ФІНАНСИ. БАНКІВСЬКА СПРАВА

УДК 336.77

Olimkhon F. Aliqoriev, PhD in Economics, senior researcher,
Saidislombek Saidhonov, bachelor, researcher assistant

THE EFFECT OF MONETARY FREEDOM ON THE INFLATION LEVEL IN EXTENDED TIME PERIOD: THE CASE OF LOW AND MIDDLE INCOME COUNTRIES

Abstract. *There are a number of determinants of inflation rate. Initially, the major attention was paid to money supply as the main determinant of the inflation rate. Over the last two decades different researches claim that another major determinant of inflation is Monetary Freedom of Central Banks (CB) which is measured by CB Independence (CBI) index. This research project is aimed in revealing the link between the CBI and the rate of inflation in the case of low and middle income countries. Also, the empirical analysis on the influence of institutional quality on the connection between CBI and inflation was held. The paper also prospered in solving the reverse causality problem with assistance of instrumental variable.*

Keywords: *Inflation, low and middle income countries, CBI index, Monetary Freedom, quality of institutions, instrumental variable.*

О. Алікорієв, к.е.н., ст. науковий співробітник,
С. Саідхонов, бакалавр, стажер-дослідник

ВПЛИВ МОНЕТАРНОЇ НЕЗАЛЕЖНОСТІ НА РІВЕНЬ ІНФЛЯЦІЇ У РОЗШИРЕНОМУ ЧАСОВОМУ ПЕРІОДІ: НА ПРИКЛАДІ КРАЇН З НИЗЬКИМ І СЕРЕДНІМ РІВНЕМ ПРИБУТКОВОСТІ

Анотація. *Існує безліч детермінантів рівня інфляції. Спочатку основна увага приділялася грошовій масі як основній детермінанті рівня інфляції. За останні два десятиліття різні дослідження стверджують, що існує інший важливий визначник - монетарна незалежність Центральних банків (ЦБ), яка вимірюється індексом незалежності ЦБ. Метою даного дослідження є виявлення зв'язку між незалежністю центральних банків (НЦБ) і рівнем інфляції в країнах низької і середньої прибутковості. Також було проведено емпіричний аналіз впливу якості інституцій на зв'язок між НЦБ та інфляцією. Більше того, у даній статті була вирішена проблема зворотної залежності за допомогою інструментальної змінної.*

Ключові слова: *інфляція, країни з низькою і середньою прибутковістю, індекс НЦБ, монетарна свобода, якість інститутів, інструментальна змінна.*

О. Аликориев, к.э.н., ст. научный сотрудник,
С. Саидхонов, бакалавр, стажер-исследователь

ВЛИЯНИЕ МОНЕТАРНОЙ НЕЗАВИСИМОСТИ НА УРОВЕНЬ ИНФЛЯЦИИ В РАСШИРЕННОМ ВРЕМЕННОМ ПЕРИОДЕ: НА ПРИМЕРЕ СТРАН С НИЗКОЙ И СРЕДНЕЙ ДОХОДНОСТЬЮ

Аннотация. *Существует множество детерминантов уровня инфляции. Первоначально основное внимание уделялось денежной массе как основной детерминанте уровня инфляции. За последние два десятилетия разные исследования утверждают, что существует другой немаловажный определитель - монетарная независимость Центральных банков (ЦБ), которая измеряется индексом независимости ЦБ. Целью данного исследования является выявление связи между независимостью центрального банка (НЦБ) и уровнем инфляции в странах низкой и средней доходности. Также был проведен эмпирический анализ влияния каче-*

ства институтов на связь между НЦБ и инфляцией. Более того, в данной статье была решена проблема обратной зависимости с помощью инструментальной переменной.

