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Central bank independence and sovereign debt crisis. Any link?

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ABSTRACT

In this paper we ask if central bank independence could lead to a bad fiscal position of some countries. Introducing autonomous central bank without changing other policy habits could expose the country to greater temptation to borrow money. We think that introducing high degree of CBI creates illusion that these countries are of similar credibility as a borrower. It opens new possibilities to borrow money and to increase consumption, thus leading to greater indebtedness. We analyse if the size of improvement in CBI was connected with country's increase in debt. We hypothesise that some countries could misuse the benefits coming from CBI, would not introduce discipline in other parts of economic policy and not only continue spending but also increase their volumes thanks to wider options for borrowing. Panel data estimations results using EMU-14 confirm our hypotheses. Greater increase in CBI was related to greater increase in debt, both public and private. These results are confirmed with alternative models and varying definitions of central bank independence.

JEL Classification: C33, E02, E58, E61

Keywords: central bank independence, sovereign debt, private debt, sound money, panel data

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1 Introduction

Why has sovereign debt crisis occur in Europe in 2010? A naive answer is to admit that governments, as well as simply individuals, often tend to spend more than they earn, thus they borrow. One understands that, in order to balance excessive consumption today, it is necessary to consume less tomorrow. Balancing could as well mean collecting additional income (like taxes for governments) or taking loans at the value representing discounted values of expected future income. Finally, in case of governments, generating debt in its own currency is practical because the value of debt can simply be decreased by additional inflation or repaid by issuance of money.

The available ways of balancing budgets determine the borrower's willingness to obtain new loans. For example, it is observed that Italy has consistently run budget deficits while minimizing the true cost of debt by using inflation, and yielding low or negative interest rates at the expense of bondholders (see for example IMF statistics). In principle, such behaviour is known to the public, which lends the money at the higher cost. Thus, the higher the debt accumulation, the greater danger of default and loan is obtained by the government at the higher interest rate.

The government may improve how the country is perceived in the market by introducing credible institutions, for example new monetary regime. One possibility is to delegate responsibility for monetary policy to an independent agent, who is inflation-averse and is not tempted to renege from its promise. This delegation introduces a wide range of different institutional arrangements, like choosing price stability as its main goal (a broad analysis of CBI definitions variability can be found in Arnone et al. (2006) and Maslowska (2012), ch.2). Public trust in inflation-aversion of central bank decides about the state's high inflation credibility. When present, the government can borrow all the way its maximum debt limits. It is accompanied by low key interest rate set by monetary authority (thanks to, assumed, successful disinflationary policy) and by low interest rates charged by creditors (thanks to public trust in time-consistent policy).

Central bank independence may bring many good but also harm. We think it might be harmful for countries which are not prepared for consequences CBI brings. It is possible that member states behave in an old-fashioned way, that is as if they were able to use inflation tax for their own benefit, despite joining a common currency area. They continue accumulating debt and benefit from low interest rates offered by both a central bank

and creditors because the public assumes that high inflation credibility of monetary authority is shared by member states.

Willingness to lend caused by trustworthiness of debtors is another explanation of high values of debts. In our opinion, it is also one of explanations why sovereign debt crisis occurred in recent years in Europe. A project of common currency, its necessary several monetary and fiscal criteria and successful first few years of the Economic and Monetary Union (EMU) created a profile of integrated, homogenous countries. Homogenous for example in terms of abilities to pay its debt back. Investors did not differentiate riskiness of each country properly and were lending the capital at similarly low interest rates. Financial markets came to view the sovereign debt of the EMU member states as perfect substitutes. This is how we can explain minimal differences in yields between national bonds and those issued by Germany. Common currency area created an illusion of high inflation credibility as a whole and among member states. The moment this illusion of homogeneity disappeared, a threat of national bankruptcy appeared.

What were the determinants of such an illusion? One can mention similar inflation rates, similar growth rates or obligation of fiscal discipline guaranteed by the Stability and Growth Pact. Membership in the EMU meant introducing several institutional changes in countries. Each of them was perceived by investors as a factor leading to stabilisation of domestic conditions and guaranteeing safer investment income. The union itself added additional benefits for countries like elimination of exchange rate risk.

The interest rate paid by investors depends on the term to maturity when the debt is issued. Differences in interest rates reflect often riskiness of investment. Those countries, where investors have doubts about country's financial condition and its growth prospects, would need to offer higher rates of return to attract investors. Under the Economic and Monetary Union condition for debt management change. With common key interest rate governments compete for investors mainly by introducing new policies of stability and transparency. Investment decisions related to the exchange rate variability among European currencies have also disappeared. To sum up, common euro denomination, similar inflation rates and same target interest rate eliminated key determinants of profitability differences and risk-variation among states. In the effect, Greece's participation in the EMU meant a decrease in market interest rates for Greece's debt by 11 percent per year. During the same time in Germany, this decrease was about 3-4 %, so significantly smaller.

