definitions of CBI and covering large samples in their empirical verification. A list of indices, which were picked according to these criteria, and their brief presentation can be found in Appendix.[6]

Another topic, concentrating interests of many, is the presence (or the absence) of robustness in empirical studies on the researched relation. Simple bivariate models have been criticized of the biased results, while multivariate ones started to prove insignificant or no relation between CBI and inflation. This study tries to avoid accusations of too simple models by the choice of other control variables.

The intuition behind author's choice of CBI indices lays mainly in the methodological explanation. Firstly, most of them are very often used by many researchers in their analysis of macroeconomic relations. Some critical points concerning these measures may remain unnoticed for them, hence this paper will act as a summarize and econometrical proof. Secondly, the technique used in their construction is different, other aspects of CB independence were chosen and different were underlined. Thirdly, the origins of this choice lay in the scarcity of indices for certain groups of countries. Problems with obtaining trustworthy information, political turnovers or other instabilities caused smaller variety of indices calculated for developing countries. On the other hand, the same reasons led many to recalculate existing measures and give new values. Some measures have been unified and connected by the definition. Hence, there is no measure calculated by Arnone et al. (2006) but their work is used as the update for the GMT. Similarly, the author used values of TOR calculated by few (despite small differences in values) to build a long data set for this index. All sources of data have been acknowledged and included in the references.

Other explanatory variables The choice of explanatory variables depends on samples (on special characteristics of each sample), the length of

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[6]For a recent larger discussion on the types of CBI measures see e.g. "The Measurement of Central Bank Autonomy: Survey of Models, Indicators, and Empirical Evidence", M. Arnone, B.J: Laurens, and J-F Segalotto, *IMF Working Paper*, 2006

series available and adequacy to the problem. Originally, we have tried to build similar models for all countries, since it would help us to compare future results. Later, however, we have decided to choose explanatory variables from many we have collected based on regressions' diagnostics, to achieve the best models. The full list of independent variables we have considered can be found in the Appendix, and the final choice can be read from result tables.

Dependent variable Defining a dependent variable may cause as many problems as finding suitable collection of explanatory ones. First empirical studies, and some currently, use the average annual inflation rate as the dependent variable, others introduce different definitions. Cukierman chooses to use a depreciation in the real value of money, $d = \frac{inflation_{i,t}}{1+inflation_{i,t}}$. He claims, several explanations stand for doing so; first, it better represents the real losses on holding of money balances; and second, it moderates the effect of outliers with very high levels of inflation.

Our main dependent variable is the annual percentage change of the consumer price index. We find it fits better to the data than mentioned above depreciation in the real value money. In previous versions of this paper, we have also tried to use a percentage change in inflation rate to eliminate large differences in inflation values. We have kept it for discussion in a part relating to developing countries.

3.2.1 Sources and frequency

While collecting the data, we have tried to refer to the one common source for the whole sample, and hence, most of the data have been downloaded from the International Monetary Fund *World Economic Outlook Database* web-pages, as well as Penn World Tables. Additional help, including more detailed description of the data, has been reached from the printed version of the same source.

We have decided to introduce variables concentrating on the democracy or conflict description in some countries (e.g. developing). For the variables describing *conflict* we have used *Databanks International. Banks Cross-National Time-Series Data Archive*.[7]. Data on political instability have been found in: Beck, T., G. Clarke, A. Groff, P. Keefer and P. Walsh, 1999, *New tools and new tests in comparative political economy: The Database of Political Institutions*, July 1999. Additionally, we have decided to control for the oil price, especially in emerging and developing countries. The source of the data on crude oil prices has been found at the Energy Information Administration (Official Energy Statistics from the U.S. Government).[8]

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[7] Available from Trinity College Web site, http://timeseries.trincoll.edu/

[8] http://www.eia.doe.gov/emeu/steo/pub/fsheets/real_prices.html

An important feature of the legislation process is that it is changed rather infrequently, once for several years. This quality determines the frequency of our data, which is annual. The longest series can be found for advanced countries (1970 - 2006), the shortest for transition ones (1990 - 2006). We identified years of significant change in CBI-related legislation in each country. Subsequently, we have assumed that the value of CBI for a country will be the same between the first and the following amendment of the legal statues. Since this assumption introduces measurement error, we have also performed the analysis for the decennial division of periods (or, as in case of transition economies, we have chosen the most important legislation year for most of countries, as the time-series divider), relating to original studies.

