Central Bank Independence Indexes in Economic Analysis: A Reappraisal

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The paper, by means of panel data analysis, reexamines the empirical regularities strongly advocated by Alesina and Summers (1993), i.e., that (1) central bank independence and inflation are negatively correlated in industrialized countries; and that (2) central bank independence and real growth are not correlated in industrialized countries. The analysis here shows that both regularities become unstable when stricter conditions are imposed, and have not proved to be robust. Therefore, one may conclude that Alesina and Summers' results have not yet provided a reliable basis for policy recommendations.

Key words: Central bank independence indexes; Panel data; Cross-country comparison

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I. Introduction

This paper, a sequel to Fujiki (1996), reviews and reexamines various analyses that make use of central bank independence indexes.

The index of legal central bank independence proposed by Cukierman, Webb, and Neyapti (1992) (hereafter abbreviated as CWN) is one of the most representative of such indexes. It is, however, a weighted average of various criteria of independence, such as the terms of office of central bank officers and the nature of policy targets, and the weights used in averaging the components are somewhat arbitrarily chosen. To capture the idea of central bank independence that CWN had in mind more effectively, I have chosen the first principal component extracted by means of a principal component analysis of the disparate criteria. Indeed, the score on this component turns out to be close to the index that CWN used and the two are therefore almost indistinguishable.

In studying the relationship between central bank independence on the one hand and inflation and economic growth on the other, Alesina and Summers (1993) found that central bank independence and inflation are negatively correlated among industrialized countries and that there is no correlation between central bank independence and real economic growth. Their conclusions suggest that by enhancing the degree of independence of central banks, one could reduce inflation without sacrificing real economic growth.

Alesina and Summers (1993), however, examined only bivariate correlations between central bank independence on the one hand and growth or inflation on the other, and this kind of approach is known to have some problems. The new literature on economic growth, which has become extremely popular in recent years (e.g., Barro [1991] and Romer [1993]), argues that all the major variables that could contribute to inflation and growth should be explicitly dealt with in empirical analysis.

Therefore, I have regressed inflation, following Romer (1993), not only on the central bank independence index, but also on external openness (the share of exports and imports in GDP) and per capita GDP as explanatory variables, using cross-country data. As for economic growth, I have estimated cross-sectional regressions with per capita GDP, educational attainment, the ratio of investment to GDP, and population growth, along with central bank independence, as explanatory variables. Whenever those explanatory variables could also be influenced by the dependent variables (growth and inflation), I have used the starting values as well as the sample means to avoid causal ambiguity.

According to the estimation results, the negative correlations between central bank independence and inflation are statistically significant in the samples of 1960–89 and 1975–89 but not significant in the restricted period of 1980–89. As for the relationship between central bank independence and growth, the sample period of 1960–89 shows a statistically significant positive correlation, but the subsample of 1975–89 shows a positive correlation and that of 1980–89 shows a negative correlation, neither of which is statistically significant.

To be sure, the approach of Romer (1993) and Barro (1991)—to use the mean values of variables over several years in a cross-sectional analysis—is also known to contain some problems. For example, this approach does not remove the effects of the specific characteristics of different countries, and therefore the parameter estimates may contain some biases. The value of central bank independence, as estimated by the method of Romer (1993) and Barro (1991), may be contaminated by some country-specific factors that could not be controlled for by explicitly including some explanatory variables.

For these reasons, this paper adopts the following two-step method in the next stage of the analysis. First, inflation (growth) is regressed on country and time dummy variables and on openness (investment relative to GDP and population growth), in order to concentrate the country-specific effects on the country dummy variables. In the second step, the coefficients of the country dummies estimated in the first step are regressed on the central bank independence index, as well as per capita GDP and educational attainment data for each country. In this estimation, I find a significant negative correlation between inflation and central bank independence only in the subsample of 1975–89, which does not involve the use of the time dummies to remove the effects of shocks that simultaneously affected all the countries. This analysis finds no correlation between central bank independence and growth, in line with Alesina and Summers (1993). Thus, this estimation method supports one of their propositions—that of zero correlation between central bank independence and growth—but casts doubt on the robustness of the other proposition concerning the relationship between central bank independence and inflation.

Thus, if one adopts a more sophisticated method and rigorously tests Alesina and Summers' hypotheses on central bank independence and macroeconomic variables, they become less robust and not as clear as they appear in a graphic representation of bivariate correlations, thereby giving rise to some reservations. However, it remains true that central bank independence indexes are useful tools for economic analysis, and they will continue to be used.

The organization of this paper is as follows. Section II describes the index for central bank independence proposed by CWN (1992) that is representative of various indexes that are used in the literature. Section III first explains the economic theory on which the notion of central bank independence is based. Then, Section III presents the results of the principal component analysis that I conducted to remove the arbitrariness found in the construction of central bank independence indexes. After reviewing the literature on the relationship between central bank independence on the one hand and economic growth and inflation on the other, Section III finally presents the results of a panel data analysis.

II. Central Bank Independence Index

Many of the central bank independence indexes are derived from legislation governing central banks. This section briefly describes the legal central bank independence index that CWN have advocated, which seems to be the most

representative of all.[1]

The CWN legal central bank independence index is computed for 72 countries and is composed of the following four classes of criteria:

(1) Variables related to the appointment and tenure of the chief executive of the central bank (the longer the tenure of the central bank chief executive, the more independent; if the central bank chief executive can appoint the board and cannot be dismissed by the government, the central bank is considered more independent);

(2) Variables concerning the policy initiatives of the central bank in the decision-making process (the more initiatives that the central bank has, the more independent);

(3) Variables concerning the policy objectives of the central bank (if price stability is the sole objective, and if the government cannot interfere in the pursuit of this objective, the central bank is considered independent); and

(4) Variables concerning the conditions attached to central bank credit to the government (the more stringent the lending conditions are, the more independent).