High country's credibility may also help the government to rollover its debt. Number and type of potential debt buyers significantly increased when initially EU countries formed the monetary union. It was additionally facilitated by introducing Single European Market regulations and increasing capital mobility. Moreover, so-called period of "great moderation" made an impression that countries' stability will last and hence decreased governments' cost of borrowing.

In this paper we investigate whether increased central bank independence could create an illusion of a country being stable and credible borrower. We analyse if the size of improvement in CBI was connected with country's increase in debt. We hypothesise that some countries could misuse the benefits coming from CBI, would not introduce discipline in other parts of economic policy and not only continue spending but also increase their volumes thanks to wider options for borrowing. Panel data estimations results using EMU-14 confirm our hypotheses. Greater increase in CBI was related to greater increase in debt, both public and private. These results are confirmed with alternative models and varying definitions of central bank independence.

The next section presents a literature review and analysis of the indebtedness problem. Description of data and defining of hypotheses can be found in section 3. Section 4 contains an empirical analysis of the problem and interpretation of results. Last section concludes the paper.

2 Literature background

Countries can import credibility for monetary policy in several ways, by delegating monetary policy to an independent agent, pegging country's exchange rate to an anchor currency or joining a currency union, among many. The concept of borrowed credibility is known at least since the seminal analysis of Barro & Gordon (1983). It explains that a low-reputation country can improve on public trust if attaches its monetary policy to a credible anchor. Government achieves similar goals without losing independent monetary policy if delegates this obligation to an institution with certain preferences. Hence, a Rogoff-type central banker is a credible one if pursues its policy independently, Rogoff (1985). Additionally, government wins on public trust that stems from this delegation to a bank with higher inflation aversion than that of a median voter. Both policies have been implemented in Europe where countries gain credibility using at least delegation to au-

tonomous monetary agency. Empirically it has been showed that, indeed, seigniorage is negatively correlated with Cukierman (1992) measure of CBI for the 1980s.

Public trust in inflation-aversion of central bank decides about the bank's high inflation credibility. When present, the government can borrow all the way its maximum debt limits. However, the temptation to inflate will be "punished" with smaller debt accumulation possibilities, but also with higher its cost. Through time-(in)consistent policy, public learns true type of a central banker. Such benefits of high inflation credibility are showed by Missale & Blanchard (1994), who claim that decreasing levels of inflation rate help countries gain credibility as a borrower. Low inflation, and ultimately price stability may bring a "credibility bonus" that helps monetary authority to offset adverse inflation shocks with smaller loss of output. In terms of investments volumes, Feldstein (1999) suggests that price stability makes financial planning easier. Maxfield (1997) explains that origins of a wave of increased legal central bank independence, that happened in the 1990s in many developing countries, can be found in local governments' will to increase countries' credibility and creditworthiness to attract and retain capital from outside.

One way of leveraging country's higher inflation credibility can be achieved by joining a currency union. Decreasing inflation rates and keeping them at the defined levels was an EMU membership condition. Thus, in accordance with for example theory of Barro and Gordon, one benefit of common currency is inflation discipline. Joining currency union would form an ultimate case for a central bank, who, as McCallum (1990) has pointed out, acts as a dominant player and moves first, while forcing fiscal authorities to accommodate its policy to avoid excessive budget deficit and temptation to inflate.

Monetary unions, however, reduce the degree of competition among central banks. Fratianni & von Hagen (1993) compare introducing a common currency to elimination of product diversification. If private sector differentiates central banks by its monetary policy discipline and makes investment decisions by comparing central banks and their success in delivering low inflation rates, then monetary unions disrupt this comparison. The discipline of policy competition is lost and may result in higher average inflation rate. Membership in monetary union may also lead lead to over-excessive accumulation of sovereign debt. Aguiar et al. (2014) show that an increase in inflation credibility acts as an invitation to borrow, while reducing an incentive to save.

For years literature on optimal policy design recommended introducing higher degree of central bank independence (CBI), as a necessary condition for successful anti-inflationary policy. Some advocated its unquestionable benefits, Alesina & Summers (1993). Others, e.g. Campillo & Miron (1997); Maslowska (2011) or Sturm & de Haan (2001), have opposed to those studies claiming that CBI might be just “much ado about nothing”. Most of the studies (Grilli et al. (1991), Cukierman et al. (1992) among many) have focused analysing potential benefits of higher degree of CBI for dis-inflationary policy. An exhaustive literature analysis in this topic has been performed by Klomp & de Haan (2010). In the end, however, any relationship between lower inflation rates and higher degree of CBI may just be driven by public’s sensitivity to inflation, Hayo (1998), Vaubel (2003).

Measures of CBI have helped explaining variability in many other aspects of economy. In area of labour market institutions, one goal has been to find a link between CBI and wage bargaining (Kilponen (1999); Cukierman & Lippi (1999)). Interactions among CBI, unemployment and wage bargaining as a special case for the EMU have been studied by Hall & Franzese (1998), whereas Iversen (1999) explores possibility that wage bargaining institutions and monetary policy regimes may actually be causally linked to each other, and to inflation. Recently its usefulness has been found in explaining levels of optimal tax and seigniorage, Nolivos & Vuletin (2014), frequency of occurrence of political cycles, Alpanda & Honig (2010), and connecting the role of an independent central banker with its role as a prudential supervisor, Pellegrina et al. (2013).