3.3 The model and comparison

The ongoing economic division among countries leads to some implications in the theoretical and empirical studies. Series of regression has been run separately for advanced and nonindustrial countries. Due to several time-series periods and the changing cross-section sample, panel data approach has been used as an econometric method. Regressions are run with the OLS method (mainly), corrected for White period. Samples are divided according to the IMF classification (as for October 2007).

3.3.1 Analysis of correlation

Firstly, the analysis of correlation is performed to find how close, in their values, CBI measures are. Table 4 in the Appendix presents first comparison results reporting correlation coefficients for advanced countries.[9] For all samples, due to the character of TOR and PROB measures, the correlation sign is expected to be negative; higher value of the legal independence should correspond with lower turnover rate of governors.

Clearly, most of legal measures are highly correlated with each other. We would have expected however larger number of significant results keeping in mind that all indices try to quantify the same phenomenon.

3.3.2 Estimation results

As mentioned at the beginning of this paper, we have performed probably hundreds of regressions, which were supposed to lead us to answers on the "best of the best" measures of CBI. We have also built regressions differently, using many explanatory variables chosen by us, and suggested by readers of previous versions of this study.[10] For samples, which could be characterized

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[9]We have also found correlation coefficients for other samples. We do not report all of them simply because the correlation patterns repeat.

[10]The full list of variables can be found in the Appendix.

with larger number of CBi measures, that is advanced and transition countries, we have decided to use the Principal Component Analysis to extract essential factors. Later we use these factors as regressors, instead of original indices, and observe their explanatory power.

We include a description of our results for each sample. Later, in the concluding section, we summarize them and systemize according to our major research questions mentioned in the introduction.

Industrial countries   First studies on CBI focused mainly on the group of advanced countries. There was probably several reasons but easier access to the reliable data could be mentioned as the one. It resulted with a large (more than 10 original definitions) number of CBI measures. We tried to capture all of them, and did not include those, which were built based on some statistical modifications of previous studies (like Alesina and Summers "average" index).

The final version of the model resulted from many substitutions, assumptions of including both macroeconomic variables and political one, as well as based on model's fit. First, we use the Ordinary Least Square (OLS) regression method (corrected for White period), similarly to other studies. Later, we have tried to perform Two-Stage Least Square (TSLS), to avoid problems of not fulfilling the OLS criteria by the regression. Despite original idea of estimating basic bivariate models, we have decided not to repeat the error made by some previous studies. It is true that bivariate models bring little informative value. Therefore, we have estimated multivariate models, results of which we extensively report in the text and in the Appendix.[11]From the correlations test it is expected that GMTE and PROB may provide the most accurate model and significant results for advanced countries. In other samples there is no such an assumption. Below we summarize the results.

The annual data fit best to the regression including lagged 1 year inflation rate, logged real gross domestic income (adjusted for terms of trade changes) and prices of gasoline.

With this specification, GMTO, GMTE and PROB have the strongest explanatory power; the same significant results are received when gasoline is exchange for XRATE. GMTP appears to be significant only when real gross domestic income in original version, insignificant when logged. Similar limits are observed for LVAU, which is significant with gasoline, however insignificant with XRATE. PROB has an expected positive sign and significant; better results of equation for gasoline, while TOR has a negative sign with both XRATE and gasoline, however insignificant. Alesina proved to have a negative sign and the result is significant but equation's fit is worse that with GMT measures. Similar results that Alesina have ES and BP. CBI_{Index} has a negative sign (insignificant) with gasoline but positive one

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[11]This rule will apply to all samples.

(insignificant) with XRATE. Finally, adding POLITY2 to regression does not bring significant changes, except that some outcomes like for GMTO are more significant that previously. Real gross domestic income gives a better fit than growth of GDP per capita.

Data averaged to decades have the best fit to regression including POLITY2 and real gross domestic income.

When gasoline or XRATE included, specifications get worse; these variables are insignificant. Averaging limits periods to three, hence we do not include lagged inflation rate. GMTO, GMTP, GMTE, all three have a negative and significant sign. Both LVAU and TOR repeats previous results; both are negative and insignificant. Alesina has a negative sign and significant but two explanatory variables are not significant, adjusted R^2 is low, other tests of fit are not good either. Similar results for BP and Distance, while ES gives a bit better results than these two. CBI_{Index} doesn't bring any interesting, neither significant results.

TSLS includes CBI measure, lagged inflation rate, and logged domestic income. Instrument list: alternatively constant, XRATE, POLITY2, UNEMP, DEFICIT/GDP.