Each of these four categories in turn is composed of more detailed criteria, and a score ranging from zero to one is assigned to each of the criteria. These values are added up for each of the four categories, and finally the weighted average of the values for the four categories becomes the index.[2]

III. Reexamining the Analysis Using Central Bank Independence Indexes

This section reexamines the existing studies that have used central bank independence indexes. First, I will present the theoretical background motivating the empirical analysis of central bank independence. Next, I will discuss some problems involved in assigning weights to various criteria in order to construct a central bank independence index. Finally, I will repeat the empirical analysis in the light of criticisms of existing economic analyses that use central bank independence indexes.[3]

A. Theoretical Background

To appreciate the analysis involving central bank independence indexes, it would be useful to know the theoretical context in which the issues of central bank independence have been discussed in economics in recent years. To do so, it is standard to begin with the time inconsistency problem, as described by Kydland and Prescott (1977) and Barro and Gordon (1983), and then to discuss the need for conservative central bankers as proposed by Rogoff (1985).

1. For details on central bank independence indexes, see Eijffinger and De Haan (1996).
2. For further details, see Table 1.
3. For a comprehensive survey of the economic analyses of central bank independence indexes, see Eijffinger and De Haan (1996).

Kydland and Prescott (1977) and Barro and Gordon (1983) assume that the government has preferences concerning inflation and unemployment, and that unemployment rates shift on expectation-augmented Phillips curves. In these models, private-sector prices and wages are set before observing aggregate demand, leaving room for the central banks to boost employment temporarily by engineering unanticipated inflation.

Under zero uncertainty, the *ex ante* optimal policy for the central bank is to set an inflation rate consistent with the natural rate of unemployment (zero inflation or target rate thereof). Once this expectation is priced into the private-sector wage-price determination, however, the *ex post* optimal response of the central bank strikes a trade-off between inflation costs and employment benefit and hence triggers a rate of inflation higher than the *ex ante* target. Therefore, an *ex ante* announcement by the central bank that it was aiming for zero inflation would not be credible. This result is known as the inflationary bias of discretionary monetary policy.

Rogoff (1985) argues that it is not socially desirable to have a central bank whose sole objective is price stability, since opportunities for accommodating supply shocks would be lost. However, if central bankers were more averse to inflation than society at large, they would value the benefits of the greater employment caused by unanticipated inflation less than the general public did. In other words, such central bankers would have little incentive to engineer unexpected inflation after lower inflationary expectations had been set, and that in turn would be anticipated by the public. Thus, argues Rogoff, the central bank would have a greater chance of attaining low inflation than would otherwise be the case.

In essence, Rogoff (1985) suggests a theoretical rationale for the delegation of monetary policy to a central bank that is more averse to inflation than society at large. To ensure that the central bank can maintain a policy orientation that differs from that of society as a whole, the central bank must have policy independence. To help safeguard the central bank's policy orientation, price stability should be legally specified as the central bank's primary policy objective.

Now, is it true that the countries with independent central banks attain lower inflation that others? To give an empirical answer to this question, it is necessary to have a measure of central bank independence that is comparable across different countries. Thus, constructing an index of central bank independence is a very important task.

Central bank independence can have several meanings. For the purpose of price stability, independence is not "the independence to do anything that CB (central bank) pleases but rather the ability to stick to the price stability objective even at the cost of other short-term real objectives," as Cukierman (1992) defines it. Thus, CWN's coding methods, illustrated in Table 1 on the following pages, which emphasize the priority of the price stability objective, are certainly consistent with such a viewpoint. Granted, the central bank independence indexes, because of their various methods of construction, clearly include some factors beyond those that central bankers and others associate with the term "central bank independence." Thus, if the analyst wishes to compare the degree of central bank independence from a perspective other than that of CWN, it is necessary to construct a new index of central bank independence that suits his or her analytical purposes.

Table 1 Variables for Legal Central Bank Independence

1. Chief executive officer (CEO) = (TOO + APP + DISS + OFF)/4

Variable	Coding
Term of office (TOO)	
Over 8 years	1
6 to 8 years	0.75
5 years	0.5
4 years	0.25
Under 4 years or at the discretion of the appointer	0
Who appoints the CEO? (APP)	
Board of the central bank	1
A council of the central bank board, executive branch, and legislative branch	0.75
Legislature	0.5
Executive collectivity (e.g., council of ministers)	0.25
One or two members of the executive branch	0
Dismissal (DISS)	
No provision for dismissal	1
Only for reasons not related to policy	0.83
At the discretion of the central bank board	0.67
At the legislature's discretion	0.5
Unconditional dismissal possible by the legislature	0.33
At the executive's discretion	0.17
Unconditional dismissal possible by the executive	0
May the CEO hold other offices in the government? (OFF)	
No	1
Only with permission of the executive branch	0.5
No rule against the CEO holding another office	0

2. Policy formulation (PF) = .25*MONPOL + .5*CONF + .25*ADV

Variable	Coding
Who formulates monetary policy? (MONPOL)	
Bank alone	1
Bank participates, but has little influence	0.67
Bank only advises the government	0.33
Bank has no say	0
Who has final say in resolution of conflict? (CONF)	
The bank, on issues clearly defined in the law as its objectives	1
The government, on policy issues not clearly defined as the bank's goals or in case of conflict within the bank	0.8
A council of the central bank, executive branch, and legislative branch	0.6
The legislature, on policy issues	0.4
The executive branch on policy issues, subject to due process and possible protest by the bank	0.2
The executive branch has unconditional priority	0
Role in the government's budgetary process (ADV)	
Central bank active	1
Central bank has no say	0

Table 1 (continued)

3. Objectives (OBJ)

Variable	Coding
Objectives (OBJ)	
Price stability is the major or only objective in the charter, and the central bank has the final word in case of conflict with other government objectives	1
Price stability is the only objective	0.8
Price stability is one goal, with other compatible objectives such as a stable banking system	0.6
Price stability is one goal, with potentially conflicting objectives, such as full employment	0.4
No objectives stated in the bank charter	0.2
Stated objectives do not include price stability	0

4. Limitations on nonsecuritized lending to the government (LLA)

Variable	Coding
Limitation on nonsecuritized lending (LLA)	
No advances permitted	1
Advances permitted, but with strict limits	0.67
Advances permitted, and the limits are loose	0.33
No legal limits on lending	0