Ключевые слова: *инфляция, страны с низкой и средней доходностью, индекс НЦБ, монетарная свобода, качество институтов, инструментальная переменная.*

Introduction. Inflation is one of the major problems in all over the world. Over the last decades the overwhelming majority of Central Banks has experienced legislative reforms. The objective of these reforms seemed to be granting CBs with more autonomy. The governments believed that less intervention in CBs operation may lead to price stability. In a number of research papers Monetary Freedom is associated with low inflation. However, initially Rogoff [20] as a founder of such relation revealed in his findings that monetary freedom is associated with price stability which also encouraged reforms in monetary system of countries. However, there are few recent studies regarding developing countries' relation between inflation and CBs Independence. This study is dedicated to factors of inflation in particularly the impact of Central Banks Autonomy on the inflation rate. The primary objective of this paper is providing answers to the following research questions whether monetary freedom reduce the level of inflation in low and middle-income countries based on the extended dataset. Objectives of this paper are to estimate the level of CBI effect on lowering the rate of inflation, to check the influence of institutional variable on CBI and inflation and to establish causal relationship by solving endogeneity problem.

The paper contributes to existing literature by estimating the link between the Central Bank and Inflation among the developing countries in the extended time period. This paper analyzes the data from 2000 to 2010 in low and middle income countries as well as makes comparative analysis to a period from 1980 to 1990. However, this paper revisits the evidence for developing countries which is particularly important to draw policy recommendations. Also, it takes into account some specific variables which have not been taken in previous research papers.

The project is organized in the following way. Firstly, it provides with comprehend review of the existing literature devoted to the link between CBI and inflation. Then, it presents the methodology which was used in this study. The next part provides with data description and empirical results of this project. Finally, this paper draws the conclusion of findings.

Literature review. Over the last two decades the legislative reforms targeted on monetary freedom of central banks has been taking place due to assumption that such reforms lead to lowering inflation rate (Walsh [22], Waller [23]). However, the question on whether the central bank independence (CBI) has impact on price stability is under the hot debates. The first research analyses conducted on this issue were by Barro and Gordon [4], Kydland and Prescott [16], and Rogoff [20] where they argued that providing with high independence to Central Banks lead to enhancing the price stability. There are some researches on this topic which contradicts to each other (Sturm and de Haan [21]). As a result of the research conducted by Jacome and Vazquez [14] which included 24 countries, the relationship between monetary freedom and the rate of inflation was negative. Moreover, one research paper conducted by Meisel and Baron [17] tended to remove subjectivity of analyses by taking three periods of different priorities. The research conducted to huge time period and it was devoted to Colombia's economy in periods 1923-2008 where in the first period the governments gifted Central Bank with autonomy. In the second period government had invasion into the policy of CB and in the last period the policy was returned as in the former case. So, the study claims that the prices were stable in the first and the last periods or in other words in the years in which the CB had independent policy from the government. Yet, this phenomenon does not hold for developed and industrialized countries according to Cukierman *et al.* [6]. Also, one of the famous research conducted by Alesina and Summers [2] concluded that developed countries with high CBI index have low level of inflation. On the contrary, Daunfeldt and de Luna [7] claims that the majority of economies achieved low rate of inflation before reforms which granted Central Banks with independence. A study by Hielscher and Markwardt [13] claimed that quality of institutions has significant impact on the relationship of CBI and inflation. They asserted that the main culprit of different results are acquired in various research papers are caused by employing de jure CBI index which does not provide with real independence of this financial organ-

ization from government. Berlemann and Nenovsky [5], Forder [11] supports this claim in particularly for countries which are not industrialized and developed.

Researchers also faced the endogeneity problem in their analysis where the direction of causality was not clear as both scenarios may be the case: CB independence cause low inflation or low inflation cause CB independence. For instance, Posen [18] claimed that the level of CBI is measured by the power of financial sector on inflation. In other words, he asserted that the low inflation indeed causes increase in CB independence.

As a result of reviewing existing literature on aforementioned topic the research gap is revealed. In other words, the researches about influence of CBI on inflation in low and middle income were not conducted. Also, existing researches are not for extended period and the previous researches did not take nonlinearity of the model. So, the main aim of this paper is to reveal and illuminate this gap as well as to remove ambiguous results acquired in previous studies.

Methodology. This paper uses cross-section data in order to test the hypothesis and meet the aforementioned research question and its objectives. The data is acquired from the World Bank data base as well as CBI index is gained from Arnone *et al.* [3] . The sample is restricted to low-and middle income countries for which the data on CBI index, the rate of inflation, openness and others are available.

