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*Laboratoire d'Economie d'Orléans*

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### **« Central Bank Independence and Budget Deficits in Developing Countries: New Evidence from Panel Data Analysis »**

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# Central Bank Independence and Budget Deficits in Developing Countries: New Evidence from Panel Data Analysis

Yannick LUCOTTE\*

**Résumé :** Au cours des vingt dernières années, de nombreux pays ont révisé profondément les statuts régissant le fonctionnement et les missions de leurs banques centrales afin de conférer à ces dernières une plus grande indépendance vis-à-vis du pouvoir politique. Cette évolution concerna plusieurs pays, aussi bien développés qu'en développement, et est conforme à la théorie de l'incohérence temporelle de la politique monétaire de Barro et Gordon, qui met en avant l'importance de l'indépendance de l'autorité monétaire pour l'acquisition d'une crédibilité anti-inflationniste. En outre, le statut de la banque centrale peut également affecter la conduite de la politique budgétaire. La littérature théorique montre en effet qu'une forte indépendance incite le gouvernement à davantage de discipline budgétaire, et inversement. Cependant, le peu d'études empiriques consacrées à cette question concernent essentiellement des pays développés et ont abouti à des résultats économétriques décevants. Afin de combler cette lacune, nous analysons la manière dont le degré d'indépendance de la banque centrale influence le niveau de déficit budgétaire pour un large échantillon de pays en développement sur la période 1995-2004, en nous appuyant sur deux indicateurs d'indépendance développés par la littérature. Les résultats des estimations indiquent une relation négative entre degré d'indépendance et niveau de déficit budgétaire.

**Abstract :** Over the past two decades, many countries have passed legislation giving more independence to their central banks. This institutional evolution has concerned several developed countries but also developing countries and, is consistent with the Barro and Gordon's theory of time-inconsistent monetary policy, which emphasizes the importance of independence in terms of acquiring anti-inflationary credibility. But, central bank independence (CBI) could also affect the design of fiscal policy. Indeed, theoretical literature shows that a greater degree of independence influences government to fiscal discipline; conversely, a weak degree of independence may influence the government to pursue lax fiscal policy. However, the few empirical studies that attempted to assess the relation between CBI and budget deficits principally focused on industrial countries and provided disappointing econometric results. This paper seeks to address this gap in the literature by providing empirical analysis of the influence of CBI on budget deficits in a large set of developing countries over the 1995-2004 period. Using a panel data analysis and two indicators of CBI, the results show a negative relationship between CBI and budget deficits.

**Keywords :** Central bank independence, Budget balances, Developing countries, Panel data analysis

**JEL Codes:** E58, H62

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## 1. Introduction

During the last two decades, many countries have deeply reformed their central banks' legislation in order to confer them greater independence and, to define clearly their primary objective: maintaining price stability. Indeed, it is often argued that a high degree of central bank independence (hereafter CBI) coupled with an explicit mandate that the central bank aim for price stability are essential for maintaining that stability. During 1989-1996, Cukierman (1996) shows that these legislative reforms concern 25 countries, both industrial and emerging or developing countries, particularly Latin American. According to Cukierman and Webb (1995), these countries have increased the independence of their monetary authorities for various reasons (economic, political, and historical).

Why the central bank should be independent? The traditional origin of theoretical studies on CBI and the governor's degree of conservatism is the time-inconsistency problem of political choices (Kydlund and Prescott, 1977). According to this concept of time-inconsistency, an *ex ante* optimal policy can prove no optimal *ex post*, the government reserved the right to "cheat" without respecting the announced policy. Applied to monetary policy (Barro and Gordon [1983a, 1983b], Backus and Driffill [1985]), the direct consequence of the time-inconsistency problem is the loss of credibility of central banks and an inflationary bias of discretionary monetary policy. One of the solutions to this problem is to appoint a conservative central bank governor, in the sense that he places a greater weight on price stability than the government does (Rogoff, 1985). In practice, CBI could be a manner of appointing a conservative central banker. Furthermore, concerning this time-inconsistency problem, recent studies have suggested that CBI could allow the protection of monetary policy against partisan electoral cycles (Alesina, 1988; Alesina *et al.*, 1997) and therefore not to divert the monetary policy from its primary objective. So the principal message of these theories is that government suffers from an inflationary bias and that, it is necessary to depoliticize monetary policy (i.e. increase the CBI) in order to fight more efficiently against inflation.

The idea that an independent central bank is associated with lower inflation was supported by an important empirical literature which suggests that average inflation is negatively related to

the CBI degree<sup>2</sup>. However, the majority of these empirical studies are done for OECD countries and, when developing countries are included in the sample, results are very weak and sensitive to the indicator of CBI used. Indeed, most empirical studies used an indicator based on central bank laws in place (*de jure* independence) but, a legal approach is not fit for developing countries. Cukierman, Webb and Neyapti (1992, pp. 361-363) argue that “*the legal status of a central bank is only one of several elements that determine its actual independence. Many central banks laws are highly incomplete and leave a lot of room of interpretation. As a result, factors such as tradition or the personalities of the governor and other high officials of the bank at least partially shape the actual level of CBI. Even when the law is quite explicit, reality may be very different*”. Thus, according to Fuhrer (1997, p. 27), “*legal CBI could be very different from actual CBI in countries where the practice of monetary policy deviates from the letter of the law. Measures of legal CBI should thus be viewed as (possibly noisy) indicators of underlying CBI*”. For this reason, Cukierman *et al.* (1992) and Cukierman and Webb (1995) have developed *de facto* indicators of CBI, more adequate than *de jure* indicators when studying the CBI in developing and emerging countries. So in this paper two complementary approaches to assess CBI are proposed: one legal with the Cukierman, Webb and Neyapti (1992) index (hereafter CWN), the most widely employed legal indicator of CBI in the empirical literature and, one behavioral with the turnover rate of central bank governors (hereafter TOR).

Moreover, the theoretical literature (Masciandaro and Tabellini, 1987; Castellani and Debrun, 2001; Montiel, 2003) shows that CBI should affect the design of fiscal policy, i.e. a greater degree of independence influences the central government to fiscal discipline; inversely, a weak independence could influence the government to fiscal laxity. This view is associated with the question of sources of financing for government deficit. The adoption of an independent central bank deprives the government from inflation tax and so constitutes a strong signal for fiscal discipline. According to Mankiw (1987), inflation is a source of revenue and must be considered as a part of the global budgetary policy. Indeed, as debt and interest rates are measured in nominal terms (i.e. the interest rates are not indexed on inflation rate), generating inflation depreciates the real value of intern public debt and interest payments. Masciandaro and Tabellini (1987, p. 133) conclude that “*the crucial determinant of fiscal policy is the monetary regime, that is, the link between current deficits and future monetization*”.

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<sup>2</sup> See Eijffinger and De Haan (1996) for a detailed survey.

However, despite the voluminous literature on CBI, the majority of empirical studies on CBI are focused on the relationship between CBI and inflation. There has been few positive analysis of the relationship between CBI and budget deficits. To the best of our knowledge, seven empirical studies have investigated the relationship between the CBI degree and the level of budget deficits<sup>3</sup>. But, quantitative analysis (statistic/econometric strategy) of these studies are open to criticism and, results are ambiguous or even not statistically significant. Besides, only Sikken and De Haan (1998) have addressed this issue for developing countries. Using three indicators of CBI (*de jure* and *de facto*) developed in the literature, these authors refute the theoretical results and, conclude that there is no relationship between CBI and the level of budget deficits during 1972-89 period on the sample of 30 developing countries.

Accordingly, the aim of this paper is to assess econometrically the influence of CBI on the level of government budget deficits in developing countries. The econometric analysis uses panel data and focuses on a large set of developing countries during 1995-2004 period. The results show a negative relationship between *de facto* CBI and government primary budget surplus.

The remainder of this paper is organized as follows. Section 2 defines the concept of CBI, while section 3 presents CBI measures used in this study. Section 4 introduces the econometric analysis and data. Section 5 provides and discusses results. The last section concludes and gives some policy implications derived from the empirical findings.