Delegating monetary policy to an independent from political influence agent has implications first and foremost for governments, which lose a direct instrument to finance its excessive deficit using money creation. As mentioned above, countries increase credibility commitment to price stability by limiting the government’s possibilities to inflate. Two key indicators of CBI (by Grilli et al. and Cukierman et al.) are constructed this way, that an important share of legal attributes are related to forbidding the government to monetize public debt. Grilli et al. (1991) weight the fiscal relations between CB and government as much as 5/7 of all economic attributes, whereas it is over half of criteria in the Cukierman index (see Banaian & Luksetich (2001) or Maslowska (2007)).

With this paper we add to the analysis by trying to explain variability in countries’ indebtedness with changes in central bank institutions. In particular, we claim that higher CBI may lead some countries to over- ex-

cessive indebtedness, if it is not accompanied with parallel improvements in other institutions. Danger of higher CBI, if used improperly, lays in illusion that credibility of monetary institution spears to other institutions. Subsequently, greater country's credibility open this nation to a wide choice of funding. These investors trust not only an inflation-averse central bank but also believe in fiscal discipline (i.e. no option for debt monetizing).

3 Data and hypotheses

The choice of variables is driven by our hypotheses. For a dependent variable, we choose three varying ones. First, we use a standard measure of indebtedness, that is, a ratio of debt to GDP. Next, we consider values of debt, especially its percentage change. Finally, volumes of debt will be defined as a change between domestic savings and country's level of investments $S-I$ (as percent of GDP). Our key explanatory variable is a change in degree of CBI observed from a period to a period. We are interested in the scale of improvements in CBI, from the starting point to the date when national central banks shifted their monetary responsibility to a new and credible institution like ECB. Although the latter indicates total dependence of MP from a supranational institution, from the market agents' point of view, the ECB is more credible than the Bank of Greece or the Bank of Italy. Hence, these, and other countries gain reputation of stable and totally independent MP from the government.

We collect data at certain point of time, that is for the years 1989, 1999 and 2007, hence right before the crisis. A quite often approach is to make an analysis based on the average data calculated for certain periods. We do not follow this method, firstly because data collected are incomplete, especially in the 1980s. Averages based on the whole decade for some countries and averages for last two-three years of the 1980s are, in our opinion, not the same. The second justification is frequency of changes in legal status of central banks and connected with it values of CBI, which is rather low.

All variables, unless mentioned otherwise, are expressed in differences. This is because we are interested in how much these variables change from one period to another. In result we have three values: a change between 1989 - 1999, a change from 1999 - 2007 and a value of total difference between 1989 - 2007 (for example, $\Delta y_{89/99} = y_{99} - y_{89}$). The last value aims to indicate how radical a change occurred between these two periods in terms of institutional

design of central banks and economic observations.

The correct choice of CBI measure is a challenge due to its large variability and accessibility. Here, we primarily choose the index constructed by Grilli et al. (1991), and alternatively a measure of legal independence constructed by Cukierman (1992). The choice of index produced by Grilli et al. is justified by the fact that it includes the most important attributes of CBI, but at the same time is not too complicated. The problem of over-complicated CBI measures has been analyzed by, f.eg. Mangano (1998), Banaian et al. (1998) or Maslowska (2012). Moreover, an update by Arnone et al. (2007) adds to the analysis a world-wide trend of increasing degree of CBI. This change in central bank autonomy is also observed among countries included in this analysis.

Our hypotheses are the following:

Hypothesis 1: the greater increase in CBI ($\Delta CBI_{i,t} > 0$), the greater increase in indebtedness ($\Delta Debt/GDP_{i,t} > 0$).

Alternatively: the greater increase in CBI ($\Delta CBI_{t,i} > 0$), the greater increase in percentage change of debt ($\Delta \%Debt_{t,i} > 0$). Equipping a central bank with sole responsibility for monetary policy and forbidding monetising debt have been associated with greater democracy in the country and larger stability of the market. Countries not only borrow credibility but also gain similar conditions of indebtedness, similar access to foreign capital and similar interest coming from foreign investors. Encouraged by easy access to funds and low enforcement of the Stability and Growth Pact, governments continued and often extended their expenditure.

Hypothesis 2: the greater increase in CBI ($\Delta CBI_{t,i} > 0$), the greater increase in private indebtedness ($\Delta Privatedebt_{t,i} > 0$). Our original assumption is to focus on public debt. We think, however, that it is interesting to investigate if institutional change on macro-level have had an effect on indebtedness of private agents.