The most important change is achieved with TOR, which, with this regression method, is positive (hence as expected) and significant, with adjusted $R^2 = 0.8$. Moreover, again GMTP gave negative and significant results (the only one among GMT measures). Among other measures, only PROB and ES resulted with expected signs (insignificant). Other measures had their coefficients with a positive sign, insignificant results, lower or rather low Durbin-Watson values.

Emerging markets An interesting group of countries appeared to be the one including those, which are not yet advanced but at the same time cannot be characterized with typical features known for poor, developing states. The number of CBI measures constructed for emerging markets is much more limited than for advanced ones. Here, in order to include large sample (19), we have distinguished three measures: TOR, LVAU, and GMT.

Along with previous studies, we believe that TOR will be the best index, since it carries elements of political in(stability). Additionally, we collect and include (alternatively) few measures of democracy or political instability, like LIEC, CHECKS, CONFLICT, or POLITY2. Similarly to other groups of countries, we have built several models, looking for the best fit. Previous versions of this paper included growth of GDP, measure of openness, and effects of gasoline prices. This study reports the following results.

- The annual data fit best to the regression including lagged 1 year inflation rate, LIEC, and growth of GDP per capita
    - Among political measures only LIEC brought some explanatory

value and results were significant. Neither POLITY2, nor other measures mattered.

– Additionally it was better to include growth of GDP than real gross domestic income. We did not modify the dependent variable by using logarithms due to very large negative values.

– TOR reported expected positive and significant values of coefficients. Differently to previous versions of this paper, as well as to some other studies, we have obtained a negative and significant sign of coefficient for LVAU (total panel (unbalanced) observations: 425). In this case specifications of the regression were rather good, with relatively high adjusted R^2. The coefficient for GMT had a negative sign but the result was insignificant.

– Including a depreciation of money value as a dependent variable resulted with a rather poor model, only 0.001% of adjusted R^2, and other diagnostics much worse than in previous versions of the model.

• Decennial data, built on averages, eliminate some information that's why we expect to receive different outcomes. Originally we can distinguish 3 periods (with the last period shorter than 10 years). However, in the process of fitting the data to the model, we have decided to add lagged one period gasoline prices, and hence we end up with 2 periods and 18 cross-sections. Additionally, the model includes measure of political instability CONFLICT (alternatively with gasoline) and growth of GDP per capita.

– Among three measures, this time only TOR resulted with expected sign (positive) and significant coefficient. Coefficient for CONFLICT is insignificant, and eliminating it brings better regression diagnostics. However, it causes increase in Durbin-Watson value (up to 2.6). Replacing TOR with LVAU causes loss of significance for the CBI coefficient. LVAU has a negative sing but otherwise the model looses on its fit. Surprisingly, we were able to receive significant results for GMT. Even bigger surprise was to receive at the same time a positive (in contrast to expected) sign for this coefficient.

The summary of results written above prove that TOR does fit the best for less developed countries. However, significance of LVAU also shows that, along the passing time and better economic results, this group of countries moves towards institutional design of industrial nations. Modification of the data by averaging to periods proves our assumption of receiving contradictory results.

Transition countries   For this sample of countries, we performed and report the estimation results both for original and periodical data (similarly to emerging markets). Due to the institutional changes during the transition time, two periods have been distinguished for transition countries, where years 1997-1998 are used as dividers. The first period is unequal for some countries due to their late (later than 1990) creation, as well as problems with obtaining reliable statistics since the beginning.

Former socialist countries in Central and Eastern Europe (CEE) have been under greater investigation in recent years, hence a larger number of CBI measures constructed for this sample. We were able to run here a PCA analysis, which among nine measures (LVAW, LVES, GMTE, GMTP, GMTE, TOR, TORMAS, OI, CBI_{DF}) extracted three factors[12]:

- one focusing around legal measures (FAC1)

- one for turnovers of governors (FAC2)

- and one for two other measures, which construction method, and hence focus they laid on, was different from legal measures (FAC3).

When included in the model, only FAC1 reported significant results, resulting with a negative sign of coefficient.

Our supposition that the modification of data by averaging can bring different results is well seen in this example. It is hard to make a decision whether LVES (legal measure) and TOR (actual independence) describe the data better than measures by Grilli, Masciandaro and Tabellini, which are significant in the second experiment.