## 2. What is independence?

Generally speaking, independence means that, abstracting from exceptional circumstances, nobody can interfere in the decisions made by the central bank in the exercise of its functions or, reverse the course of its decisions (Patat, 2003).

More precisely, CBI refers to three areas where the influence of government must be either excluded or drastically curtailed (Hasse, 1990): organic, functional and financial independence.

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<sup>3</sup> See Appendix A for most details concerning empirical studies on the relationship between CBI and budget deficits.

*Organic independence* relates to the conditions under which central bank executives are appointed, the term and the renewal of their mandates (in particular of the governor), as well as the composition of the central bank's governing bodies, i.e. if government representatives have (or not) the right to sit and vote within these authorities. However, Bassoni and Cartapanis (1995) underline that recent studies have focused on real term of governors' mandates (TOR) and, on the degree of synchronization between the mandates of central bank governor and of chief of executive power.

*Functional independence* (or operational independence) refers to the effective freedom the central bank enjoys, not only in the definition of objectives to pursue, but also in the conduct of monetary policy, which includes the choice of instruments. According to Henning (1994), independence refers to the ability of the central bank to use the instruments of monetary control without instruction, guidance or interference from the government. Thus, some authors subdivide the functional independence and make a difference between: (i) goal independence, (ii) target independence and (iii) instrument independence. The difference between these three levels of independence is nevertheless subtle and so requires to be clarified, especially for the two first levels<sup>4</sup>.

- (i) Goal independence imparts to the central bank to determine the monetary policy and exchange rate regime, or simply the monetary policy in the case of a floating exchange rate. More precisely, goal independence gives to the emission institute the authority to determine its primary objective among several objectives included in the central bank law or, less frequently, to determine its primary objective if the law doesn't clearly define the objectives.
- (ii) Target independence, as the precedent form of independence, entrusts the monetary authority with the responsibility of determining the monetary policy and exchange rate regime, or simply the monetary policy if the exchange rate is floating. However, target independence differs from goal independence because the primary objective that the central bank must pursue through its monetary policy is clearly defined in the law. So, the central bank has an absolute autonomy in the choice of specific target (monetary base, interest rate, inflation rate) to pursue its legislative objective(s), such as price stability.

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<sup>4</sup> The distinction between goal independence and target independence is due to Lybek (1999), while Debelle and Fischer (1994) only distinguish goal/target independence and instrument independence.

- (iii) Instrument independence means that the government or the legislature defines the monetary policy and its objectives, in accordance with the central bank and the exchange rate regime. However, the monetary authority keeps sufficient autonomy to implement this policy using the appropriate instruments.

According to Debelle and Fischer (1994), a central bank should enjoy instrument independence but not goal independence (Grilli *et al.* [1991] call these two dimensions “political independence” and respectively “economic independence”). Indeed, goal independence is clearly the form of independence giving greater autonomy to a central bank. But, Lybek (2004) and Blinder (1998) bring interrogation to the justification to give the central bank such authority because governors, who are not elected by citizens directly, should have the power to decide the short-term trade-off between inflation and unemployment. On the contrary, we think that the fight against inflation must be seen as an inestimable public good and not as the simple counterpart of unemployment, particularly in developing economies where inflation affects primarily poor and vulnerable populations.

*Financial independence* refers to the possibility (and to what extent) for a government to finance its expenditures by resorting directly or indirectly to advances and loans from central bank. Moreover, according to Bassoni and Cartapanis (1995) financial independence allows the assessment of the budgetary “breathing space” which central bank disposes, i.e. CBI vis-à-vis its financial resources necessary to its functioning. This second aspect of financial independence can be described as *budgetary independence*<sup>5</sup>.

The definition of CBI allows us to show the complexity and the pluri-dimensionality of this concept and so, the difficulty to measure this independence.

### 3. Measures of Central Bank Independence

The first and main challenge of empirical studies dealing with the relationship between CBI and inflation is to quantify CBI. Several measures of CBI have been proposed in the literature: *de jure* indexes (Bade and Parkin, 1988; Bodart, 1990; Grilli *et al.*, 1991; Cukierman *et al.*, 1992; Alesina and Summers, 1993; Eijffinger and Schaling, 1993; Ilieva

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<sup>5</sup> According to Bassoni and Cartapanis (1995), financial independence and budgetary independence are equivalent concepts. However, in this paper, we distinguish these two concepts.

and Healey, 2001) and, *de facto* indexes (Cukierman *et al.*, 1992; Cukierman and Webb, 1995).

But as previously mentioned, CBI is a multidimensional concept and so, defining and constructing a relevant index is arduous. The difficulty with measuring independence is reinforced by the fact that empirical results are very sensitive to the indicator of CBI used, especially when the sample of the study contains some “moderately independent” central banks. Indeed, even though these indicators are similar in general, in the sense that their common objective is to measure CBI, they provide quite different outcomes if we compare the rank of countries by degree of CBI for the same period. The rank correlation coefficients between four legal indexes of CBI calculated by Eijffinger and De Haan (1996) confirm this result, with relatively low correlations. According to Mangano (1997), three explanations can be given for these diverging outcomes: (i) the components contained in the indicators are different because the measures focus on different aspects of CBI; (ii) the interpretation of central bank status by researchers regarding each individual criterion differs; (iii) the indicators are differently weighted combinations of the same components. These limits underline that coding and measuring legal independence is an inherently arbitrary and subjective process.

As mentioned in the introduction, this study focuses on two CBI indicators: one *de jure*, with CWN index and, one *de facto*, with TOR. Construction methodology, advantages and limits of these indexes are presented below.

### ***De jure independence***

The important number of empirical studies using CWN index can be explained by the fact that this index of legal independence is the most comprehensive. Certainly, and contrary to other CBI indexes, CWN index focuses on the four aspects of CBI outlined in section 2. Moreover, this index is “*comprehensive in terms of its elements and is relatively easy to replicate since the authors provide a thorough guide to coding the various subcomponents*” (Crowe and Meade, 2008, p. 765).

The CWN index is a weighted sum of 16 sub-items which are grouped into the following four categories (the number between brackets indicates the number of variables into each cluster): organic independence (4) [code: CEO]; monetary policy formulation (3) [code: PF]; monetary policy final objectives (1) [code: OBJ]; limitations of lending to government (8) [code: LL].

In comparison to alternative CBI measures developed in the literature that only permit yes/no decisions for each criterion, the major evolution brought by the CWN index is that it widens considerably the range of responses, in the sense that a score between 0 (smallest level of independence) and 1 (highest level of independence) is given to each of the 16 variables. For example, there are five possible ratings for the question concerning the term of the mandate: 1 (if the central bank governor serves > 8 year term), 0.75 (6-8 year term), 0.5 (5 year term), 0.25 (4 year term) or 0 (under 4 year term). Moreover, Cukierman *et al.* (1992) include a weighting system in their indicator aiming to give a different weight to each component and so implicitly, a different weight to each of the four aspects of independence. The weighting system is the following: CEO (0.20 % of index), PF (0.15%), OBJ (0.15%) and, LL (0.50%). This codification and weighting system certainly permits a more fine analysis and measure of CBI but gives also a more important place to arbitrary and subjectivity. Finally, the “overall index” for each central bank is obtained by calculating a weighted arithmetic average of variables<sup>6</sup>.

### ***De facto independence***

The concept of actual independence includes many aspects, such as the turnover rate of central bankers, their personality and charisma and also the design of fiscal and monetary policies (Radzyner and Riesinger, 1997). To identify the differences between *de jure* and *de facto* CBI, Cukierman *et al.* (1992) and Cukierman and Webb (1995) use three nonlegal measures of CBI<sup>7</sup>. This paper restricts the analysis of real CBI to TOR because many empirical studies have proven that TOR is a good proxy to assess actual CBI in particular for developing countries and, data are easily available (via notably central bank websites).