Hypothesis 3: the greater increase in CBI ($\Delta CBI_{t,i} > 0$), the smaller values of savings, the greater values of investments and hence greater indebtedness ($\Delta S - I < 0$)

This dependent variable is defined as a difference between savings and investments as percent of GDP. Its positive value means savings greater than investments. In our analysis we expect to see a negative relation between

degree of CBI and values of savings. It means that for those countries where increase in CBI was significant but no other discipline was introduced, greater credibility leads to higher consumption and discourages savings.

A basic form of the model includes measures of CBI,

$$\Delta y_{i,t} = \beta_1 \Delta CBI_{i,t} + \beta_2 \Delta(R - E) + \beta_3 \Delta R + \epsilon_{i,t} \quad (1)$$

where $\Delta y_{i,t}$ - change in degree of indebtedness, $\Delta CBI_{i,t}$ - change in degree of central bank independence, $\Delta(R - E)$ - change in difference between public revenue and expenditure as a ratio to GDP, and ΔR - change in the long term interest rates for convergence purposes.

$$\Delta y_{i,t} = \beta_1 \Delta CBI_{i,t} + \beta_2 \Delta ECON_{i,t} + \beta_3 \Delta POLIT_{i,t} + \epsilon_{i,t} \quad (2)$$

$\Delta ECON_{i,t}$ - change in economic variables and $\Delta POLIT_{i,t}$ - change in political variables that could explain variability of public debt.

Figure 1 gives a summary look at the data by plotting change in Debt-to-GDP ratio with a change in degree of CBI. Already in this sample plot of the data, there is preliminary evidence for our main hypothesis: the greater improvement in CBI, the larger increase in sovereign debt. The plot includes all countries in interest except Ireland. The state has gone through perhaps the most intensive growth period in recent years among European countries. This ‘‘Celtic Tiger’’ has witnessed high FDI rate, low tax rates, favourable business environment and the period of reducing government spending, like no other country in Europe. Hence, after analysing the original data, we have decided to eliminate Ireland as an outlier.

Additionally we have collected a wide range of economic explanatory variables. One of those is interest rate (used for convergence purposes or real rate corrected by inflation). We assume that greater decrease in interest rate have caused greater indebtedness. This is because lower cost of capital creates larger incentive to borrow. Another covariate suggested by literature is balance between public revenues and public expenditures. We expect that larger deficit causes greater debt. The full list of other explanatory variables with explanations and sources can be found in appendix.

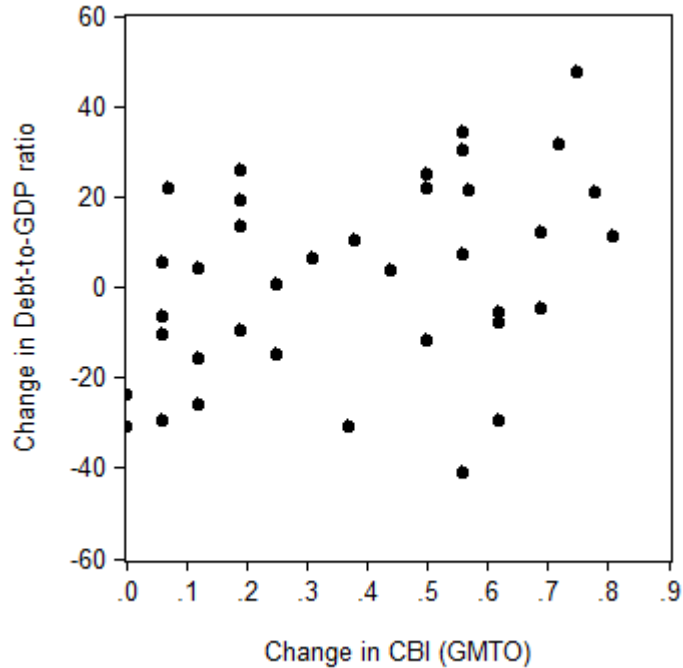


Figure 1: Change in debt-to-GDP ratios between 1989-2007 and corresponding changes in degrees of central bank independence

4 Results and their assessment

We proceed estimations starting with bivariate model and gradually add other covariates. Next, we redefine definition of indebtedness to test effects of CBI on financial balances and on the size of private loans. Finally, we test similar hypotheses by replacing measures of CBI with similar indices measuring quality of institutions and policy-making in a state. We regress models using panel data structure, Least Square with White cross-section standard errors.