Developing markets   We were not able to obtain any significant and reliable results for developing countries. The reasons of this may be of course our inability of finding the best regression equation. We have tried many modifications, including defining the dependent variable as the change of inflation $\Delta \pi = \frac{\pi_n - \pi_{n-1}}{\pi_{n-1}}$, and choosing different control variables as seen below:

$$
\begin{aligned}
\Delta \pi_{i,t-1} &= \beta_o + \beta_1 CBI_{i,t} + \beta_2 \frac{world\pi_t}{\pi_{i,t}} + \beta_3 CHECKS_{i,t} \\
&\quad + \beta_4 XRATE + \beta_5 DEF_{i,t} + \epsilon_{i,t}
\end{aligned} \tag{1}
$$

With such a model, TOR proved being a good explanatory variable. However, we have tried to modify this regression with other variables like the price of gasoline and conflict, instead of checks, as well as use differencing for the dependent variable. Neither of these transformations worked well enough to report results in this study.

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[12]Varimax, Kaiser 0.664

3.4 Additional statistical tests

3.4.1 Extracting factors

Having an adequate number of CBI measures, we performed several Principal Component Analysis tests aiming to extract factors. Number and type of measures included in the analysis was determined by Kaiser-Meyer-Olkin measure of sampling adequacy (KMO)[13]. Factors received by rotating with Varimax; factors scores obtained with the Anderson-Rubin method.

Advanced countries When included both Alesina and ES indices, along with "standard" package of measures, The KMO test manages to reach 0.613. However, due to short time series for two first mentioned measures, this analysis covers only 37 observations. Excluding them, and thus increasing the number of observations results in the significant decline in the KMO test (0.474).

The first extraction brings three factors. We would expect exact division between legal and non-legal factors but due to a larger number of statute-reading based measures, a legal factor is divided into two parts. Hence, one factor (FAC1) included indices Alesina and LVAU, placing them however on the opposite side in the plot (Alesina with a negative sign); FAC2 consists of the remaining measures that is GMTP, GMTO and ES (all with the same sign); finally FAC3 reminds a typical non-legal measure including TOR and CBIPROB, however with a modification of GMTE having an opposite sign to two previous ones.

The second extraction, that is without Alesina and ES, brings two factors: FAC1 with LVAU, GMTO and GMTP, and FAC2 the same as previously. These two factors performs relatively well in the test with decennial data. The first factor shows negative and significant relationship with inflation, the second one shows also a negative but insignificant one.

Transition countries We were able to receive the highest value of the KMO test(0.664) for a group of indices including: LVAW, LVES, three measures of GMT, TOR, TORMAS, OI, and CBI-DF. It resulted with the extraction of three factors: one including all legal measures, second combining two measures of actual independence, and third one with just one measure CBI-DF.

3.4.2 Stepwise selection

Using statistical applications, we have performed a regression using stepwise selection method. We have decided to include only CBI indices as

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[13]The KMO statistic varies between 0 and 1, for values closer to 0 indicating very poor sampling, and close to 1 superb sampling choice. See Hutcheson and Sofroniou (1999), "The multivariate social scientist".

explanatory variables. We are aware of drawbacks that this method carries, hence we treat it as an additional supplementary test. It is also necessary to mention that we have recorded high partial correlations between few measures. Our method criteria was based on probability of entering F≤0.50, and probability of removing from regression F≥ 0.100.

At first, we have included all available for us measures but some of them were not accepted by the programme. Eliminating few, which have not performed well in previous regressions, we ended our selection to 3 (5) the most important and most discussed indices: three measures by GMT, LVAU and TOR.[14]

Advanced countries In the test based on annual data, the only regressor included was GMTE, however diagnostics of regression were very low: adjusted R^2 reached 0.025, D-W=0.4. Then, we turned into decennial data, having in mind it brought interesting results in previous analysis. This time, we could also include 2 factors, extracted in the PCA analysis (one for legal, and one for nonlegal attributes). Here we started from including also measure by Alesina and ES, keeping in mind they were calculated just once and for limited number of countries. In the first analysis (with number of observations equals 15), Alesina appeared to be the stronger regressor. R^2=0.613, D-W= 1.578.

Since as noticed, previous test limited us to 15 observations, we repeated it excluding Alesina and ES, staying with N=40 (still keeping factors in). The result was not very surprising. We received 3 regressors this time GMTE (again), GMTO and LVAU. However, while both GMT measures had very strong significant and negative sign of coefficients, the same for LVAU appeared to be positive.

Our final trial for advanced countries focused only on five major indices, excluding those extracting with PCA. Again, we used decennial data and were able to include 43 observations. The pattern has repeated also in this test. The only variable chosen was GMTE, with adjusted R^2 equal 0.342, and diagnostics for Durbin-Watson being low, 0.985.