TOR is defined as the average term of office of central bankers. It is calculated by dividing the number of central bank governors during a given period by the number of years of this reference period. Thus, for example, a TOR equal to 0.5 means that there has been a change of governor every two years (0.5 change per year). So, this indicator takes into account the potential deviations from the law concerning the term of office of the central bank governor. To prove the pertinence of this index as a proxy of actual CBI, Cukierman *et al.* (1992) give the example of Argentina, where an informal tradition wants that the governor of *Banco*

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<sup>6</sup> See Appendix D and Cukierman *et al.* (1992) for a detail description of the CWN index, its subcomponents and, its coding and weighting system.

<sup>7</sup> These three measures are TOR, Political vulnerability index and an index based on responses to a questionnaire provided by specialists. See Cukierman *et al.* (1992) and Cukierman and Webb (1995) for a thorough description of these indicators.

*Central de la Republica Argentina* resigns whenever there is a change of government, or even a new finance minister, even though the legal term of the central banker office is four years. Consequently, during 1950-89, the real term of office of Argentina central bank governors is less than one year (TOR = 0.93). Through this example, we comprehend the intuition of this index: a high turnover of central bankers indicates a low level of independence because monetary authority executive directors are subject to electoral and political cycles which means they are under government's influence when conducting the monetary policy. The term of office of central bank governors is therefore a guarantee of CBI vis-à-vis political power, especially when it exceeds the average length of electoral cycle of a considered country. Thus, as in many countries the average length of this cycle is four years, Cukierman *et al.* (1992) consider that a TOR superior to 0.25 is synonymous with low CBI. Nevertheless, Mas (1994) expresses a limit about the use of this index as proxy of real CBI: a long term in office may also indicate a low level of independence, because a subservient governor can hold his position for a long period of time and survive to several governments despite his lack of independence.

Despite their apparent limits, these two CBI indexes are very used by the empirical literature. So, in this study, we decide to retain these indicators to assess the influence of CBI on budget deficits in developing countries.

#### 4. Econometric Strategy and Data

To estimate the influence of CBI on budget surpluses during the period of 1995-2004, we use a panel data analysis. The sample includes all developing countries for which we have the required data (see Appendix B).

The estimated equation is therefore

$$\begin{aligned} CGPBS_{it} = & \beta_0 + \beta_1 CBI_i + \beta_2 LRGDP_{it} + \beta_3 GRGDP_{it} + \beta_4 URB_{it} + \beta_5 AGRI_{it} + \beta_6 ILLY_{it} \\ & + \beta_7 OPEN_{it} + \gamma_1 RD_i + \gamma_2 CU_i + \mu_{it} \end{aligned} \quad (1)$$

$$\mu_{it} = \alpha_i + \varepsilon_{it}$$

where  $i$  denotes the country and  $t$  denotes the time,  $\alpha_i$  is an unobserved country-specific effect,  $\varepsilon_{it}$  is the error term, and the variables are defined as follows:

$CGPBS_{it}$  denotes the central government primary budget surplus (as a percentage of GDP),

$CBI_i$  is the central bank independence measured by the two subindexes of CBI previously described (CWN and TOR),

$LRGDP_{it}$  is the log of real per capita GDP,

$GRGDP_{it}$  is the real GDP annual growth rate,

$URB_{it}$  is the degree of urbanization,

$AGRI_{it}$  is the share of agriculture in the GDP,

$ILLY_{it}$  is the ratio of liquid liabilities of the financial system to GDP,

$OPEN_{it}$  is the trade openness,

$RD_i$  corresponds to regional dummies,

$CU_i$  is a binary variable equal to 1 if the country  $i$  is a member of a currency union and 0 otherwise.

We are interested in the  $\beta_1$  coefficient, which is the effect of CBI on primary budget surplus. The main advantage of our econometric analysis compared to the previous empirical studies is the use of panel data technique to estimate the relationship between the degree of CBI and the budget deficit. However, for the period under consideration, the time variation of our CBI indicators is limited or even null for TOR. Thus, we cannot use fixed effects methodology because it removes the variables with not intra-individual variability, like in the case of CBI indexes and dummies<sup>8</sup>. Concerning the random effects model, the generalized least squares (GLS) estimator is consistent and efficient only under the assumption that the explanatory variables are not correlated with specific effects. If this assumption is not verified, the GLS estimator is biased and inconsistent. According to Mundlak (1978), the probability of no correlation between individual specific effects and some explanatory variables is low. But, in the presence of time-invariant variables, the usual test of Hausman (1978) consisting in the comparison of the within and between estimators cannot be used because the test concerns only variables with intra-individual variability (Sevestre, 2002).

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<sup>8</sup> Note, however, that a recent methodology, the *unit fixed effects vector decomposition*, developed by Plümper and Troeger (2007) allows the use of a fixed effects model in presence of time-invariant variables.

To resolve this potential endogeneity bias specific to panel data econometrics, Hausman and Taylor (1981) (hereafter HT) developed “*an estimator that is, in essence, a hybrid of the fixed effects and generalized least squares (random effects) models*” (Gardner, 1998, pp. 39-40). This alternative methodology rests upon the method of instrumental variables but, offers the advantage of using internal instruments and so, doesn’t require finding valid instruments outside the model. For that, HT makes a classification of explanatory variables according to their endogenous or exogenous character, i.e. correlated or not correlated with unit specific effects, and according to the variables are time-variant or time-invariant. Thus, four sets of right-hand-side variables are distinguished:  $X1$ ,  $X2$ ,  $Z1$  and  $Z2$  where  $X1$  is  $n \times k1$ ,  $X2$  is  $n \times k2$ ,  $Z1$  is  $n \times g1$ ,  $Z2$  is  $n \times g2$  and,  $n = N \times T$ .  $X1$  and  $Z1$  are doubly exogenous i.e. they are not correlated with unit specific effects and idiosyncratic error, while  $X2$  and  $Z2$  are endogenous because they are correlated with specific effects but uncorrelated with the error term. The set of variables  $X$  ( $X1$ ,  $X2$ ) contains variables with intra-individual variability, while the group of variables  $Z$  ( $Z1$ ,  $Z2$ ) comprises variables with no intra-individual variability. So, from this classification, the presence of  $X2$  and  $Z2$  is the cause of bias in the random-effects estimator and these variables must then be instrumented. As emphasized previously, the originality of HT’s methodology is to use information already contained in the model to instrument the variables  $X2$  and  $Z2$ . The matrix of instruments suggested by HT is as follows:  $[QX1, QX2, PX1, Z1]$  where  $Q$  is a projection matrix which transforms a vector of observations into a vector of deviations from group means and,  $P$  transforms a vector of observations into a vector of group means. The order condition for identification is that the number of  $X1$  variables must be larger or equal than the number of  $Z2$  variables ( $k1 \geq g2$ ). The principal limit of the strategy proposed by HT is that the decision on which variables are treated as exogenous/endogenous is not obvious and, HT suggest mainly using economic intuition<sup>9</sup>. In this paper, we assume that the variable of GDP per capita is endogenous, i.e. correlated with specific effects, and so we include this variable in  $X2$ . In fact, we can think that this variable is linked to unobservable characteristics of countries as for example the historical past, the dominant religion or the culture.

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<sup>9</sup> Besides economic intuition, Claessens *et al.* (2007) rely on the insight of Baltagi *et al.* (2003) and develop a “formal test” to help researchers in their selection of the explanatory variables considered as endogenous. Their methodology consists in applying a Hausman test between fixed effects and HT models by instrumenting one variable at the time (from least to most exogenous on the basis of economic intuition), up to the point where the Hausman test suggests that the non-instrumented regression is more appropriate. So, variables instrumented can be considered as endogenous and the remaining explanatory variables exogenous vis-à-vis individual specific effects. But, this methodology cannot be used when the model contains time-invariant variables or dummy variables because these variables are eliminated by the within transformation.