5. Securitized lending (LLS)

Variable	Coding
Securitized lending (LLS)	
Not permitted	1
Permitted, but with strict limits	0.67
Permitted, and the limits are loose	0.33
No limits on lending	0

6. Terms of lending (LDEC)

Variable	Coding
Terms of lending (LDEC)	
Controlled by the bank	1
Specified by the bank charter	0.67
Agreed between the central bank and executive	0.33
Decided by the executive branch alone	0

7. Potential borrowers from the bank (LWIDTH)

Variable	Coding
Potential borrowers from the bank (LWIDTH)	
Only the central government	1
All levels of government	0.67
Those mentioned above and public enterprises	0.33
Public and private sector	0

Table 1 (continued)

8. Limitations on lending (LL)

Variable	Coding
Limits on central bank lending defined in (LTYPE)	
Currency amounts	1
Shares of central bank demand liabilities or capital	0.67
Shares of government revenue	0.33
Shares of government expenditures	0
Maturity of loans (LMAT)	
Within 6 months	1
Within 1 year	0.67
More than 1 year	0.33
No mention of maturity in the law	0
Interest rates on loans (LINT)	
Above minimum rates	1
At market rates	0.75
Below maximum rates	0.5
Interest rate is not mentioned	0.25
No interest on government borrowing from the central bank	0
Central bank prohibited from buying or selling government securities in the primary market? (LPRM)	
Yes	1
No	0

Note: CWN Index = .2*CEO + .15*PF + .15*OBJ + .15*LLA + .1*LLS + .1*LDEC + .05*LWIDTH + .1*LL.
Source: Adapted from Table 1 in CWN (1992).

B. Problems with the Construction of Central Bank Independence Indexes

In the following, I will accept, as a premise, existing criteria and the scores for individual criteria for central bank independence, while bearing in mind the reservations mentioned in Section III.A.

The weights that CWN used to aggregate separate scores to arrive at a value for the legal central bank independence index were not chosen objectively but were determined on an *a priori* basis. Therefore, those weights can be improved. The more independent the central bank is deemed to be, the higher the score for each of the criteria, and hence it is possible to derive appropriate weights for those criteria by using a principal component analysis to compute a simple index measuring the degree of central bank independence.

The results of the principal component analysis are shown in tables 2 through 5. Table 2 indicates that the first principal component accounts for approximately 40 percent of the variance for all the subperiods—1960–71, 1972–79, and 1980–89. Since the principal component analysis is an efficient means of identifying linear relations to represent covariance structure among several variables, and if all the criteria for central bank independence measure the concept very well, the first principal component should summarize the variances of all the variables, but that is not the case here.

Next, tables 3, 4, and 5 show that, as judged by factor loadings, the first component positively correlates with most of the variables, and therefore is useful as a

Table 2 Principal Component Analysis of CWN Index Eigenvalues

Eigenvalue	1960–71	1972–79	1980–89
1	3.1347 (0.3918)	3.2652 (0.4081)	3.2128 (0.4016)
2	1.3713 (0.5633)	1.3642 (0.5787)	1.4025 (0.5769)
3	1.2337 (0.7175)	1.1784 (0.7260)	1.2930 (0.7385)
4	0.7813 (0.8151)	0.9026 (0.8388)	0.7203 (0.8286)
5	0.6295 (0.8938)	0.5619 (0.9090)	0.6590 (0.9109)
6	0.4015 (0.9440)	0.3974 (0.9587)	0.4506 (0.9673)
7	0.2974 (0.9812)	0.1702 (0.9800)	0.1441 (0.9853)
8	0.1505 (1.0000)	0.1601 (1.0000)	0.1178 (1.0000)

Note: Cumulative contribution ratios are in parentheses.

Table 3 Principal Component Analysis of CWN Index Factor Loadings (1960–71)

	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6	Comp 7	Comp 8
CEO	0.276	0.628	0.523	–0.434	0.163	–0.149	0.011	0.139
PF	0.767	–0.354	–0.052	–0.008	0.368	0.215	–0.298	0.116
OBJ	0.598	–0.093	–0.326	–0.639	–0.274	0.177	0.048	–0.099
LLA	0.770	–0.152	–0.461	0.125	–0.023	–0.230	0.257	0.193
LLS	0.823	0.242	–0.043	0.171	–0.178	–0.334	–0.259	–0.150
LDEC	0.639	–0.389	0.518	0.043	0.279	–0.028	0.244	–0.179
LWIDTH	0.211	0.736	–0.461	0.157	0.348	0.186	0.101	–0.106
LL	0.624	0.264	0.395	0.337	–0.401	0.320	0.056	0.070

Table 4 Principal Component Analysis of CWN Index Factor Loadings (1972–79)