Transition countries Apart from "standard" package of CBI indices, we were able to find other original measures, as well as extract from this group three factors. It gave us a number of 14 measures, adding first the measure by Freytag and Masciandaro (FM), new values of TOR, and three factors, hence starting with N=40. Stepwise selection entered four variables into regression, with somewhat surprising signs of coefficients: FAC1 (neg.), GMTO (pos.), GMTE (neg.), and LVAW (pos.). Next, eliminating FM, our number of observations rose to 80, including to the regression three variables mentioned above, with the same signs (GMTE was not included this time). Finally, we

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[14]Selected results are reported in the Appendix

have also excluded factors, and left the group of "standard" CBI measures (three GMTs, LVES, LVAW, and twice TOR), which helped us to raise the number of observation significantly up to 210. This time, only measures of "actual" independence were included: TOR and TORMAS, of which only TORMAS 'produced' expected positive sign. Finally, repeating the same test for periodical data, we obtained the same outcome as previously.

4 Who is the winner? - conclusions...

The major goal of this paper, choosing the most adequate CBI definition, is done by the empirical verification of the impact that each index has on the economy. The value added of this work is gathering and comparison of several various measures of central bank independence. The theoretical discussion on their precision did not bring the consensus and did not point the optimal design for central banks. Thus, this study reaches for empirical methods in order to point the "winner".

We have faced many drawbacks since the beginning of the study. All samples are of very different patterns when macroeconomic variables are concerned. Starting from the dependent variable, it is not clear whether simple annual change of inflation rate is 'good' enough for the model, or the depreciation rate introduced by Cukierman et al. (1992) should be used here. We were not able to find a model that would suit all the data. We found that the modification of the frequency of the data may change the final outcome.

Table 2: Summary of results for advanced and transition countries.

ADVANCED	COUNTRIES			
TEST	OLS-annual	OLS-period	Stepwise-annual	Stepwise-period
Expected, Significant	GMT *3 PROB, BP, ES Alesina, LVAU	GMT*3 Alesina, BP ES, FAC1	GMTE Alesina	GMTE(3) GMTO(3) GMTE(4)
Expected, Insignificant	GMTP LVAU	LVAU FAC2		
Unexpected Significant				LVAU(3)
Unexpected Insignificant	TOR	TOR		
TRANSITION	COUNTRIES			
Expected Significant	FAC1	GMTO, GMTP TORMAS	FAC1(1,2) GMTE(1), TORMAS(3)	TORMAS(4)
Expected Insignificant		GMTE TOR		
Unexpected Significant			GMTO(1, 2) LVAW (1,2), TOR(3)	TOR(4)
Unexpected Insignificant		LVES LVAW		

Notes: Numbers in brackets stand for the number of regression.

We are summarizing the results in the table 2. We indicate a type of the

sample, the frequency of the data, whether the result was expected at the beginning of the study, and if this result was significant.

4.1 Choosing the best

Regardless all problems, the group of advanced countries is the strongest example that the process of disinflation has been accompanied by increasing degree of central bank independence in many countries. Long 36 years period, several changes in the degree of CBI with the upward trend and, despite financial turbulences at the beginning of the 1990s, decreasing inflation rate, this all prove to be significant in the search for a negative relation between CBI and inflation.

Based on this report, we would point to the measure constructed by Grilli, Masciandaro and Tabellini as the "winner" in this selection. The commonly accepted as the right one, legal index LVAU (or LVAW), has failed to explain the change in inflation in some tests. The main difference between LVAU and GMT is weighting method. The former distinguishes different importance of CBs' attributes, whereas the latter gives equal number of points to all of them. Perhaps, this second option eliminates researcher's arbitrariness, makes the measure more objective and this way, more universal.

4.2 Do differences in legal proxies matter

The analysis performed by Cukierman (1992), which led him to the conclusion mentioned in the introductory part of this study, is one of the most influential in the history of studies on CBI and its relations with inflation. At the moment of his study, a limited number of CBI measures was available.

One of our aims in this paper was to challenge an opinion that differences in regression results would be mainly caused by differences in institutional development of countries, rather than variations in legal proxies of CBI. With considerably long time series and large cross-country data, as well as varying tests, we were able at least to hint the thought of contradictory results given by "competing" CBI measures within the same sample. While legal proxies by Grilli, Masciandaro and Tabellini performed in the majority of tests for advanced countries as expected, other failed to prove their significance.