The HT estimator was firstly used in labour economics to assess the returns to schooling (see for example Cornwell and Rupert, 1988; Baltagi and Khanti-Akom, 1990; Guillotin and Sevestre, 1994), because the unobserved individual ability (specific effects) may be correlated with education. More recently, this method enjoys a great popularity in international economics empirical literature using gravity models owing to many determinants of bilateral trade that are time invariant such as the distance or the common language between two countries (see for example Lochard, 2005; Carrère, 2006).

As part of our study, the interest of using the methodology developed by HT appears clearly. It enables to apply a Hausman procedure for testing the joint exogeneity hypothesis of the whole explanatory variables (time-variant and time-invariant) in order to determine the appropriate model between random effects and HT estimators from the perspective of policy implications<sup>10</sup>. Thus, under the null hypothesis of no correlation between unobserved heterogeneity and observable explanatory variables, the random effects estimator and the HT estimator are both consistent, but the random effects estimator is efficient. Under the alternative hypothesis, only the HT estimator is consistent and unbiased.

### ***The Data***

The dependent variable is the central government primary budget surplus in percent of GDP (CGPBS) and is taken from Brun *et al.* (2007). This measure of budget surplus, which excludes net interest payments by the treasury, is probably the most appropriate measure of fiscal discipline because it assesses the orientation of fiscal policy over the fiscal year. Furthermore, from an econometric point of view, this measure allows us to avoid a potential simultaneity bias between the dependent variable and the principal explanatory variable. Indeed, the greater the government influences the monetary authority to monetize deficits, the smaller is the degree of CBI. Thus, if we use the conventional budget balance (which includes public debt interest payments) as an indicator of fiscal stance, a potential endogeneity bias may exist.

The principal explanatory variable is the degree of CBI measured by the two *de jure* and *de facto* indicators previously defined. CWN index is given by Crowe and Meade (2008), who compute an updated CWN index for a large set of countries using the International Monetary

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<sup>10</sup> The Hausman test comparing random effects and HT estimators is as follows:  $H_0$ : difference in coefficients not systematic.  $Q_H = (\hat{b}_{HT} - \hat{b}_{GLS})' [\hat{V}(\hat{b}_{HT}) - \hat{V}(\hat{b}_{GLS})]^{-1} (\hat{b}_{HT} - \hat{b}_{GLS})$ .  $H_0$  is rejected and the random effects estimator is inconsistent if  $Q_H > \chi^2_r$  (r denotes the degrees of freedom).

Fund's Central Bank Law Database<sup>11</sup>. Concerning TOR, the authors constructed the data based on central bank websites and central bank survey. The degree of CBI is expected to have a positive effect on budget surplus when it is measured by CWN index. Conversely, we expect TOR to have a negative effect on budget surplus.

We include three regional dummies,  $RD_i$ : AFRICA for Sub-Saharan Africa, EASIAP for East Asia and Pacific, and LATINCA for Latin America and the Caribbean. The inclusion of regional dummies allows the control of structural characteristics related to geographical location but not to sociopolitical and institutional factors (Woo, 2003).

In addition to regional dummies, we include other control variables mentioned by many empirical studies on the determinants of public deficits. The determinants of the primary budget balance are on one hand, the capability of a country to mobilize public resources and, on the other hand, the country's allocative efficiency of these resources.

The log of real GDP per capita (LRGDP) is introduced in the regression to capture the differences in the level of economic development between countries. Indeed, although the sample of countries includes only developing market economies, some studies show a relative heterogeneity concerning the level of development of fiscal administrations in developing countries and, therefore, these countries have unequal capabilities to mobilize fiscal resources. More developed countries, i.e. countries with a relatively high level of fiscal transition, probably have a greater ability to design efficient fiscal systems. So, a higher income per capita reflecting a higher level of development is held to indicate a greater capacity to levy and collect taxes (Chelliah, 1971). This is true concerning the management and the efficiency of public expenditures. Moreover, according to Roubini (1991), the GDP per capita may capture some sociopolitical effects if social conflicts are more important in poor countries. The sign of GDP per capita is expected to be positive.

The real GDP annual growth rate (GRGDP) is included in the regression as a proxy for economic activity because government budget balance is sensitive to economic fluctuations. Indeed, when the level of economic activity is low or moderate, the amount of tax revenues collected by the government decreases while social expenditures increase, that leads to a deterioration of budget balance. Conversely, a higher economic growth generates an improvement in the budget balance (automatic stabilizers). Thus, the sign of the coefficient of

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<sup>11</sup> We would like to thank Christopher Crowe for providing us with the data.

GRGDP is expected to be positive. However, some authors (see for example Talvi and Végh, 2000) have suggested that fiscal policy can be procyclical in developing countries with weak governments, because political pressures to increase public spending go hand in hand with the growing tax revenue due to higher economic growth. The strong increase in fiscal demands during economic boom is called “*voracity effect*” (Lane and Tornell, 1999). Thus, according to Woo (2003), the sign of the coefficient of GRGDP is an empirical question.

Concerning the urban population ratio (URB), this variable is introduced in the model because Edwards and Tabellini (1991) show that it is relatively easier and less costly for tax authorities to collect taxes in urban areas with higher concentration of the formal sector than in rural areas, where the degree of tax evasion and avoidance is particularly high (Ansari, 1982). We then expect URB to have a positive sign.

Furthermore, according to Tanzi (1992), the country’s economic structure is an important factor that could influence the level of taxation. For this reason, the share of agriculture in GDP (AGRI) is included. Nevertheless, the expected sign of AGRI is uncertain because the theory distinguishes two opposite effects of the share of agriculture in GDP on the tax share. Thus, on the supply side, the share of agriculture in GDP is expected to have a negative effect on tax revenues because political constraints could encourage the government to cut taxation in this sector, often heavily taxed in many implicit ways through import quotas, tariffs, controlled prices for output, or overvalued exchange rates (Bird, 1979; Ahmad and Stern, 1991; Tanzi, 1992). Moreover, agricultural sector in developing countries is mainly characterized by subsistence farming and the predominance of small farmers and so, it appears difficult for a government to tax the main foods that are used for subsistence (Stotsky and WoldeMariam, 1997). Conversely, on the demand side, the share of agriculture in GDP is expected to have a positive effect on budget surplus because many public sector activities being city-oriented, the demand for public goods and services and so the public expenditures are theoretically reduced (Teera, 2003).

Woo (2003) includes the ratio of liquid liabilities (M3) of the financial system to GDP (ILLY) as a proxy for the financial market development level, the so-called “financial depth”. According to this author, “*countries with highly developed financial markets can more easily finance the fiscal deficit by issuing bonds without having to resort to inflationary finance*” (Woo, 2003, p. 393). Thus, the sign of the coefficient of ILLY is expected to be negative.

The trade openness (OPEN) is here measured by the ratio of the sum of exports and imports of goods and services to GDP. This variable assesses the intensity of the national economy's integration into world trade and, to a certain degree, the dependence of an economy on international conjuncture and its sensitivity to changes in international prices. Above all, the trade openness enables the assessment of the relative strength of the external constraint to which the economy is submitted and partly determines the political economy "breathing space", especially concerning fiscal policy (Blancheton, 2004). Consequently, a country with a relatively high degree of trade openness theoretically may be more vulnerable to external shocks. This increase of vulnerability is not without consequence on government budget balance. However, Combes and Saadi-Sedik (2006) emphasize the contradictory results concerning the effect of trade openness on budget balances in the studies that included this proxy of external vulnerability as a control variable for budget deficits. Moreover, although this measure of trade openness is widely used in empirical literature, it has been criticized by some economists<sup>12</sup>. Thus, the expected sign of the coefficient of OPEN is uncertain.

Finally, we introduce in the model a currency union dummy (CU) which takes the value of one if the country is a member of a currency union, or zero otherwise. In our sample, accession to currency union concerns fourteen African countries, each affiliated with one of the two monetary unions of the CFA Franc Zone: the West African Economic and Monetary Union (WAEMU) and the Central African Economic and Monetary Community (CAEMC)<sup>13</sup>. The sign of the coefficient of CU is expected to be positive. Indeed theoretically, these countries must respect a set convergence criteria pertaining notably to public finances, the key criterion being the ratio of the basic fiscal balance<sup>14</sup> to nominal GDP which must be 0 or more. So, we could expect that these budgetary rules, which constrain politician's tax and spending behavior, have a positive impact on primary budget surplus.