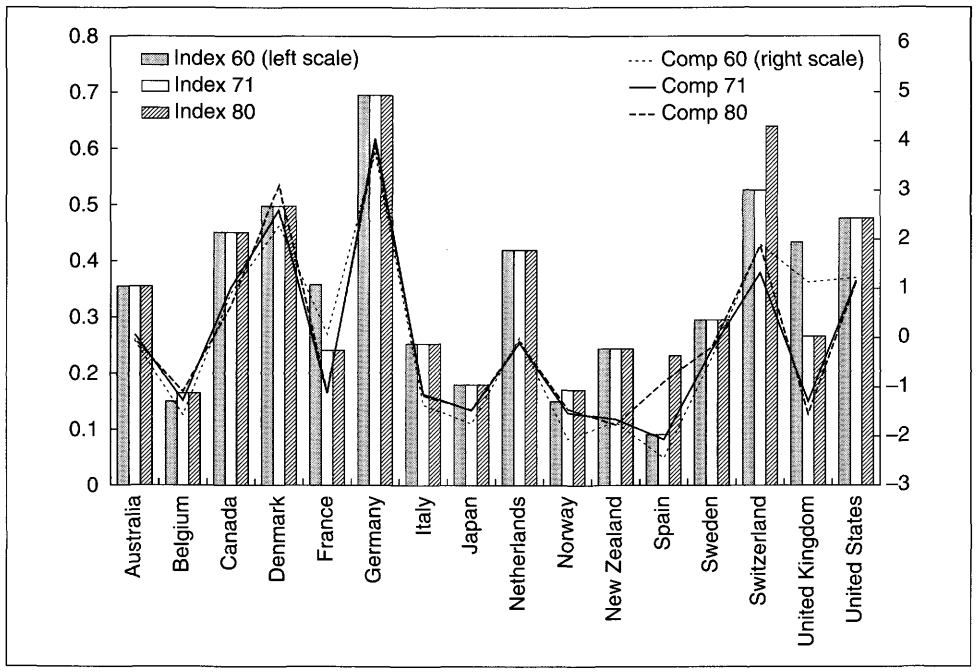
	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6	Comp 7	Comp 8
CEO	0.202	–0.881	–0.020	–0.122	0.380	0.032	0.015	0.150
PF	0.763	0.235	0.132	–0.382	–0.074	–0.406	–0.077	0.153
OBJ	0.633	–0.026	0.262	0.639	0.247	–0.177	–0.130	–0.114
LLA	0.775	0.352	0.218	0.202	–0.029	0.377	0.005	0.212
LLS	0.926	–0.062	0.093	–0.099	–0.002	–0.021	0.317	–0.142
LDEC	0.766	0.009	–0.379	–0.387	0.084	0.216	–0.197	–0.167
LWIDTH	–0.043	–0.388	0.841	–0.202	–0.276	0.100	–0.086	–0.080
LL	0.443	–0.505	–0.431	0.304	–0.517	–0.042	–0.027	0.039

Table 5 Principal Component Analysis of CWN Index Factor Loadings (1980–89)

	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6	Comp 7	Comp 8
CEO	–0.078	–0.582	–0.670	–0.269	0.343	0.033	–0.045	–0.116
PF	0.782	0.173	0.137	–0.315	–0.275	0.375	–0.020	–0.156
OBJ	0.671	0.416	–0.336	0.212	0.371	0.201	0.195	0.055
LLA	0.805	0.324	–0.012	0.235	0.129	–0.365	–0.128	–0.158
LLS	0.903	–0.116	–0.255	–0.128	–0.080	0.005	–0.181	0.224
LDEC	0.720	–0.438	0.258	–0.287	–0.063	–0.300	0.217	0.016
LWIDTH	–0.214	0.350	–0.753	–0.063	–0.475	–0.170	0.083	–0.012
LL	0.344	–0.655	–0.117	0.588	–0.275	0.126	0.026	–0.038

proxy variable for the central bank independence index. As illustrated in Figure 1, however, this first principal component and the CWN index are strongly correlated, and hence, there may be no great merit in substituting the first principal component for the CWN index. This illustrates the point that the analyst's theoretical background and subjective judgments in selecting the criteria are more important than the problems associated with the weights assigned to constituent variables.

Figure 1 CWN Index and Principal Component Scores



C. The Relationship between Central Bank Independence Indexes and Inflation/Growth

Cukierman (1994) summarizes the empirical regularities in the correlations between central bank independence index and the inflation/growth as follows:

(1) Among industrialized countries, the legal central bank independence index and the inflation rates are negatively correlated; but the turnover in the position of central bank chief executives has no correlation with inflation;

(2) Among industrialized countries, the legal central bank independence index has no correlation with real growth;

(3) Among developing countries, the legal central bank independence index and inflation are not correlated; and

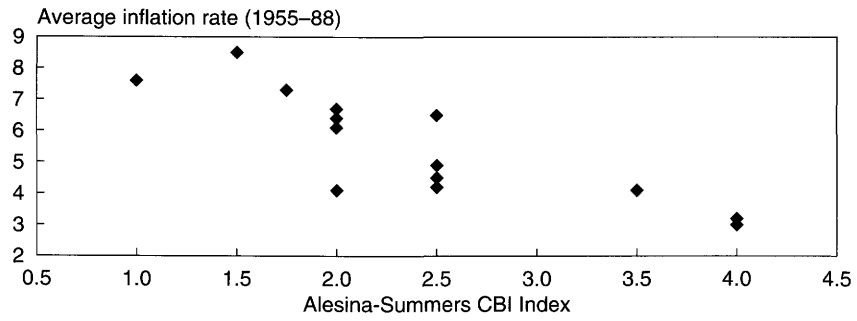
(4) Among developing countries, after controlling for other factors that account for cross-country differences in economic growth, the central bank independence index is positively correlated with economic growth.

I will examine the first two points here.

1. The analysis by Alesina and Summers

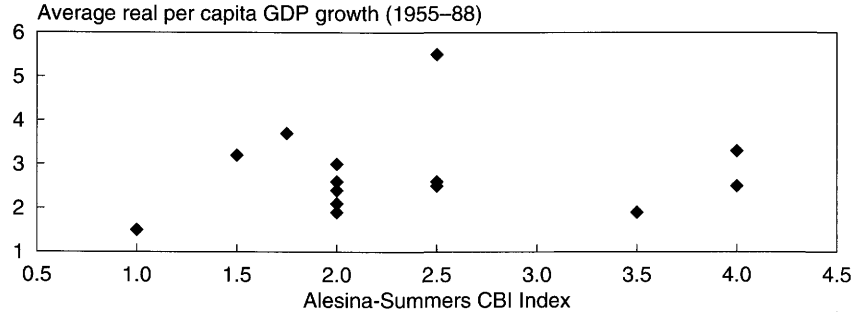
The study by Alesina and Summers (1993) illustrates the first and second propositions very clearly. Their findings are based on data from 16 industrialized countries, summarized in figures 2 and 3.

Figure 2 Alesina-Summers Index vs. Inflation



Source: Alesina and Summers (1993), Figure 1a, p. 155.

Figure 3 Alesina-Summers Index vs. Real Per Capita GDP Growth



Source: Alesina and Summers (1993), Figure 3a, p. 156.