4.3 Ways of receiving preferred results

In this experiment, we have observed that data on CBI is vulnerable to data modifications. Averaging time-series from annual to periodical causes significant loss of information for some countries followed by the loss of significant relations, and at the same time leads to obtaining different outcomes.

Opposite signs received for measures of turnover ensured us with our assumption that this measure depends a lot on other factors than those con-

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cerning central banks. Due to its composition, a fraction with a changing period (months, years) in the denominator, it is possible to obtain contradictory results for the same country within a very short period of time. Hence, in a stepwise selection method, we could obtain varying (opposite) results for the same (by definition) measure, with a moment of measurement being different.

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A Measures, their authors and description

1. BP - Bade and Parkin (1988) - Focus on three main criteria: (1) relationship between a central bank and a government in the formulation of monetary policy; (2) procedures in appointing the board of the central bank; (3) financial aid and budgetary relations between the central bank and the government.

2. Alesina - Alesina (1988, 1989) - Similar to BP and additional interest if the central bank is not required to absorb the excess supply of short term treasury bills.

3. GMT - Grilli, Masciandaro and Tabellini (1991) - GMT introduces definitions of political (GMTP) and economic (GMTE) independence. The first one is determined by (1) procedure leading to appoint members of the central bank board; (2) relationship between monetary authorities and the government; (3) formal responsibilities of central banks. Economic independence is described for example by (1) the government's ability to influence their amounts of borrowings from the central bank or; (2) the nature of monetary instruments, which remain under control of the central bank.

4. LVAU - Cukierman (1992) and Cukierman et al. (1992) - Based on sixteen CB attributes divided into four clusters, relating to (1) appointment, dismissal, and term of office of the chief executive officer of the bank (CEO); (2) policy formulation and resolution of conflicts between the executive branch and the CB; (3) objectives of the central bank; and (4) legal restrictions on the ability of the central bank to lend to the public sector.

5. TOR and VUL - Cukierman (1992) and Cukierman et al. (1992) - Turnover rate of governors and the measure of vulnerability have been called the 'actual' independence indices. The first one decides on the degree of CBI based on the turnover (change) on the CEO post. The latter provides more sensitive analysis looking at the probability of dismissing a central bank governor shortly after a political change of the government.

6. TORMAS - turnover of governors updated for transition countries (Maslowska, 2007, unpublished).

7. ES - Eijffinger and Schaling (1993) - This measure focuses on criteria concerning (1) the central bank being a sole final monetary authority or being one of many subjects deciding on the monetary policy; (2) presence of the government authority in the bank board; (3) independent (or non) procedures of the board's members.

8. Distance - Fratianni and Huang (1994) - The measure is constructed based on nine different measures of CBI and their arithmetic mean. The German Bundesbank being the benchmark with the value of unity, the values for other measures were calculated using the following formula: distance=$\sqrt{(average-1)^2 - variance}$

9. CBI-Index - Freytag and Masciandaro (2005) - The CBI index is the aggregate of eight of the twelve components of the monetary commitment index index.

10. OPCBI-N - Eijffinger and Schaling (1995) - The optimal degree of CBI (normalized) as explained by by the NAIRU, the number of years that a left-wing (socialist) party has been in government, variance of output growth, and the ratio between the compensation of employees paid by resident producers to resident housholds and GDP.

11. PROB - Krause and Méndez (2007) - A measure of CBI that incoporates the probability that there will be a turnover in the central bank governor following a government change.

12. CBI-DF - Loungani and Sheets (1997) construct their index by combining elements of the GMT index considering Debelle and Fisher methodology. CBI-DF is formulated on the basis of Debelle and Fischer (1994) work that attributes equal weights on goal and economic independence

13. SIB - (Loungani and Sheets, 1997) - formulated by evaluating the similarity of attributes between a given central bank and the German Bundesbank.

14. OI - overall independence (Maliszewski, 2000), measure by GMT modified with two factors, which refer to provisions for governor's dismissal as non-political only (political independence) and consider whether all direct credit is securitised (economic independence).