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<sup>12</sup> The principal criticisms made for this measure are : (i) its construction fault (ratio of sales to a sum of value added) ; (ii) its double dependence on political (intensity of commercial protections) and structural (population, dimension). See Siroën (2000) and Blancheton (2004) for a comprehensive survey.

<sup>13</sup> The eight members of WAEMU are : Benin, Burkina Faso, Côte-d'Ivoire, Guinée-Bissau (who joined in May 1997), Mali, Niger, Senegal and Togo. The six members of CAEMC are: Cameroon, Central African Rep., Chad, Congo Rep., Equatorial Guinea and Gabon.

<sup>14</sup> The basic budget balance is defined as total revenue, excluding grants, minus total expenditures, excluding foreign-finance investment.

## 5. Results

This section discusses the empirical results for each specification, i.e. for each measure of CBI (*de jure* and *de facto*). For each specification, we estimate the panel regression of equation (1) using random effects and HT models. In either case, the Hausman test suggests that the non-instrumented regression is more appropriate. Nevertheless, to show the robustness of our results, we present the HT model and random effects panel regression results using the same specification. We then compare the results of the two models.

**Table 1 : The influence of *de jure* independence (CWN index) on budget surplus**

The dependent variable is primary budget surplus	RE (1)	RE (2)	RE (3)	RE (4)	RE (5)	RE (6)	RE (7)	HT (8)
INTERCEPT	-15.53*** (4.999)	-14.99*** (5.049)	-14.22** (5.665)	-17.14** (8.481)	-12.99 (8.802)	-12.17 (8.853)	-12.21 (8.910)	-8.177 (15.36)
EASIAP	-3.744 (2.659)	-3.664 (2.680)	-3.595 (2.710)	-3.432 (2.738)	-2.656 (2.747)	-3.965 (2.885)	-3.991 (2.911)	-5.289 (5.511)
LATINCA	-3.919* (2.145)	-3.668* (2.170)	-3.711* (2.190)	-3.404 (2.263)	-4.600** (2.331)	-4.759** (2.349)	-4.843** (2.379)	-3.415 (4.551)
AFRICA	0.626 (1.763)	0.556 (1.777)	0.564 (1.792)	0.745 (1.818)	-1.019 (2.035)	-1.839 (2.113)	-1.578 (2.264)	-3.829 (4.278)
CWN	1.458 (4.683)	1.116 (4.726)	0.682 (4.968)	-0.317 (5.218)	-3.595 (5.469)	-3.808 (5.509)	-3.784 (5.559)	-9.436 (11.32)
LRGDP	2.450*** (0.547)	2.365*** (0.554)	2.191*** (0.792)	2.574** (1.078)	2.565** (1.083)	2.348** (1.094)	2.345** (1.101)	3.347* (1.743)
GRGDP		0.0494 (0.0377)	0.0511 (0.0381)	0.0501 (0.0385)	0.0388 (0.0390)	0.0277 (0.0404)	0.0280 (0.0404)	0.0174 (0.0405)
URB			0.0138 (0.0448)	0.0158 (0.0454)	0.0327 (0.0460)	0.0353 (0.0463)	0.0372 (0.0472)	-0.0985 (0.0790)
AGRI				0.0293 (0.0587)	0.0257 (0.0600)	0.0255 (0.0603)	0.0272 (0.0607)	0.00559 (0.0774)
ILLY					-0.0430* (0.0227)	-0.0501** (0.0232)	-0.0513** (0.0235)	-0.0736** (0.0324)
OPEN						0.0226 (0.0142)	0.0232 (0.0144)	0.0345** (0.0175)
CU							-0.637 (1.768)	0.0303 (3.430)
Observations	508	508	508	499	494	493	493	493
Nb. of countries	56	56	56	55	55	55	55	55
R <sup>2</sup>	0.32	0.31	0.32	0.33	0.35	0.35	0.35	—
Hausman Test								6.64

Note: Standard errors are reported in brackets. Columns (1) to (7) present the random effects (RE) estimates. Column (8) reports the estimate with Hausman Taylor (HT) estimator. Levels of significance are indicated by asterisks: \*\*\*1%, \*\*5%, \*10%. Variables X1: GRGDP, URB, AGRI, ILLY, OPEN; Z1: EASIA, LATINCA, AFRICA, CWN, CU; X2: LRGDP.

Table 1 shows the results of the influence of legal CBI on primary budget surplus. As stressed by the economic literature on CBI, the estimated coefficient of CWN is insignificant at the

conventional level. Thus, this result confirms that a legal approach is not fit for developing countries, characterized by weak institutions which deviate from the law. Concerning the control variables, the estimated coefficients of LRGDP and ILLY are statistically significant and have the expected sign. URB has the expected sign with random effects and the wrong sign with HT model but is not significant. The estimated coefficient of AGRI has a positive sign but is insignificant. OPEN has a positive sign and is significant at the 5 percent level with HT methodology. The sign of the coefficient CU is insignificant in both the models. This last result could be nevertheless explained by the fact that few WAEMU and CAEMC countries have satisfied convergence criteria<sup>15</sup>. Concerning the coefficients on the regional dummies, they are insignificant for Sub-Saharan African and Latin American and Caribbean countries, but are globally significant for East Asian and Pacific countries at the conventional level, reflecting the fact that most of the countries of this region have run higher primary budget deficits than other developing countries.

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<sup>15</sup> See annual reports drafted by the WAEMU and the CAEMC Commissions for more details.

**Table 2 : The influence of *de facto* independence (TOR) on budget surplus**

The dependent variable is primary budget surplus	RE (1)	RE (2)	RE (3)	RE (4)	RE (5)	RE (6)	RE (7)	HT (8)
INTERCEPT	-6.981** (3.480)	-6.895** (3.502)	-6.613* (3.602)	-6.944 (5.748)	-7.071 (5.614)	-6.208 (5.637)	-6.007 (5.677)	11.41 (8.661)
EASIAP	-2.232 (2.204)	-2.201 (2.218)	-2.134 (2.237)	-2.113 (2.239)	-2.072 (2.169)	-2.429 (2.259)	-2.342 (2.282)	-1.502 (2.283)
LATINCA	-1.747 (1.540)	-1.659 (1.551)	-1.738 (1.573)	-1.534 (1.607)	-3.159* (1.719)	-3.026* (1.730)	-2.986* (1.740)	-1.524 (1.823)
AFRICA	-1.404 (1.362)	-1.456 (1.371)	-1.354 (1.406)	-1.295 (1.407)	-2.595* (1.481)	-2.713* (1.557)	-2.583 (1.604)	-3.055* (1.606)
TOR	-11.80*** (4.404)	-11.76*** (4.433)	-11.40** (4.566)	-12.01*** (4.636)	-11.43** (4.493)	-11.16** (4.519)	-12.21** (5.354)	-14.22*** (5.406)
LRGDP	1.714*** (0.437)	1.677*** (0.441)	1.530*** (0.592)	1.599** (0.764)	1.951** (0.761)	1.758** (0.770)	1.758** (0.773)	-0.440 (1.298)
GRGDP		0.0389 (0.0338)	0.0403 (0.0340)	0.0388 (0.0343)	0.0294 (0.0345)	0.0329 (0.0350)	0.0333 (0.0350)	0.0373 (0.0358)
URB			0.0128 (0.0341)	0.0128 (0.0343)	0.0177 (0.0334)	0.0182 (0.0337)	0.0197 (0.0341)	0.0234 (0.0397)
AGRI				-0.000316 (0.0484)	0.00184 (0.0476)	-0.00316 (0.0483)	-0.00105 (0.0488)	-0.116* (0.0629)
ILLY					-0.0375** (0.0168)	-0.0366** (0.0173)	-0.0377** (0.0176)	-0.0353* (0.0183)
OPEN						0.00660 (0.0110)	0.00683 (0.0110)	0.00712 (0.0112)
CU							-0.602 (1.641)	-0.623 (1.615)
Observations	707	707	707	696	696	694	694	694
Nb. of countries	77	77	77	76	76	76	76	76
R <sup>2</sup>	0.29	0.29	0.29	0.3	0.34	0.33	0.33	–
Hausman Test								8.71

Note: Standard errors are reported in brackets. Columns (1) to (7) present the random effects (RE) estimates. Column (8) reports the estimate with Hausman Taylor (HT) estimator. Levels of significance are indicated by asterisks: \*\*\* 1%, \*\* 5%, \* 10%. Variables X1: GRGDP, URB, AGRI, ILLY, OPEN; Z1: EASIA, LATINCA, AFRICA, TOR, CU; X2: LRGDP.