Figure 2 succinctly presents the empirical law which states that the higher the degree of central bank independence, the lower the rate of inflation. Figure 3, on the other hand, gives the impression that central bank independence has no correlation with the real growth rate of per capita income. Thus, Alesina and Summers write, "Our results here do, however, create some presumption that the inflation benefits of central bank independence are likely to outweigh any output costs (p. 159)."

Roll et al. (1993) also argue that lower inflation can be achieved without any long-term costs and, by referring to Figure 3, claim that "[t]here simply is no link

apparent to the naked eye or the careful statistician (p. 17)." But how credible are these arguments by Alesina and Summers (1993) and Roll et al. (1993)?[4]

2. The Barro-Romer approach

Now, let us examine the empirical relations found by Alesina and others, in the light of empirical studies of new growth theory. One problem with the method of Alesina and Summers (1993) is that it pays no attention to other variables that may account for cross-country differentials in inflation and growth. Therefore, I will explore this problem, following Barro (1991) and Romer (1993).

In order to retest the statistical relationship between inflation and central bank independence in Figure 2 and that between growth and central bank independence, one has only to estimate the following equations:

$$\pi\,(s, \tau)_i = c_0 + c_1 \cdot Z_i + \varepsilon_i \qquad (1)$$

$$\gamma\,(s, \tau)_i = d_0 + d_1 \cdot Z_i + v_i \qquad (2)$$

where $\pi\,(s, \tau)_i$ is the inflation rate between time s and time τ in country i, $\gamma\,(s, \tau)_i$ is the real growth rate between time s and time τ in country i, Z_i is the value of the central bank independence index for country i (the more independent, the greater), and ε_i and v_i are error terms.

In terms of equations (1) and (2), Alesina and Summers (1993) essentially argue that the parameter c_1 is statistically distinguishable from zero in (1) and d_1 is statistically indistinguishable from zero. CWN estimated an equation of the type (1) with data from 72 countries, including developing countries, and pointed out the following anomalies: Argentina, Nicaragua, and Peru have above-average central bank independence but also show above-average inflation rates; on the other hand, Belgium, Japan, Morocco, and Qatar, with below-average central bank independence, exhibit below-average inflation rates.

It is known, thanks to Romer (1993), that one of the most important factors which accounts for cross-country differences in inflation rates is openness of the economy, as measured by the volume of trade (exports and imports combined) as a share of GDP. In light of Romer (1993), then, it seems more appropriate, in testing for the relationship between central bank independence and inflation, to estimate the following equation:

$$\pi\,(s, \tau)_i = a_0 + a_1 \cdot X_i + a_2 \cdot Z_i + \varepsilon_i \qquad (3)$$

where X_i is openness of country i. In this case, a_2 in the equation estimates the effect of central bank independence on inflation, keeping openness constant.[5]

On the other hand, as result of the work of Barro (1991) and others, we now know that it is important to include real GDP per capita, educational attainment levels, the ratio of investment to GDP, and population growth as explanatory

4. Incidentally, CWN (1992) argue that the turnover of central bank chiefs has greater explanatory power for inflation than legal central bank independence as far as developing countries are concerned, and therefore, that the former reflects real independence better than the latter. This argument, however, assumes *a priori* that one of the determinants of inflation is central bank independence, as Walsh (1993) has pointed out.

5. For an example of a cross-country comparative analysis of inflation from the perspective of the inflation-unemployment trade-off in orthodox macroeconomics, see Debelle and Fischer (1994).

variables in comparing cross-country growth differentials. Therefore, in order to explore the relationship between central bank independence and growth, it may be advisable to estimate the following equation:

$$\gamma(s, \tau)_i = b_0 + b_1 \cdot Y_i + b_2 \cdot Z_i + \varepsilon_i \qquad (4)$$

where Y_i is a vector of explanatory variables consisting of GDP per capita, educational attainment, investment relative to GDP and population growth in country i at times s. Again, b_2 in this equation measures the effect of central bank independence on growth while keeping constant all the other relevant variables.

I have estimated equations (3) and (4), employing data from the same 16 countries as used by Alesina and Summers (1993). The inflation rates employed in the estimates are the rates of increase in the consumer price index (CPI) taken from *International Financial Statistics*. The indexes of central bank independence are the CWN index and the principal component scores.[6] The other macroeconomic variables are taken from Penn World Table 5.6a and Barro and Lee (1994), using the same selection criteria as Ramey and Ramey (1994).[7]

First, I regressed the period-averages of CPI changes on the initial values of GDP per capita (YINI), the initial values (INIOPEN) or period-averages of openness (AOPEN), and the CWN legal index (CBI) or the first principal component scores (CBI2).[8] The sample periods used for estimation are 1960–89, 1975–89, and 1980–89.

While Table 6 shows the results of estimation with the period-averages of openness, and Table 7 shows these with the initial values thereof, the results are actually very similar. The leftmost column of numbers in Table 6 shows the estimation results, using per capita GDP and external openness as explanatory variables while varying the sample periods. In no period does openness demonstrate statistically a significant effect on inflation. Thus, when the sample is confined to developed countries, the results are consistent with those of Romer (1993). Also, the coefficient of initial per capita GDP takes a negative sign, though it is not statistically significant. The second and third columns in tables 6 and 7 show the results with the central bank independence indexes in addition to initial GDP levels and openness as explanatory variables. The correlations between central bank independence and inflation are negative and statistically significant in the samples of 1975–89 and 1960–89, but when restricted to 1980–89, the negative correlation is not statistically significant. Thus while valid for long-term samples, the Alesina-Summers proposition is not true when the sample is restricted to the most recent period.[9]

6. As mentioned, the central bank independence index and this first principal component are closely correlated. The first principal component is included here to confirm that the results remain unchanged whether one uses the central bank independence index or the scores of the first principal component. For a price index, the CPI is used, following Barro (1995).
7. For the Penn World Table, see Summers and Heston (1991).
8. The central bank independence index in Alesina and Summers (1993) and the CWN index are closely correlated, suggesting that the results would be more or less the same irrespective of the choice of the index.
9. Martin (1994) reports a negative correlation between the size of the economy and inflation among the OECD member countries. In tables 6 and 7, the coefficient on YINI takes different signs in different models, and the coefficient on YINI and that on CBI and CBI2 are not statistically significant at the same time. These results may be due to the close correlation between the size of the economy and YINI.