Table 1: CBI and its effect on changes in indebtedness

$\Delta Debt/GDP_{i,t}$	(1)	(2)	(3)	(4)
$\Delta GMTO$	13.57 (4.43)***	28.87 (1.27)***	-7.16 (6.17)	-6.98 (5.71)
$\Delta(R-E)$		-2.12 (0.53)***	-2.58 (0.42)***	-2.53 (0.43)***
ΔR			-3.63 (0.66)***	-2.46 (4.11)
$\Delta GMTO*dR$				-1.78 (5.46)
Total obs	37	37	37	37
Countries	13	13	13	13
R-squared		0.28	0.47	0.51
$\%changeinDebt$	(1)	(2)	(3)	(4)
$\Delta GMTO$	3.84 (0.42)***	4.51 (0.63)***	-0.06 (0.37)	-0.03 (0.15)
$\Delta(R-E)$		-0.09 (0.03)***	-0.15 (0.04)***	-0.13 (0.03)***
ΔR			-0.46 (0.08)***	-0.13 (0.09)
$\Delta GMTO*\Delta R$				-0.51 (0.09)***
Total obs.	39	39	39	39
R-squared	0.35	0.38	0.82	0.89
D-W	1.33	1.53	2.64	2.06

Notes: $\Delta Debt/GDP$ - change in debt/GDP; $\% \Delta Debt$ - percentage change in debt values; GMTO overall index; R-E - revenue minus expenditure as a ratio to GDP, R - long-term interest rate for convergence purposes; Δ - indicator of change in values. Panel OLS estimates with White cross-section standard errors and covariance.

4.1 Central bank independence and public debt

Does institutional design of central banks matter for the size of public debt? Does increase in the bank's independence lead to greater accumulation of debt? Table 1 reports empirical results using GMTO as the indicator for CBI. We replicate the same analysis with remaining indices and include them in the report below.

In a simple bivariate model, as well as with budget balance as an additional covariate, coefficient on central bank autonomy has an expected sign. It means that it is observed that increase in degree of CBI has been accompanied with an increase in public debt. Hence, it is in accordance with our expectations and the first hypothesis.

A negative sign of coefficient for a change in budget balance (regression no. 2) indicates, that the greater growth of public deficit (or in fact in our case negative difference between revenue and expenditure), the larger debt accumulation. This is true for models with two alternative measures of debt. Results do not differ after replacing GMTO with other three measures of CBI (that is GMTE, GMTP and LVAU). Coefficients for both change in CBI and in budget balance are also statistically significant, however estimation

diagnostics suggest that the model is not perfect.

Large values of estimated coefficients for CBI cause a problem in its interpretation. Data suggest that they originate from divergence in scales of time series for change in debt and change in independence. The latter scores in the range [0;1], the former [-41; +47] with standard deviation of 21. That's why the interpretation of the size of this relation has to be made cautiously. A summary of descriptive statistics for key variables can be found in appendix.

Adding interest rate as a covariate changes these results quite dramatically. It seems that the cost of debt dominates the results and informs that larger decrease in interest rate is followed by greater increase in public debt. Analyzing the data we notice that the most significant decrease in interest rate values is reported for Greece (even 13 percent between 1989 and 1999), Italy (8 percent in similar period) or Spain (around 6.5 percent in reported period). The smallest change in interest rate between 1989 and 1999 is marked for Austria, Germany and the Netherlands (2.0 percent).

In models augmented for changes in interest rate, coefficient for budget deficit still remains consistent with expectations but those for CBI change a sign to negative (larger increase in CBI implies smaller increase in debt) but are statistically insignificant. This result, however would be in accordance to theory stating that delegating monetary policy to an autonomous institution introduces greater fiscal discipline.

Even though including interest rate to the model results in rejecting our first hypothesis, we find it anyway interesting for our study. It is difficult to separate institutional design of central banks and its effect on the major instrument of monetary policy. A credible independent monetary institution is able to achieve low inflation goals more effectively and adjust its level to inflation expectations driven by reputation of central bank. Thus an increase in central bank independence increases inflation credibility, which decreases the interest rate.

The fourth model in table 1 introduces the interaction between the legal index of central bank independence and the variable for interest rate. In estimations of this model, CBI measure coefficient remains with a negative sign (on contrary to our hypothesis), but is statistically insignificant. The effect of CBI is diminished the larger decrease of interest rate is observed (the coefficient on $\Delta CBI * \Delta R$ is negative).

Table 2: CBI and its effect on changes in alternative measures of indebtedness

$\Delta(S - I)/GDP$	(1)	(2)	(3)	(4)
dGMTO	0.92 (1.51)	3.05 (0.61)***	11.69 (1.68)***	11.54 (1.42)***
dGDPCAP		1.32 (0.31)***	1.39 (0.39)***	1.38 (0.36)***
dR			0.78 (0.15)***	0.48 (0.45)
dGMTO*dR				0.47 (0.69)
Total obs.	42	42	42	42
R-squared	-0.00	0.23	0.38	0.39
D-W	1.16	1.34	1.77	1.88
dGMTE				11.37 (3.14)***
dR				0.32 (0.09)***
dLVAU				12.56 (3.77)***
dR				0.38 (0.13)***
dGMTO			7.18 (1.29)***	
dPOLCON5			-18.62 (1.19)***	
dGMTO*dPOLCON5			-17.29 (7.85)**	

Notes: S-I - saving minus investment as a ratio to GDP; GMTO overall and GMTE - economic indices of independence based on Grilli et al.; LVAU - legal independence based on Cukierman; R - long-term interest rate for convergence purposes. GDCAP - GDP per capita; Panel OLS estimates with White cross-section standard errors and covariance.