Attribute/Measure	BP	Alesina	ES	GMT	Legal	FM	LS	Rank
Policy responsibility								2
* is CB the sole final policy authority	●	●	●	●	●	●		
* is this authority entrusted to the CB alone			●	●	●	●		
* is it entrudted to G			●		●	●		
* is CB given an active role in formulation of the G's budget					●			
Presence of the G's representative in the CB's board	●	●	●	●				
* does he has a vote							●	
* does he has a veto power							●	
CEO and board appointment								4
*CEO not appointed by the G				●	●		●	
* length of CEO appointment				●	●		●	5
* CEO allowed to hold other office					●			
* CEO an expert						●		
* more than half of the board appointed independently	●	●	●				●	
*none of the board appointed by the G					●		●	
* length of board appointment				●			●	
Financial and budgetary relations between CB and G								6
* direct credit facility not automatic				●	●	●		
* DCF is at the market interest rate				●	●			
* DCF is temporary				●	●	●		
* DCF is of limited amount				●	●	●	●	
* CB does not participate in the primary market				●	●	●		
* discount rate is set by the CB				●	●			
* circle of potential borrowers					●			
* who decides control of terms of lending					●			
Conflict resolution rules		●		●	●		●	3
Responsibilities for commercial banks supervision		●						
Locus of legal commitment					●	●	●	
Accountability of the CB						●		
CB controls monetary instruments							●	1

Table 3: Similarities in measures

Notes: BP-Bade and Parkin, ES-Eijffinger and Schaling, GMT-Grilli, Masciandaro and Tabellini, Legal-Cukierman, FM-Freytag and Masciandaro, LS-Loungani and Sheets, Rank-Frey et al.

B   List of variables

1. Inflation - average consumer prices, annual percent change (World Economic Outlook Database for October 2007).

2. Growth rate of Real GDP per capita (Constant Prices: Chain series), unit: % in 2000 Constant Prices. (PWT, 6.2)

3. Real Gross Domestic Income (RGDPL adjusted for Terms of Trade changes), unit: I$ terms of trade in 2000 Constant Prices. The RGDPTT variable is Gross Domestic Income and follows the recommended method in the UN System of National Accounts. (PWT, 6.2)

4. XRATE - historical exchange rate regimes (IMF publications and Reinhart C.M., and K.S. Rogoff, The Modern History of Exchange Rate Arrangements: a Reinterpretation, NBER *Working Paper*, No. 8963, 2002.)

5. xrate - Exchange Rate, unit: US=1 in General Variables (PWT, 6.2)

6. Openness in Current Prices, unit: % in Current Prices. Exports plus Imports divided by GDP is the total trade as a percentage of GDP. The export and import figures are in national currencies from the World Bank and United Nations data archives. (PWT, 6.2)

7. Openness in Constant Prices, unit: % in 2000 Constant Prices. Exports plus Imports divided by RGDPL. This is the constant price equivalent of the OPENC variable and is the total trade as a percentage of GDP. (PWT, 6.2)

8. Government general balance as a percent of GDP (World Economic Outlook Database for October 2007).

9. Unemployment rate - Percent of total labor force ((World Economic Outlook Database for October 2007).

10. Oil - Refiner Acquisition Cost of Imported Crude Oil (IRAC) (nominal us dollars). (Energy Information Administration, www.eia.doe.gov)

11. Gasoline - Retail Gasoline Price, cents/gallon, cpiu adjusted (Energy Information Administration, www.eia.doe.gov).

12. CONFLICT - The weighted conflict index is calculated in the following manner: Multiply the value of the number of Assassinations by 24, General Strikes by 43, Guerrilla Warfare by 46, Government Crises by 48, Purges by 86, Riots by 102, Revolutions by 148, Anti-Government Demonstrations by 200. Sum the 8 weighted values and divide by 9. The result is the value (with decimal) stored as the Weighted Conflict Index. (http://library.trincoll.edu/timeseries/)

13. LIEC - Legislative and Executive Indices of Electoral Competitiveness (Database of Political Institutions: Changes and Variable Definitions, Philip Keefer, Development Research Group, The World Bank Issued: July 2005)

14. CHECKS - Checks and balances (Database of Political Institutions: Changes and Variable Definitions, Philip Keefer, Development Research Group, The World Bank Issued: July 2005)

15. POLITY2 - POLITY IV PROJECT, Political Regime Characteristics and Transitions, 1800-2006, Center for Global Policy School of Public Policy George Mason University and Center for Systemic Peace www.systemicpeace.org/polity4.