Next, I present the results of regressions of period-averages of per capita GDP growth rates on the initial values of per capita GDP (YINI), education (INIEDU), investment-GDP ratios, and population growth, as shown in the leftmost column of Table 8.[10] Again, I use both the period-averages (AINV, AGRPOP in Table 8) and initial values (INIINV, INIPOP in Table 9) for investment-GDP ratios and population growth. The signs of the estimated coefficients are as expected. Not all the parameter estimates for population growth are statistically significant, and this is probably because the sample is limited to developed countries.

The regression results, including central bank independence indexes, in addition to these explanatory variables, are summarized in the second and third columns of

Table 6 Cross-Sectional Analysis

Period-averages are used for openness

Dependent variable: GRCPI Period: 1960–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	22.706	2.032	5.000	0.432	6.050	0.505
YINI	–1.799	–1.398	0.584	0.412	0.150	0.108
AOPEN	–0.016	–0.980	–0.025	–1.767	–0.023	–1.572
CBI			–7.513	–2.581		
CBI2					–0.621	–2.342
Adjusted R-squared	0.070		0.350		0.314	
Standard error	1.680		1.405		1.452	

Dependent variable: GRCPI Period: 1975–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	74.452	1.872	22.319	0.506	33.523	0.800
YINI	–7.077	–1.645	–1.038	–0.212	–2.636	–0.581
AOPEN	–0.028	–1.101	–0.032	–1.386	–0.031	–1.339
CBI			–10.281	–2.020		
CBI2					–0.867	–1.932
Adjusted R-squared	0.114		0.283		0.267	
Standard error	2.839		2.552		2.580	

Dependent variable: GRCPI Period: 1980–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	63.423	1.698	30.745	0.747	37.892	0.946
YINI	–5.960	–1.492	–2.170	–0.482	–3.222	–0.752
AOPEN	–0.020	–0.920	–0.024	–1.121	–0.021	–1.011
CBI			–7.352	–1.560		
CBI2					–0.613	–1.440
Adjusted R-squared	0.069		0.162		0.140	
Standard error	2.658		2.523		2.555	

10. The choice of the variables here follows Levine and Renelt (1992). For a similar analysis, see Cukierman, Kalaitzidakis, Summers, and Webb (1994), who use terms of trade instead of the share of investment in GDP and primary school enrollment instead of population growth and pool the average values of the 1960s, 1970s, and 1980s. Their results show that central bank independence does not significantly account for economic growth among industrialized economies, in line with Alesina and Summers (1993).

tables 8 and 9. When the period-average values are used in the sample of 1960–89, central bank independence indexes are positively correlated with growth rates, a result contrary to the findings of Alesina and Summers (1993). However, when the sample is restricted to 1975–89, the parameter estimates for initial per capita GDP and education levels become unstable, and the correlation between central bank independence and growth is no longer significant.

These results suggest that the relationship between central bank independence on the one hand and inflation or growth on the other are contingent both on sample periods and the other variables that are involved in a cross-country comparison. In the next section, I will further estimate equations (3) and (4), by means of panel data analysis.

Table 7 Cross-Sectional Analysis

Initial values are used for openness

Dependent variable: GRCPI Period: 1960–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	22.197	1.956	5.298	0.437	5.955	0.480
YINI	–1.763	–1.345	0.492	0.332	0.128	0.089
INIOPEN	–0.014	–0.802	–0.022	–1.372	–0.020	–1.268
CBI			–7.064	–2.351		
CBI2						–2.196
Adjusted R-squared	0.056		0.300		0.270	
Standard error	1.703		1.466		1.497	

Dependent variable: GRCPI Period: 1975–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	75.490	1.878	23.153	0.520	34.188	0.810
YINI	–7.201	–1.658	–1.129	–0.229	–2.710	–0.593
INIOPEN	–0.029	–0.979	–0.034	–1.288	–0.034	–1.258
CBI			–10.376	–2.016		
CBI2					–0.881	–1.943
Adjusted R-squared	0.097		0.269		0.256	
Standard error	2.864		2.577		2.600	

Dependent variable: GRCPI Period: 1980–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	61.821	1.644	28.372	0.683	35.467	0.881
YINI	–5.791	–1.437	–1.906	–0.419	–2.955	–0.685
INIOPEN	–0.020	–0.822	–0.025	–1.057	–0.023	–0.969
CBI			–7.453	–1.568		
CBI2					–0.629	–1.469
Adjusted R-squared	0.058		0.153		0.135	
Standard error	2.675		2.536		2.563	

Table 8 Cross-Sectional Analysis

Period-averages are used for investment ratios and population growth

Dependent variable: GRY Period: 1960–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	23.339	7.761	28.350	8.360	27.751	8.010
YINI	–2.491	–8.039	–3.099	–8.212	–2.986	–8.065
INIEDU	0.266	1.808	0.398	2.876	0.361	2.600
AINV	0.051	2.113	0.043	2.068	0.045	2.067
AGRPOP	–0.136	–0.588	–0.128	–0.647	–0.060	–0.286
CBI			1.389	2.260		
CBI2					0.113	1.995
Adjusted R-squared	0.881		0.913		0.906	
Standard error	0.317		0.270		0.281	

Dependent variable: GRY Period: 1975–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	17.003	1.562	32.813	1.937	34.156	2.260
YINI	–1.866	–1.599	–3.683	–1.942	–3.745	–2.284
INIEDU	0.500	1.196	0.880	1.700	0.936	1.931
AINV	0.077	1.706	0.078	1.761	0.073	1.709
AGRPOP	–0.278	–0.522	–0.271	–0.518	–0.207	–0.411
CBI			2.057	1.202		
CBI2					0.220	1.545
Adjusted R-squared	0.143		0.176		0.239	
Standard error	0.656		0.643		0.618	