4.2 Autonomous monetary institutions and other aspects of indebtedness

Figure 2 summarizes relationship between size of savings less investment conditional on change in autonomy of a country's central bank. The data have three outliers deciding about relationship between variables in question. We assume that higher degree of CBI would discourage from savings and increase spending on investment. This relationship would be driven by countries like Greece, Portugal or Spain. Austria, Germany, and the Netherlands would also fit in this group and would describe a country where habits of savings over excessive spending is accompanied with small or no change in degree of monetary authority independence.

Our hypothesis may be rejected, however, due to a strong effect of countries like Finland or Sweden, where relationship between savings and investment did not change drastically along with institutional change of central banks. We keep in mind that in case of Sweden, not only has the Riksbank improved its level of CBI, but also inflation credibility has been increased by introducing inflation targeting as the rule of monetary policy.

Results of model estimations with $\Delta(S - I)/GDP$ as a dependent variable

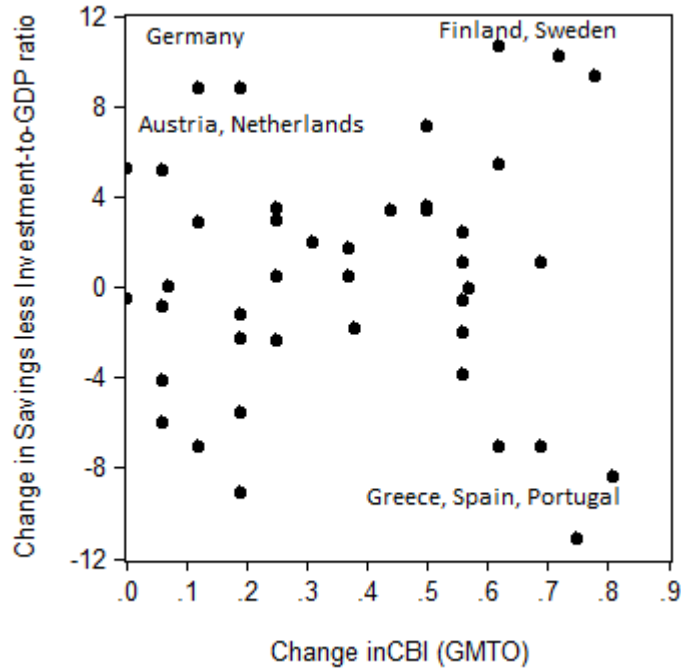


Figure 2: Change in Saving less Investment-to-GDP ratios between 1989-2007 and corresponding changes in degrees of central bank independence

reject our hypothesis, that larger improvement in degree of CBI is associated with smaller accumulation of savings and greater increase in investment. Estimated coefficients for CBI have positive signs and are statistically significant. As table 2 reports, it remains so with alternative measures of central bank autonomy. This effect doesn't disappear when values of interest rate are added as an additional covariate.

We augment the model with changes in GDP per capita, as table 2 shows. Adding other economic variables, for example, changes in inflation rate or public indebtedness do not change signs or their significance of CBI coefficients. Finally, we estimate the base model as defined in table 2 and add a variable describing continuity of government's policy *Political constraints index* V^1 , Henisz (2000). Higher values of the index inform about strong

¹Description in the next section

Table 3: CBI and its effect on changes in alternative measures of indebtedness

$\Delta Dom.Credit/GDP$	(1)	(2)	(3)	(4)
dGMTO	84.51 (24.66)**	79.41 (18.02)***	63.68 (14.16)***	33.16 (7.79)***
dU		-6.03 (0.97)***	-5.46 (0.21)***	-5.57 (0.22)***
dGDPCAP			-10.06 (1.88)***	-8.77 (2.12)***
dREG				19.18 (4.44)***
Total obs.	42	42	42	42
R-squared	-0.33	0.02	0.19	0.24
D-W	1.55	1.79	1.39	1.53

Notes: Dom.Credit/GDP - domestic credit to private sector; GMTO overall and GMTE - economic indices of independence based on Grilli et al.; LVAU - legal independence based on Cukierman; GDCAP - GDP per capita; U - unemployment rate; REG - index measuring regulation of credit, labor and business environment; Panel OLS estimates with White cross-section standard errors and covariance.

presence of political constraint to change planned policy.

Estimated coefficients are negative and thus suggest that the environment of stable macroeconomic policy discourage from savings and increases investments. Introducing the interaction between the legal index of CBI and political constraint index V still suggests that high degree of bank's autonomy increases savings over investment, but this effect is diminished as countries increase constraints on variability of government policy (the coefficient $dCBI * dPOLCON5$ is negative). The last result and its interpretation are dependent, however on the definition of CBI. When we replace GMT index by Grilli et al. (1991) for LVAU by Cukierman (1992), the interaction coefficient changes sign to positive (statistically insignificant, though) suggesting, that effect of institutional design of central banks is stronger over general policy stability.