Table 2 reports the results of the influence of actual CBI on budget surplus. The coefficient of TOR appears with the expected sign and is significant at the 1 or 5 percent level. This result means that the turnover rate of central bank governors is negatively associated with primary budget surplus. It suggests that the greater the independence of a country's central bank, the lower is its budget deficit and so, confirms the theoretical predictions which suppose that CBI is a key determinant of budget deficits. We can see that results are robust to various econometric specifications in terms of statistical significance and size of coefficients. Moreover, while the Hausman test suggests the random effects model to be the preferred specification, we see that there are very few differences between random effects and HT models, which lead to very similar coefficients and statistical significance levels. So, our results are not sensitive to the estimation technique and show the robustness of the relation

between CBI and budget deficits. Concerning the control variables, results are similar to table 1 and confirm that LRGDP and ILLY are robust determinants with CBI of budgets deficits in developing countries. Finally, coefficients on the regional dummies are uniformly negative and largely insignificant. Only EASIA is significant in the complete random effects model (column 7) at the 10 percent level.

## 6. Conclusions and Policy Implications

Theoretical literature argued that CBI should affect the design of fiscal policy, in the sense that a higher independence is associated with lower budget deficits. Nevertheless, the few empirical studies which have sought to econometrically assess this relationship were mainly focused on developed countries, and have found insignificant results. So, using two indicators measuring *de jure* and *de facto* CBI, this paper aims to re-examine the effect of CBI on budget deficits in a large sample of developing countries over the 1995-2004 period employing a panel data analysis.

Our empirical results suggest that a significant negative relation exists between CBI and primary budget deficits in developing countries. These results are in accordance with the theoretical literature and mean that, *ceteris paribus*, a country with a weak independent central bank tends to have higher primary budget deficits. Moreover, we find that the difference between *de jure* and *de facto* independence is relevant in developing countries, because actual CBI evaluated by TOR is statistically significant whereas legal CBI measured by CWN index appears insignificant.

The policy implications of these results are clear: CBI must be promoted and consolidated in developing countries in order to exert a disciplining influence on political decision makers who improve fiscal policies. Thus, more disciplined fiscal policies should enable to avoid debt crisis, such as those that have been observed in developing countries prior the adoption of the Multilateral Debt Relief Initiative (MDRI) by international financial institutions in June 2005. In addition to the increase of CBI, developing countries should also implement structural reforms to define sound budgetary institutions and efficient fiscal administrations.

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## Appendix A. Empirical studies on the relationship between CBI and budget deficits

<i>Study</i>	<i>Countries</i>	<i>Period</i>	<i>CBI index</i>	<i>Relation between CBI and budget deficits</i>
Masciandaro and Tabellini (1987)	5 industrial countries	1970-85	-	Negative (not statistically measured)
Burdekin and Laney (1988)	12 OECD countries	1960-83 and sub-periods	Dummy variable	Negative, significant
Grilli <i>et al.</i> (1991)	18 OECD countries	1950-89 and sub-periods	GMT	Negative, insignificant
De Haan and Sturm (1992)	18 OECD countries	1961-87 and sub-periods	5 <i>de jure</i> CBI indexes	Negative, significance depends on CBI measure
Pollard (1993)	16 OECD countries	1973-89	Alesina and Summers (1993) index	Negative, insignificant
Bénassy-Quéré and Pisani-Ferry (1994)	20 OECD countries	1978-92	CWN, GMT	Negative (not econometrically assessed)
Sikken and De Haan (1998)	30 developing countries	1972-89 and sub-periods	CWN, LL*, TOR	Ambiguous, insignificant

\* LL is an indicator disaggregated from CWN index and corresponds to the limitations on lending to government.

## Appendix B. List of countries in the sample

Algeria*	Congo, Dem. Rep.#	India	Nigeria
Angola*	Congo, Rép.	Indonesia	Pakistan
Argentina	Costa Rica	Jamaica	Peru
Bahamas, The	Côte d'Ivoire	Jordan*	Philippines
Bangladesh*	Djibouti*	Kenya	Rwanda*
Barbados	Dominican Rep.*	Kuwait	Senegal
Belize*	Egypt, Arab Rep.	Lebanon	Seychelles*
Benin	El Salvador	Lesotho*	South Africa
Bolivia	Equatorial Guinea	Madagascar*	Sri Lanka
Botswana	Ethiopia	Malawi*	Sudan*
Brazil	Fiji*	Malaysia	Swaziland*
Burkina Faso	Gabon	Mali	Tanzania
Burundi*	Gambia, The*	Mauritius*	Thailand
Cameroon	Ghana	Mexico	Togo
Cape Verde*	Guatemala	Morocco	Tunisia
Central African Rep.	Guinea*	Mozambique*	Uganda
Chad	Guinea-Bissau	Namibia	Uruguay
Chile	Haiti*	Nepal	Venezuela
Colombia	Honduras	Nicaragua	Zambia
		Niger	Zimbabwe

\* Indicates that data on CWN are not available / # Indicates that data on TOR are not available

## Appendix C. Data description and source

Variables	Description and sources
AFRICA	Dummy variable for Sub-Saharan African countries (according to the World Bank country classification).
AGRI	Share of the value added of agriculture sector in GDP. Agriculture includes forestry, hunting and fishing, as well as cultivation of crops and livestock production. Source: World Development Indicators (2008).
CGPBS	Central government primary budget surplus (% of GDP). Source: Brun <i>et al.</i> (2007).
CU	Dummy variable for currency union: 1 if the country is a member of a currency union and 0 otherwise.
CWN	<i>De jure</i> central bank independence measured by the Cukierman, Webb and Neyapti index over 1995-2004. Source: Crowe and Meade (2008).
EASIAP	Dummy variable for East Asian and Pacific countries (according to the World Bank country classification).
GRGDP	Annual percentage growth rate of GDP per capita based on constant local currency. Source: World Development Indicators (2008).
ILLY	Financial depth: the ratio of liquid liabilities (M3) of the financial system to GDP. Liquid liabilities are the sum of currency and deposits in the central bank (M0), plus transferable deposits and electronic currency (M1), plus time and savings deposits, foreign currency transferable deposits, certificates of deposit, and securities repurchase agreements (M2), plus travelers checks, foreign currency time deposits, commercial paper, and shares of mutual funds or market funds held by residents. Source: World Development Indicators (2008).
LATINCA	Dummy variable for Latin America and Caribbean countries (according to the World Bank country classification).
LRGDP	Log of GDP per capita in constant 2000 U.S. dollars. Source: World Development Indicators (2008).
OPEN	Trade openness is the sum of exports and imports of goods and services measured as a share of GDP. Source: World Development Indicators (2008).
TOR	<i>De facto</i> central bank independence measured by the turnover rate of central bank governors over 1995-2004. Source: Author's calculation based on central bank websites and central bank survey.
URB	Urban population (% of total). Source: World Development Indicators (2008).