Dependent variable: GRY Period: 1980–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	13.946	1.753	6.525	0.544	8.922	0.702
YINI	–1.492	–1.725	–0.639	–0.474	–0.938	–0.673
INIEDU	0.272	0.817	0.037	0.084	0.101	0.213
AINV	0.074	2.341	0.073	2.284	0.074	2.263
AGRPOP	–0.227	–0.585	–0.186	–0.470	–0.236	–0.586
CBI			–0.995	–0.835		
CBI2					–0.062	–0.519
Adjusted R-squared	0.225		0.203		0.169	
Standard error	0.477		0.484		0.494	

Table 9 Cross-Sectional Analysis

Initial values are used for investment ratios and population growth

Dependent variable: GRY Period: 1960–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	26.668	9.623	31.449	9.479	31.143	9.250
YINI	–2.805	–8.718	–3.390	–8.581	–3.312	–8.567
INIEDU	0.281	1.833	0.420	2.814	0.396	2.660
INIINV	0.023	1.165	0.017	0.951	0.020	1.124
INIPOP	0.028	0.167	–0.011	–0.077	0.044	0.297
CBI			1.492	2.106		
CBI2					0.123	1.957
Adjusted R-squared	0.851		0.886		0.881	
Standard error	0.354		0.309		0.316	

Dependent variable: GRY Period: 1975–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	19.192	1.435	36.390	2.063	35.930	2.155
YINI	–2.042	–1.440	–4.035	–2.064	–3.876	–2.162
INIEDU	0.622	1.281	1.048	1.893	1.063	1.966
INIINV	0.053	1.458	0.058	1.678	0.049	1.448
INIPOP	–0.347	–1.117	–0.351	–1.181	–0.327	–1.117
CBI			2.345	1.417		
CBI2					0.215	1.536
Adjusted R-squared	0.169		0.239		0.261	
Standard error	0.646		0.618		0.609	

Dependent variable: GRY Period: 1980–89 Number of observations: 16

Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	16.285	2.047	13.016	1.027	14.799	1.136
YINI	–1.736	–1.987	–1.355	–0.940	–1.571	–1.087
INIEDU	0.324	1.045	0.227	0.528	0.272	0.572
INIINV	0.062	2.263	0.059	2.042	0.061	2.112
INIPOP	0.087	0.336	0.080	0.294	0.085	0.313
CBI			–0.429	–0.341		
CBI2					–0.018	–0.148
Adjusted R-squared	0.218		0.150		0.142	
Standard error	0.479		0.500		0.502	

3. The analysis of panel data

After taking the average value of the data for each country over several years, Romer (1993) and Barro (1991) compare countries cross-sectionally (so-called between-group estimation). As pointed out in Fujiki and Kitamura (1995), however, this method does not take into account long-term country-specific factors that may cause biases in parameter estimation. Furthermore, the central bank independence index is derived from central bank legislation and hence remains constant in each country over the sample period. Therefore, the effects attributed to central bank independence may include the effects of other country-specific factors that could not be explicitly included in estimation.[11]

A standard method of stripping out the effects of country-specific factors is to include country dummy variables. Also, time dummies are often included to strip out the effects of shocks that affect all countries. However, the effects of the country and time dummies could not be distinguished from those of central bank independence indexes, initial per capita GDP, and educational attainment since the latter three variables remained almost constant throughout the sample period in the data used here. Therefore, I decided to use the following two-step estimation method: first, I regressed inflation (growth) on the country dummies, the time dummies, and external openness (investment ratios, population growth) to concentrate all the country-specific effects on the country dummy variables; in the second step, the estimated coefficient on the country dummies was regressed on central bank independence indexes and initial per capita GDP and education levels.

Table 10 shows the results for inflation. The sample periods are varied, and the time dummies are either included or excluded. The results show that, if the time dummies are not included, openness has a negative effect on inflation in the 1975–89 sample. In the second step of the analysis, central bank independence and inflation exhibit statistically significant relationships only in the 1975–89 sample without the time dummies. Thus, although the analysis in Section III.C.2 supported the negative correlation between inflation and central bank independence, the degree of support in this panel data analysis was weaker.[12]

Next, the results on economic growth are shown in Table 11. In all the sample periods, both the ratio of investment to GDP and population growth have statistically significant effects, the signs of which are in line with the theory. But in the second step of the analysis, the coefficients on the country dummies and central bank independence have no significant correlations. This is consistent with the findings of Alesina and Summers (1993).

The results of tables 10 and 11 are only preliminary, but nonetheless suggest that the arguments of Alesina and Summers (1993) and others do not stand up to changes in samples and in statistical methods.

11. See Eijffinger, Van Rooij, and Schaling (1996) for the application of the panel data approach to identify the degree of central bank independence by means of a fixed-effect model.
12. I also did the same analysis with the starting values of openness, the ratio of investment to GDP, and population growth in the sample, but the results were the same as in tables 10 and 11, except that the negative correlation between central bank independence and inflation was significant in the 1975–90 subsample.