The research approach in this paper obviously is quantitative due to statistical calculations make conclusion to what extent variables are depend on. So, according to this research approach the hypothesis should be stated. A zero hypothesis (H_0) is that "monetary freedom reduces the level of inflation in low and middle income countries" which should be rejected. On the other hand, an alternative hypothesis (H1) argues that "monetary freedom does not have impact on the level of inflation in the low and middle income countries". As in this paper the quantitative research approach is used and the main trait of this approach is deductive reasoning from general to specific.

Following traditional empirical literature on inflation, the following econometric specification is used in the analysis:

$$\ln inflation_i = \beta + \beta 2X + \beta 3freedom_{it} + \beta 4openness_{it} + \beta 5OECD_{it} + u_{it},$$

where the dependent variable is the natural log of inflation rates during 2000's. *Freedom* is proxied by the CBI, *openness* is the trade openness of country *i*, measured as trade to GDP ratio, *OECD* is a dummy for OECD countries to account for quality of development; *X* is a traditional vector of control variables (money supply growth, real GDP growth).The model is developed by De Grauwe and Polan [10] and methodology follows this paper. The study was devoted to reveal whether the inflation persists always and everywhere or not.

To check whether CBI index perform adequate effect on the rate of inflation the quality of institutions (rule of law) has been implemented or in other words to reveal how well legal CB autonomy matches the actual one. Moreover, in order to solve the endogeneity problem the instrumental variable was used to find direction of cause.

Data description. The cross-section data for this research is collected from the World Bank for the period of 2000-2010. It includes variables such as M2 growth, GDP growth, Central Bank Independence index, trade openness (in which level the particular country has international trade), OECD (whether the country is the member of OECD or not). As a result, dummies are created for OECD variable in order to take into account the effect of this variable. Dummy equals to 1 if particular country is the member of OECD and 0 if it is not true. Our variable of interest is CBI index is obtained from Arnone *et al.* [3]. This indicator measures political autonomy and economic autonomy of Central Banks across countries in conducting monetary policy. The index has been calculated as of 2003. The CB Autonomy index includes such important factors as political autonomy, economic autonomy, objectives of central bank, and policy formulation. In order to measure the rate of inflation the annual average change in either from log GDP deflator is calculated. Trading account of countries or their openness is measured by dividing average share of trading account by GDP for corresponding years. Also, some countries as Argentina, Brazil and African countries have high level of average inflation. Therefore, taking the log from the average inflation is meaningful. Moreover, there are some control variables such as real income per capita where only countries with low and middle income per capita are

going to be included, dummy variables for regions as well as whether country is in the list of OECD are taken into account. All aforementioned variables tend to have impact on the average level of inflation.

Preliminary results. According to the results of the regression, money supply is positively related to the rate of inflation which proves common phenomenon. However, GDP growth has vice versa relation to inflation with significant p value where 1 unit raise in GDP growth contributes to decrease in the level of inflation by 2.26. These results follow the logic from the real economy. CBI index has negative impact on the average price change which approves a number of different studies conducted before and it has the strongest effect on inflation with significant p value. If CBI index grow by 1 unit the level of inflation goes down by 6.7 units. If CBs become more independent from government, have autonomous politics, treat authority as ordinary clients without any priorities in providing credits the level of inflation significantly stabilize. However, the dummy variable namely OECD has insignificant p value which in turn means the effect of this variable cannot be proved at 95% confidence interval. Trade openness also insignificant at 95% confidence interval and the relation of this variable with inflation is not asserted at 5% significance level.

Table 1

Variables	Coefficient	Standard errors
M2 (Money supply)	0.635***	0.135
Y (Real growth of GDP)	-2.257**	1.093
CBI	-6.690**	3.363
OECD	3.494	3.071
Lnopen (trade openness)	-1.712	1.076
Constant	16.93**	7.074

*** p<0.01, ** p<0.05, * p<0.1 R^2=0.633, Observations=90

Outlier. The test on outlier detection shows that the significance and the value of the variable have not changed significantly. This is additional evidence that CB independence is an important tool in combating inflation in countries that do not suffer from hyperinflation. The outlier countries are Angola, Mexico, and Zimbabwe where average annual inflation in these countries accounted for 25% while other 168 countries experienced average annual inflation equaling to 6,6% (Table 2). The main causes of hyperinflation in these countries were resulted from devaluation, capital flight and crises. According to empirical results, in these countries granting CB with independence may not yield reduction in the rate of inflation.