Redefining the dependent variable once again with a measure of domestic credit to private sector supports our original hypothesis. It is observed that countries with larger increase in central bank independence witness greater boost of indebtedness in private sector at the same time (results in table 3). Thus, more independent central bank sends a signal to private entities about its chosen policy (some form of low inflation rate and price stability) and assures no political pressure would change this direction. Private sector, both creditors and debtors, understands the message, sees the bank as a credible inflation-averse institution, and is encouraged to either be a loan taker or be a creditor of funds. In result, the share of domestic credit to private sector as a share of GDP increases.

The final model (model no.4), apart from CBI measure, includes also variables measuring changes in level of unemployment, GDP per capita and a variable describing access to credit in a state. The measure called *Regulation of Credit, Labor and Business* is the Fraser Institute, Gwartney et al. (2012) index that ranges from 0-10. A value 0 corresponds to elements like ‘low percentage of deposits held in privately owned banks’, ‘high foreign bank license denial rate’, ‘private sector’s share of credit is close to the base-year-minimum’,etc. The estimated coefficient has a positive sign (according to expectations) informing that greater access to credit facilitates larger indebtedness.

4.3 Alternative measures of sound monetary policy

In this section we want to redefine our main independent variable, that is central bank independence. As already mentioned, delegating monetary policy to an autonomous agent is often associated with improving quality of other institutions in the state, as well. This presupposition is key for our analysis. Therefore, we reach for measures that could describe the soundness of monetary policy and stability of policymaking in an alternative way. We obtained the data from the Quality of Government Institute Teorell et al. (2013) and we report the original sources of data under each description.

Access to sound money Fraser Institute, Gwartney et al. (2012) Consistency of monetary policy performed by inflation-averse and independent central bank can be evaluated using key variables like levels of inflation rate or its variation. The bank’s ability to refrain from financing governments’ budget deficit can also be seen by following the speed of money growth.

Access to sound money measure is a part of a complex Economic Freedom of the World Index, and is one of five measures. Access to sound money index includes data on inflation rate and its variability, the average annual money growth and access to own foreign currency bank accounts. It ranges from 0-10 where 0 indicates high inflationary environment and 10 informs about high price stability.

Political constraints index V Henisz (2000) Monetary policy conducted by an autonomous central bank can be the more successful, the higher quality of other public institutions is in a state. Political constrains index (version V) covers several aspects defining the feasibility of policy change, that is presence of institutions with a veto power over policy change; number of public entities involved in the legislature process; the extent of party alignment

Table 4: Alternative measures of institutional change in a state and indebtedness

$\Delta Debt/GDP_{i,t}$	(1)	(2)	(3)	(4)
FISM	4.06 (0.42)***			
POLCON5		82.76 (30.24)**		70.39 (27.80)**
ICRG			-4.70 (10.66)	29.19 (12.29)**
GMTO				12.51 (5.74)**
R-squared				0.15
D-W				1.15

Notes: FISM - Access to sound money, POLCON5 - political constraints index V, ICRG - government quality indicator, GMTO - Grilli et al. measure of central bank independence

over units of government; heterogeneity of preferences within each legislative branch; and presence of the judiciary and sub-federal entities that hold veto power. Higher values of the index indicate more political constraint and thus less feasibility of policy change. From monetary authority all aspects are important; they allow to consistently conduct even less acceptable by government anti-inflationary policies without a threat of disturbances from ruling parties. We compare this index to standard measures of CBI; we assume that higher values of political constraints index would be accompanied by higher degree of CBI.

ICRG indicator of quality of government, Group (2013) The International Country Risk Guide measure collects political, financial and economic data on the presence of corruption, law and order, and bureaucracy quality in the state. Higher values indicate higher quality of government, that is absence of corruption (excessive patronage, nepotism, job reservations and financial bribes).

Results from bivariate models confirm our hypotheses in all measures, except quality of government index ICRG. Both, increase in quality of money and in policy constraints act as encouragement for borrowing.

5 Conclusions and recommendation for further analysis

The mainstream literature on central bank independence has focused its analysis on relationship between CBI and inflation rate or output variability. We

add to these studies by pointing towards possible explanatory power of CBI on degrees of country's indebtedness. In our opinion, greater CBI creates an illusion of general monetary and fiscal discipline in a state. This can encourage investors to locate their capital in these countries. We hypothesise that some European countries may have misused benefits of greater CBI, that is increased trust of investors. Greater CBI meant for them greater credibility as a borrower and led to increase in their indebtedness beyond the possibility of repayments.

This is tested using standard measures of CBI and other determinants of indebtedness among fourteen countries of the EMU during three decades 1980-2000s. Based on the estimation results we conclude that measures of CBI are good proxies to evaluate how both public and private indebtedness change. That is, the greater increase in the bank's autonomy, the larger accumulation of debt. Effect of CBI has weakened, however, when interest rate is included as a covariate. Even though including interest rate to the model results in rejecting our main hypothesis, it is difficult, in our opinion, to separate institutional design of central banks and its effect on the major instrument of monetary policy, that is key interest rate. A credible independent monetary institution is able to achieve low inflation goals more effectively and adjust its level to inflation expectations driven by reputation of central bank. Thus an increase in central bank independence increases inflation credibility, which decreases the interest rate.