## Appendix D. Construction of the CWN Index

<i>Description of variables</i>	<i>Variables</i>	<i>Weight</i>	<i>Score</i>
<b>1/ Executive independence</b>	<b>CEO</b>	<b>0.20</b>	
<i>a) Length of governor's term of office</i>	<i>Too</i>	<i>0.05</i>	
- ≥ 8 years			1.00
- Between 6 and 8 years			0.75
- 5 years			0.50
- 4 years			0.25
- < 4 years or at the discretion of appointer			0.00
<i>b) Who appoints the governor?</i>	<i>App</i>	<i>0.05</i>	
- Appointed by the board of the central bank			1.00
- Appointed by a board composed of members of executive branch, parliament, and the board of the central bank			0.75
- Appointed by the legislative branch			0.50
- Appointed by the executive branch			0.25
- Appointed by one or two members of the executive branch			0.00
<i>c) Dismissal of governor</i>	<i>Diss</i>	<i>0.05</i>	
- No provision for dismissal			1.00
- Only for reasons not related to monetary policy			0.83
- At the discretion of the central bank board			0.67
- At legislative branch's discretion for reasons related to monetary policy			0.50
- Unconditional dismissal possible by the legislative branch			0.33
- At executive branch's discretion for reasons related to monetary policy			0.17
- Unconditional dismissal possible by the executive branch			0.00
<i>d) Possibility for governor to hold government office</i>	<i>Off</i>	<i>0.05</i>	
- Governor prohibited by law from holding government office			1.00
- Prohibited unless authorized by the government			0.50
- No prohibitions of law in this matter			0.00
<b>2/ Monetary policy formulation</b>	<b>PF</b>	<b>0.15</b>	
<i>a) Who formulates monetary policy?</i>	<i>Monpol</i>	<i>0.05</i>	
- Central bank alone has this authority			1.00
- Authority is shared by government and central bank			0.67
- Central bank has advisory role in setting policy			0.33
- Only government has this power			0.00
<i>b) Government directives and conflict resolution</i>	<i>Conf</i>	<i>0.05</i>	
- Central bank has final authority on matters explicitly defined by law as its objectives			1.00
- Government has ultimate authority only on policy matters not explicitly defined as objectives of the central bank, or in the event of internal conflict within the central bank			0.80
- In case of conflict, the final decision lies with a body comprising members of the central bank, the legislative branch, and the executive branch			0.60
- Legislative branch has final authority in policy matters			0.40
- Executive branch has final authority in policy matters, but is subject to possible opposition by the central bank			0.20
- Executive branch has unconditional final authority			0.00
<i>c) Does central bank has advisory role in formulating government budget?</i>	<i>Adv</i>	<i>0.05</i>	
- Central bank plays an active role			1.00
- Central bank has no influence			0.00
<b>3/ Objectives of the central bank</b>	<b>OBJ</b>	<b>0.15</b>	
- Price stability is the sole/main objective; takes precedence if conflict with other government objectives (e.g. full employment, economic growth)			1.00
- Price stability is the only objective			0.80
- Price stability is mentioned together with other objectives that do not conflict with it			0.60
- Price stability mentioned together with other objectives that may potentially conflict with it			0.40
- Central bank law does not include objectives of this type			0.20
- Central bank law identifies objectives but not price stability			0.00

<b>4/ Limitations on lending to the government</b>	<b>LL</b>	<b>0.50</b>	
<i>a) Limitations on advances</i>	<i>Lla</i>	<i>0.15</i>	
- Advance lending to the government is prohibited			1.00
- Advances are possible with strict limits (e.g. up to 15% of government revenue)			0.67
- Advances are possible but subject to more accommodating limitations (e.g. over 15% of government revenue)			0.33
- No legal limitations on advances; amount is periodically negotiated between the central bank and the government			0.00
<i>b) Limitations on guaranteed loans to the government</i>	<i>Lls</i>	<i>0.10</i>	
Same distinctions as for <i>Lla</i>			
<i>c) Who has authority to control terms and conditions of loans to the government?</i>	<i>Ldec</i>	<i>0.10</i>	
- Central bank			1.00
- Terms and conditions specified by the central bank law			0.67
- Terms and conditions agreed between the central bank and the executive branch			0.33
- Terms and conditions decided by the executive branch alone			0.00
<i>d) Who has access to loans granted by the central bank?</i>	<i>Lwidth</i>	<i>0.05</i>	
- Only the central government			1.00
- All levels of government			0.67
- All levels of government and public enterprises			0.33
- Public and private sector			0.00
<i>e) Types of limitations on loans, where limits exist</i>	<i>Ltype</i>	<i>0.025</i>	
- Limit on loan amount is prescribed in absolute terms			1.00
- Limit on loan amount is prescribed in terms of capital or other liabilities of the central bank			0.67
- Limit on loan amount is prescribed in terms of percentage of government's revenues			0.33
- Limit on loan amount is prescribed in terms of percentage of government's expenditures			0.00
<i>f) Maturity of possible loans</i>	<i>Lmat</i>	<i>0.025</i>	
- < 6 months			1.00
- < 1 year			0.67
- > 1 year			0.33
- No legal limit on maturity of loan			0.00
<i>g) Limitations on interest rates applicable to loan by central bank</i>	<i>Lint</i>	<i>0.025</i>	
- Loan is possible only at market rates			1.00
- Minimum level applies to interest rates paid by the government			0.75
- Ceiling applies to interest rates paid by the government			0.50
- No explicit legal provisions on interest applied to loans by the central bank			0.25
- Law does not provide for the government to pay interest on loans from the central bank			0.00
<i>h) Prohibitions on lending on the primary market</i>	<i>Llprm</i>	<i>0.025</i>	
- Central bank prohibited from underwriting public debt securities on the primary market			1.00
- Central bank may underwrite public debt securities on the primary market			0.00

Source: Cukierman *et al.* (1992) and Arnone *et al.* (2007)

## Appendix E. Central Bank Independence: CWN Scores and TOR (1995-2004)

	CWN	TOR		CWN	TOR
Algeria	-	0.2	Indonesia	0.84	0.3
Angola	-	0.5	Jamaica	0.42	0.2
Argentina	0.79	0.6	Jordan	-	0.3
Bahamas, The	0.4	0.2	Kenya	0.48	0.3
Bangladesh	-	0.4	Kuwait	0.41	0.1
Barbados	0.41	0.3	Lebanon	0.46	0.1
Belize	-	0.3	Lesotho	-	0.3
Benin	0.49	0.1	Madagascar	-	0.2
Bolivia	0.78	0.2	Malawi	-	0.3
Botswana	0.52	0.3	Malaysia	0.47	0.3
Brazil	0.46	0.5	Mali	0.49	0.1
Burkina Faso	0.49	0.1	Mauritius	-	0.3
Burundi	-	0.3	Mexico	0.64	0.2
Cameroon	0.6	0.1	Morocco	0.31	0.2
Cape Verde	-	0.3	Mozambique	-	0.1
Central African Rep.	0.6	0.1	Namibia	0.43	0.2
Chad	0.6	0.1	Nepal	0.67	0.3
Chile	0.79	0.3	Nicaragua	0.79	0.3
Colombia	0.69	0.1	Niger	0.49	0.1
Congo. Dem. Rep	0.59	-	Nigeria	0.53	0.3
Congo. Rep.	0.6	0.1	Pakistan	0.38	0.2
Costa Rica	0.73	0.3	Peru	0.89	0.3
Côte d'Ivoire	0.49	0.1	Philippines	0.74	0.2
Djibouti	-	0.1	Rwanda	-	0.3
Dominican Rep.	-	0.4	Senegal	0.49	0.1
Egypt. Arab Rep.	0.47	0.3	Seychelles	-	0.3
El Salvador	0.73	0.4	South Africa	0.48	0.2
Equatorial Guinea	0.6	0.1	Sri Lanka	0.5	0.3
Ethiopia	0.43	0.3	Sudan	-	0.3
Fiji	-	0.3	Swaziland	-	0.2
Gabon	0.6	0.1	Tanzania	0.53	0.2
Gambia, The	-	0.2	Thailand	0.21	0.5
Ghana	0.56	0.3	Togo	0.49	0.1
Guatemala	0.78	0.3	Tunisia	0.51	0.3
Guinea	-	0.3	Uganda	0.52	0.2
Guinea-Bissau	0.49	0.1	Uruguay	0.43	0.5
Haiti	-	0.4	Venezuela	0.8	0.2
Honduras	0.67	0.4	Zambia	0.51	0.3
India	0.28	0.3	Zimbabwe	0.52	0.2