Table 2

Variables	Coefficient	Standard errors
M2 (Money supply)	0.633***	0.172
Y (Real growth of GDP)	-2.257**	1.092
CBI	-6.634*	3.363
OECD	3.028	8.488
Lnopen (trade openness)	-1.711	1.088
Outlier	0.455	9.158
Constant	16.93**	7.074

*** p<0.01, ** p<0.05, * p<0.1 R^2=0.633, Observations=90

Robustness check. This section of this paper will test the robustness of results on alternative specifications. The model for robustness check is from Hielscher and Markwardt [13]. Other variables are also included such as GDP growth, trade openness, OECD membership status and others which differentiates from the model analyzed by Hielscher and Markwardt [13]. As CBI index de jure indicates how independently central banks objectives and targets are stated. However, in order to check de facto values of CBI another variable as quality of institutions is going to be implemented. This particular study is going to take “Rule of law” to identify the real effect of CBI and it is assumed that this variable has close relation to both CBI and the rate of inflation. As Kaufmann *et al* [15]. asserts by taking two countries with high inflation rate which are Chile and Venezuela they revealed that in spite of the fact that both countries increased the CBI index to the same value. Nevertheless, the average

price in Chile normalized to 3% while inflation in Venezuela did not change from two digits number. The main culprit of such phenomenon was hidden behind the quality of institutions or CBI had not been increased indeed in the latter country. These aforementioned facts encourage analyzing the effect of rule of law.

Model description. The analysis based on the following equation developed by Hielscher and Markwardt [13]:

$$\Delta\pi_i = \alpha_0 + \alpha_1 * \pi_{t-1} + \alpha_2 * \Delta CBI_i + \alpha_3(\Delta CBI)^2 + \alpha_4 * RL + \alpha_5 * RL^2 + \alpha_6 * (RL_i * \Delta CBI_i) + \alpha_7 * M2 + \alpha_8 * y + \alpha_9 * OECD + \alpha_{10} * lnopen + u_i$$

where $\Delta\pi$ is the dependent variable which includes the change in inflation from 2007 and 1985 in particular country *i*, π_{t-1} is inflation for the first period, ΔCBI_i is difference between CBI in 2007 and 1985, *α*s represent the marginal effect of change in variables on the dependent variable, the *RL* measures the quality of institutions and stands for rule of law, ΔCBI^2 and RL^2 takes into account the magnitude of CBI changes as well as nonlinearity effect of *RL*, $RL_i * \Delta CBI_i$ includes the impact of rule of law on the change in CBI and positive α_6 shows that the increase in the rule of law controlling the change in CBI, the effectiveness of CBI increase if the quality of institutions improve.

Results. As the majority of research papers devoted to Central Bank autonomy claim results expected that CBI index increased in t2 in comparison to t1 as more and more countries have been granting their central banks with more autonomy in policy making. Hence, ΔCBI tend to be more than zero as $\Delta CBI = CBI_{t2} - CBI_{t1}$ which logically should yield vice versa in $\Delta\pi$ and it also should be more than zero as $\Delta\pi = \pi_{t1} - \pi_{t2}$.

Table 3

Variables	Coefficient	Standard errors
ΔCBI	3.584	3.117
ΔCBI^2	-7.475	6.392
RL (Rule of law index)	0.637	1.101
RL^2 (Rule of law index^2)	1.392	1.485
RLΔCBI (Rule of law *ΔCBI)	4.136**	2.092
M2 (Money supply)	-0.0396	0.0326
Y (Real growth of GDP)	-0.826**	0.378
OECD	-0.317	0.712
Lnopen (trade openness)	-2.128**	0.974
Constant	14.14***	4.620