Measures of central bank independence are used often in many other studies as regressors, and at the same time are widely criticized for their imprecision. That's why we search for alternative measures that would define quality of money or quality of government institutions. We find that Both, increase in quality of money (measured with the Fraser Institute index of sound money) and in policy constraints (Henisz's political constraint index V act as encouragement for borrowing.

To summarise, we think there may exist a link between current debt crisis that stem from country's excessive indebtedness and conditions to obtain this debt, which could be related to central bank institutional changes observed in the 1990s and 2000s in Europe.

This study can be improved in at least two ways². By taking first differences we eliminate unobserved heterogeneity, thus making OLS estimator a consistent one. This is true with two periods panel data set. However, when-

²All suggestions are most welcome.

ever $T > 2$, some problems may still remain, hence leading to re-estimation of models using Generalized Method of Moments (GMM). Some preliminary estimation results using GMM still support our major hypothesis.

Second direction of changes suggests enlarging the sample with countries outside the eurozone. It is possible that data on debt, interest rates, CBI etc. in Europe are strongly driven by the euro convergence criteria recommendations³. We observe increase in central bank independence globally. So a natural step would be to test our hypotheses on an enlarged sample, as well.

³Although current crisis exposed it may not be the case.

A Data description and sources

A.1 Central bank independence indices and its other representations

Data used in estimations is represented in changes of values between two periods. They are defined as: $\Delta CBI_{i,1} = CBI_{i,1990s} - CBI_{i,1980s}$ or $dCBI_{i,1} = CBI_{i,1990s} - CBI_{i,1980s}$ for measures of central bank independence. The rest of variables calculated in a similar way, unless specified otherwise.

- GMTO, GMTE and GMTP - Grilli et al.(1991) and Arnone et al. (2007); GMTE - Monetary financing of public deficits and monetary instruments; GMTP - Appointment, relations with government and constituting laws
- LVAU - Cukierman (1992); a composition of economic and political aspects
- FISM - Fraser Institute; access to Sound Money (Current). The index ranges from 0-10 where 0 corresponds to “high annual money growth”, “high variation in the annual rate of inflation”, “high inflation rate”, and “restricted foreign currency bank accounts” and 10 corresponds to “low annual money growth”
- POLCON5 - Henisz; This index measures the feasibility of policy change, i.e. the extent to which a change in the preferences of any one political actor may lead to a change in government policy. The index scores are derived from a simple spatial model and theoretically ranges from 0 to 1, with higher scores indicating more political constraint and thus less feasibility of policy change.
- ICRG indicator of Quality of Government The mean value of the ICRG variables “Corruption”, “Law and Order” and “Bureaucracy Quality”, scaled 0-1. Higher values indicate higher quality of government. - difference analysis should be negative coefficient - growth in quality, smaller debt

A.2 Other data

Values for the rest of data is taken for years: 1989, 1999 and 2007, unless specified otherwise. Sources: International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates, unless specified otherwise. Changes calculated as: $\Delta Debt/GDP_{i,1} = Debt/GDP_{i,1990s} - Debt/GDP_{i,1980s}$ or $dDebt/GDP_{i,1} = Debt/GDP_{i,1990s} - Debt/GDP_{i,1980s}$

- Investment/GDP - ratio of savings to GDP
- Saving/GDP - ratio of savings to GDP
- Saving less Investment as share of GDP- own calculations
- Revenue/GDP - Germany (1991)
- Expenditure/GDP
- Revenue less expenditure as share of GDP - own calculations
- Debtgross/GDP- General government gross debt as share of GDP; except for Denmark (1992), Germany (1991), the Netherlands (1995), Portugal (1990), and Sweden (1993)
- Debt (percentage change) - Based on general government gross debt, calculated as $(1999 - 1989)/1989$ etc.; in national currency; Denmark 1992, Germany 1991, the Netherlands 1995, Portugal 1990, Sweden 1993
- Domestic credit to private sector (as % of GDP) - refers to financial resources provided to the private sector by financial corporations;
- Long-term interest rate - European Central Bank; Long-term interest rate for convergence purposes, data for Jan 1993, Jan 1998, Jan 2008
- GDPCAP - GDP per capita
- Unemployment rate
- REG - Fraser Institute; Regulation of Credit, Labor and Business (Current)

Table 5: Descriptive statistics of key variables for the full sample

	dGMTO	dDebt/GDP	dDebt percent	d(S-I)/GDP	dPrivate loan
Mean	0.39	-1.95	1.29	0.28	44.98
Max	0.81	47.28	10.24	10.64	167.63
Min	0.00	-75.01	-0.37	-11.17	-27.99
Std. Dev.	0.25	25.72	1.89	5.54	43.85
Obs.	40	40	40	40	40

Notes: d- indicates changes in values.

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