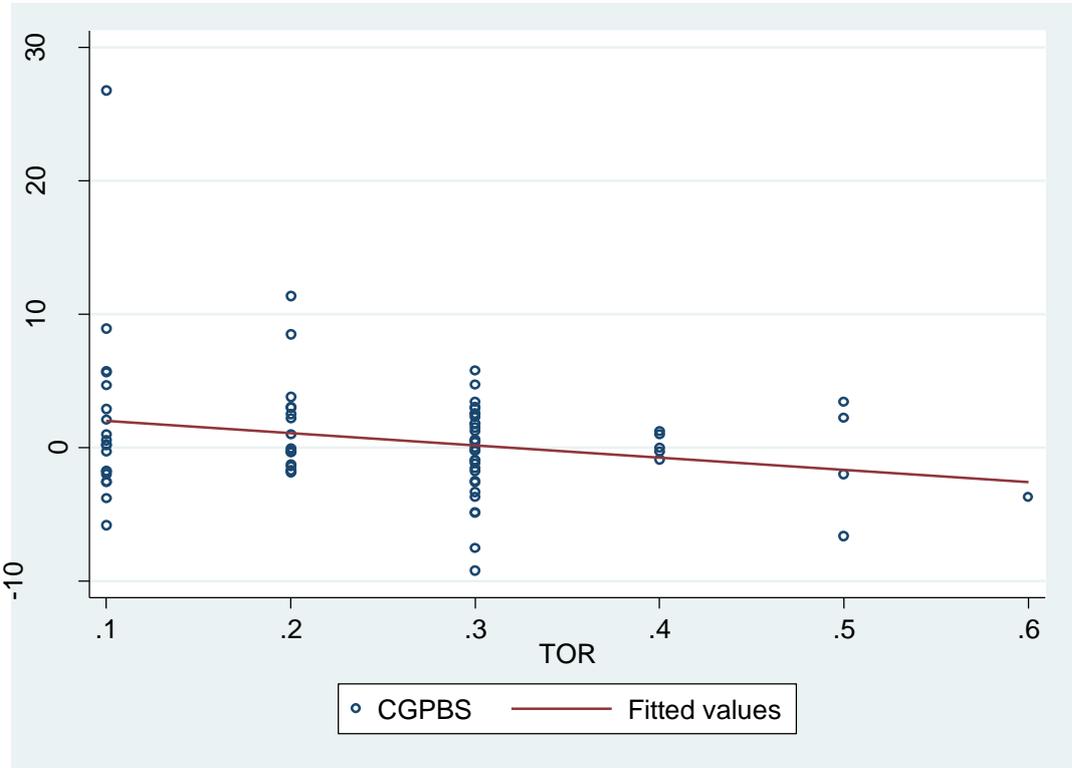
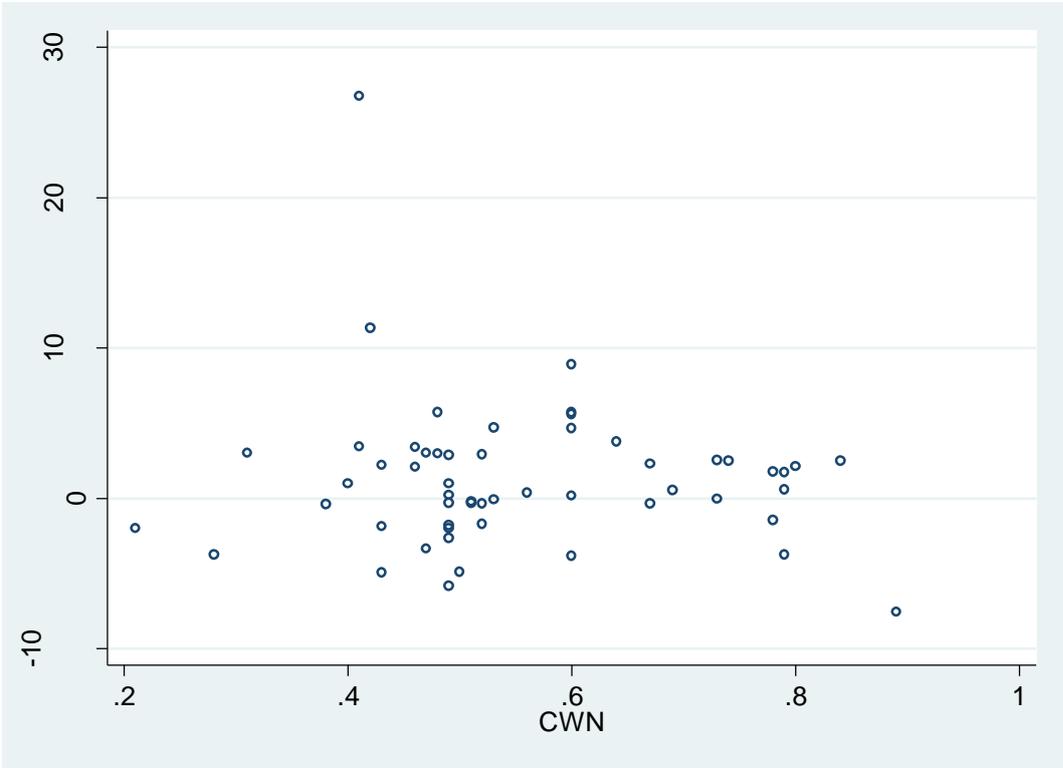
## Appendix F1. Summary statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
CWN	56	0.55	0.15	0.21	0.89
TOR	77	0.25	0.12	0.1	0.6
CGPBS	78	0.28	5.55	-22.9	36.3
RGDP	78	2044.76	2978.01	81.01	19551.13
GRGDP	78	4.08	5.78	-28.09	71.19
URB	78	46.26	22.51	7.3	98.28
AGRI	77	20.88	14.49	0.36	62.38
ILLY	78	42.19	30.01	2.07	219.92
OPEN	77	73.95	40.09	14.93	275.23

## Appendix F2. Correlation matrix of variables

	CWN	TOR	CGPBS	RGDP	GRGDP	URB	AGRI	ILLY	OPEN
CWN	1.00								
TOR	0.04	1.00							
CGPBS	-0.04	-0.11	1.00						
RGDP	0.12	0.32	0.32	1.00					
GRGDP	-0.01	-0.12	0.06	0.01	1.00				
URB	0.42	0.29	0.25	0.71	-0.13	1.00			
AGRI	-0.17	-0.38	-0.27	-0.65	0.03	-0.72	1.00		
ILLY	-0.34	0.28	-0.01	0.28	-0.10	0.21	-0.34	1.00	
OPEN	-0.10	-0.07	0.15	0.17	0.31	0.04	-0.26	0.24	1.00

**Appendix G1. Central Bank Independence level and fiscal discipline on average over the 1995-2004 period (scatter plots)**



**Appendix G2. Central Bank Independence level and fiscal discipline on average over the 1995-2004 period (means comparison)**

CWN	Nb. Of countries	Mean CGPBS	Std. Deviation	TOR	Nb. Of countries	Mean CGPBS	Std. Deviation
[0.2; 0.3 [	2	- 2.87	1.21	0.1	19	1.99	7.04
[0.3; 0.4 [	2	1.32	2.39	0.2	17	1.54	3.7
[0.4; 0.5 [	21	2.06	6.84	0.3	31	- 0.35	3.4
[0.5; 0.6 [	10	0.06	2.69	0.4	5	0.19	0.88
[0.6; 0.7 [	10	2.75	3.72	0.5	4	- 0.75	4.57
[0.7; 0.8 [	8	0.50	2.19	0.6	1	- 3.75	-
[0.8; 0.9 [	3	- 0.96	5.71				