*** p<0.01, ** p<0.05, * p<0.1 R^2=0.42, Observations=48

As can be seen from the regression table, the coefficient change in CBI is positive with insignificant p-value, however. The square of the change in CBI (ΔCBI^2) is negative but also insignificant at appropriate confidence interval. As claimed above the quality of institutions has positive value. The effect of rule of law is considerable on the change in the inflation level which accounted for 0.64. This coefficient can be interpreted as the higher the rule of law or the quality of institutions the higher the decrease in inflation in *t2* which rises the $\Delta\pi$ due to $\Delta\pi = \pi_{t1} - \pi_{t2}$ but has large p value. The quadratic term of this variable also has positive high coefficient. Yet, this variable is also insignificant. The coefficient *(rlΔCBI)* which demonstrates whether the quality of institutions has impact on the rate of inflation or not is positive and made up 4.14 and significant at 95% confidence interval . GDP growth (y) has negative value which made up -0.83 with significant p-value. It means that GDP growth has negative impact on inflation in t2 and inflation in this period tends to rise which shrinks $\Delta\pi$. Countries which are member of OECD or not has no any effect on delta in inflation as p value is insignificant according to the table. And the last variable is trade openness which is significant as p-value is less than 5%.

Solving the endogeneity problem. As a result of analysis the problem of reverse causality tends to occur. The question is whether the CBI leads to reduction in the rate of inflation or low rate of inflation contributes to high CBI index. The majority of research papers conducted on the topic of Central bank independence argues that former statement is true. In order to cope with this problem the instrumental variable is going to be implemented. Regression analyses is going to be conducted with instrument which is geographical variables and concluded the effectiveness of this instrument. This

instrumental variable was commonly used in studies regarding the relationship of CBI and inflation rate. Researches of Acemoglu *et al.* [1], Hall and Jones [12] illustrate the point. These papers revealed also that CBI alters the inflation rate and excluded vice versa.

The instrumental variable takes into account latitude which is angular distance from equator, Africa, OECD (whether countries are members of OECD or not), landlocked countries (countries totally surrounded by only land without any access to the oceans) and lnland which is natural logarithm of total area of country.

It is clear from the results of the regression that instrumental variable is significant at 5% significance level. Obviously, the CBI and inflation has negative relationship with the coefficient -11.89. One unit increase in money supply leads to 0.64 rise in the rate of inflation at 99% of confidence interval while GDP growth leads to reduction in the average price significantly by 2.25 at 5% significance level. Moreover, the trade openness also has reverse link with the rate of inflation with -1.96 which is significant at 90% confidence interval. R^2 accounted for 62%.

Table 4

Variables	Coefficient	Standard errors
M2 (Money supply)	0.640***	0.133
Y (Real growth of GDP)	-2.251**	1.068
CBI	-11.89**	5.615
Lnopen (trade openness)	-1.906*	1.125
Constant	20.49**	7.861

*** p<0.01, ** p<0.05, * p<0.1 R^2=0.624, Observations=90

Conclusion. Most of the studies conducted on the effect of monetary freedom on the price stability generally acknowledge the negative relationship of CBI and the rate of inflation. This research empirically proved in the case of low and middle income countries that CB autonomy leads to price stability by rejecting the conclusion of Daunfeldt and de Luna [7] and De Haan and Kooi [9] as they argued neither CB independence has influence on price stability nor inflation has impact on monetary freedom. These findings also provide that there is causal relationship between two variables. However, to answer the question regarding which variable cause what, effective instrumental variable should be discovered. So, with the help of instrument it can be clearly stated that the endogeneity problem has been solved as it became obvious that monetary freedom influences inflation rate. Thus, the aforementioned results supports the arguments presented in the research papers by Jacome and Vazquez [14], Meisel and Baron [17] and Alesina and Summers [2]. As in some economies in particularly in developing countries legal CBI does not correspond to the real monetary freedom in countries. Therefore, to exclude such problem the study included variable which measures the quality of institutions where it demonstrates that rule of related to CBI and price stability support in the results achieved by Hielscher and Markwardt [13]. The general recommendation from this study can be stated as to guarantee reduction in the rate of inflation the real independence of CBs should be the same as real monetary freedom otherwise the effect of CBs autonomy tend to be insignificant tool in terms of price stability.

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Надійшла 07.09.2014