C Correlation coefficients and selected results from estimations

Table 4: Simple correlation coefficients for a group of advanced countries

Measure	GMTE	GMTP	GMTO	LVAU	TOR	BP	ALESINA	ES	PROB
GMTE	1	0,326*	0,791**	0,562**	0,018	0,425	0,574*	0,210	-0,464**
GMTP	0,181	1	0,781**	0,766**	0,00	0,440	0,571*	0,492*	-0,207
GMTO	0,584**	0,626**	1	0,849**	0,23	0,554	0,665**	0,407	-0,359*
LVAU	0,391**	0,597**	0,651**	1	0,068	0,682*	0,664**	0,560*	-0,111
TOR	-0,017	-0,120	0,25	0,059	1	0,256	-0,40	-0,165	0,383*
BP	0,387	0,298	0,403	0,340	0,224	1	1,00**	0,824**	-0,198
ALESINA	0,507*	0,373	0,513*	0,395	-0,062	1,00**	1	0,628*	-0,031
ES	0,140	0,271	0,263	0,269	-0,088	0,702**	0,430	1	-0,432
PROB	-0,329**	-0,154	-0,230	-0,103	0,294*	-0,245	0,00	-0,434*1	

Notes: Upper part Pearson's, lower part Kendall's nonparametric coefficients.

Correlation is significant at the: ** - 0,01 level, * - 0,05 level.

Table 5: Results of regressions - for advanced countries (OLS: annual | periodical | TSLS

Regressor	(1)	(2)	(3)	(1)	(4)	(5)	(2)	(6)
Constant	14.17**	12.05*	7.36*	21.12***	113.788**	-32.22	-48.66**	-41.99**
CBI	-1.37**	-1.89*	1.34**	-6.67***	-1.2**	-2.58**	1.58	7.75*
$\pi(-1)$	0.79***	0.78***	0.769***			1.06***	1.19***	1.09***
logRGDI	-1.49**	-1.23*	-0.92**		-8.74***	3.345*	4.66**	4.056**
GAS	0.01***	0.014***	0.013***					
POLITY2				-0.22**	-2.24			
RGDI				-0.0005***				
N.Obs.	748	748	500	63	40	522	522	522
Adj. R^2	0.78	0.78	0.86	0.74	0.64	0.79	0.77	0.81
D-W	2.09	2.08	1.588	1.82	1.2	1.478	1.57	1.66

Notes: where CBI≡(1) GMTO, (2) GMTE, (3) PROB, (4) FAC1, (5) GMTP, (6) TOR
(*), (**), (***) - significant at the level of 0,1; 0,05; 0,001 respectively

Table 6: Results of OLS regressions - for emerging markets (annual | periods)

Regressor	(1)	(2)	(3)	(4)	(5)	(1)	(3)	(5)
Constant	-132.99**	8.27	71.33**	149.65**	53.35	-330.6*	205.1**	-359.9*
CBI	262.82***	220.58***	-115.8*	-141.69*	-119.09	403.1***	-60.3	257.2**
$\pi(-1)$	0.43***	0.43***	0.457***	0.45***	0.46***			
LIEC	21.7**		12.72*		14.08			
POLITY2		3.57		5.29*				
CONFLICT							-0.223	
GDPG	-21.02*	-21.23*	-23.95**	-24.43**	-23.77**	-29.6*	-41.42**	-31.1
GAS(-1)						1.76*		1.74*
N.Obs.	422	398	425	401	436	36	54	38
Adj. R^2	0.28	0.28	0.27	0.275	0.27	0.28	0.107	0.12
D-W	1.988	1-99	2-02	2.02	2.018	2.6	1.788	2.14

Notes: where CBI≡(1,2) TOR, (3,4) LVAU, (5) GMT
(*), (**), (***) - significant at the level of 0,1; 0,05; 0,001 respectively

Table 7: Results of OLS regressions - for transition countries (annual | periods)

Regressor	(1)	(2)	(3)
Constant	-0.67	2.14**	0.66**
CBI	-9.25***	-1.2*	2.297**
π(-1)	0.17*		
CHECKS	4.4**		
logConflict		0.17**	0.12*
GDPG	-0.987**	-0.09***	-0.08**
N.Obs.	69	42	34
Adj. R^2	0.49	0.42	0.51
D-W	2.14	2.14	1.46

Notes: where CBI≡(1) FAC1, (2) GMTO, (3) TORMAS

(*), (**), (***) - significant at the level of 0,1; 0,05; 0,001 respectively

Aboa Centre for Economics (ACE) was founded in 1998 by the departments of economics at the Turku School of Economics, Åbo Akademi University and University of Turku. The aim of the Centre is to coordinate research and education related to economics in the three universities.

Contact information: Aboa Centre for Economics, Turku School of Economics, Rehtorinpellonkatu 3, 20500 Turku, Finland.

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Yhteystiedot: Aboa Centre for Economics, Kansantaloustiede, Turun kauppakorkeakoulu, 20500 Turku.

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