Table 10 Panel Data Analysis

First step Dependent variable: rate of change in CPI

	Period: 1960–89				Period: 1975–89				Period: 1980–89			
Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Canada	3.533	2.919	–0.676	–0.650	1.875	1.123	9.189	4.391	–0.527	–0.208	–2.612	–0.777
United States	3.181	3.831	2.924	4.199	2.392	2.529	6.935	6.165	1.663	1.446	2.070	1.329
Japan	3.747	4.157	2.570	3.407	0.061	0.058	5.052	4.028	–1.633	–1.238	–1.571	–0.883
Belgium	2.789	1.223	–9.748	–4.668	–3.001	–0.777	11.247	2.256	–10.604	–1.590	–19.533	–2.213
Denmark	5.100	3.498	–1.175	–0.918	1.827	0.895	10.367	4.010	–1.653	–0.512	–4.923	–1.147
France	4.728	4.421	1.797	1.982	3.089	2.105	9.706	5.324	0.928	0.424	–0.578	–0.198
Germany	1.583	1.315	–2.568	–2.483	–1.977	–1.143	5.538	2.550	–4.330	–1.602	–6.713	–1.867
Italy	6.797	6.261	3.712	4.027	7.151	4.810	13.837	7.482	4.685	2.197	3.274	1.151
Netherlands	2.645	1.350	–7.502	–4.233	–3.196	–1.070	8.348	2.176	–9.033	–1.826	–15.137	–2.310
Norway	4.598	2.537	–4.444	–2.729	1.514	0.597	11.645	3.591	–1.644	–0.424	–5.990	–1.164
Spain	7.816	7.810	5.558	6.595	7.756	5.913	13.815	8.551	4.122	2.101	3.008	1.148
Switzerland	4.723	3.563	–0.470	–0.408	2.578	1.326	10.805	4.397	–0.341	–0.111	–3.344	–0.820
Sweden	1.887	1.243	–4.874	–3.636	–2.913	–1.327	6.128	2.196	–5.629	–1.611	–9.339	–2.013
United Kingdom	5.685	4.552	1.142	1.059	4.308	2.482	11.845	5.431	0.282	0.111	–1.815	–0.538
Australia	4.892	4.834	2.520	2.954	4.663	3.782	10.426	6.905	3.020	1.756	2.337	1.015
New Zealand	6.583	5.018	1.505	1.321	6.411	3.436	14.381	6.109	3.627	1.270	0.984	0.259
T60	–2.823	–3.203										
T61	–2.177	–2.458										
T62	–0.883	–0.992										
T63	–0.981	–1.107										
T64	–0.886	–1.002										
T65	–0.088	–0.099										
T66	–0.226	–0.255										
T67	–0.859	–0.966										
T68	–0.895	–1.016										
T69	–0.616	–0.707										
T70	0.863	0.998										
T71	1.656	1.906										
T72	1.310	1.504										
T73	3.591	4.190										
T74	7.684	9.139										
T75	7.023	8.271			7.293	9.373						
T76	5.245	6.212			5.429	7.096						
T77	5.277	6.249			5.466	7.138						
T78	3.147	3.707			3.416	4.391						
T79	3.737	4.439			3.852	5.081						
T80	6.359	7.569			6.372	8.454			6.389	9.685		
T81	5.835	6.943			5.783	7.663			5.714	8.625		
T82	4.534	5.397			4.499	5.967			4.453	6.738		
T83	2.043	2.431			2.011	2.668			1.970	2.983		
T84	0.894	1.059			0.716	0.936			0.481	0.695		
T85	0.960	1.138			0.784	1.026			0.552	0.799		
T86	–0.572	–0.680			–0.477	–0.630			–0.352	–0.526		
T87	–0.393	–0.466			–0.249	–0.328			–0.061	–0.090		
T88	–0.779	–0.925			–0.669	–0.884			–0.526	–0.783		
OPEN	0.003	0.176	0.129	7.296	0.043	1.508	–0.043	–1.153	0.094	2.032	0.170	2.770
Adjusted R-squared	0.655		0.236		0.768		0.399		0.794		0.393	
Standard error	2.376		3.536		2.132		3.433		1.865		3.202	

Second step Dependent variable: estimated coefficients of country dummies

	Period: 1960–89				Period: 1975–89				Period: 1980–89			
Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	7.296	0.577	26.178	0.728	22.034	0.379	21.921	0.512	36.890	0.491	43.871	0.392
CBI	–6.103	–1.951	0.149	0.017	–8.924	–1.335	–10.483	–2.130	–4.705	–0.550	–3.013	–0.236
YINI	–0.089	–0.059	–3.076	–0.710	–1.844	–0.286	–0.918	–0.194	–3.884	–0.474	–4.980	–0.408
Adjusted R-squared	0.230		–0.086		0.110		0.280		–0.061		–0.115	
Standard error	1.550		4.426		3.360		2.470		4.605		6.861	

Note: Country names: country dummies
T60–88: *time dummies*
OPEN: openness

Table 11 Panel Data Analysis

First Step Dependent variable: real GDP growth

	Period: 1960–89				Period: 1975–89				Period: 1980–89			
Explanatory variable.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Canada	–2.080	–1.750	–4.089	–3.944	–6.861	–4.213	–5.893	–3.663	–10.817	–4.223	–9.620	–4.382
United States	–2.633	–2.384	–4.254	–4.436	–6.129	–4.250	–5.230	–3.716	–9.142	–4.129	–7.949	–4.239
Japan	–2.307	–1.472	–4.100	–2.808	–10.302	–4.778	–9.606	–4.410	–14.959	–4.610	–14.086	–4.948
Belgium	–2.931	–2.447	–3.558	–3.238	–7.375	–4.869	–7.286	–4.877	–9.982	–4.724	–9.517	–5.243
Denmark	–3.793	–2.978	–4.629	–3.938	–7.933	–4.972	–7.840	–4.956	–10.919	–4.905	–10.514	–5.456
France	–3.331	–2.542	–4.651	–3.879	–8.708	–5.086	–8.266	–4.860	–12.190	–4.840	–11.387	–5.249
Germany	–4.114	–3.045	–5.031	–3.999	–8.716	–5.060	–8.732	–5.067	–12.671	–5.120	–12.210	–5.666
Italy	–3.227	–2.388	–4.240	–3.378	–7.916	–4.746	–7.660	–4.625	–11.718	–4.763	–11.163	–5.234
Netherlands	–2.913	–2.396	–4.363	–4.003	–7.256	–4.896	–6.708	–4.628	–10.204	–4.709	–9.359	–5.091
Norway	–4.182	–2.839	–5.436	–3.941	–9.533	–4.846	–9.167	–4.633	–13.615	–4.874	–12.933	–5.311
Spain	–1.880	–1.525	–3.291	–2.965	–7.976	–4.937	–7.365	–4.621	–10.643	–4.470	–9.877	–4.835
Switzerland	–3.429	–2.902	–4.242	–3.948	–7.348	–4.925	–7.116	–4.857	–10.058	–4.662	–9.477	–5.132
Sweden	–4.745	–3.430	–6.164	–4.834	–10.875	–5.792	–10.685	–5.667	–14.971	–5.043	–14.220	–5.480
United Kingdom	–2.245	–2.247	–2.693	–3.058	–4.979	–3.886	–4.897	–3.952	–7.426	–4.047	–6.899	–4.451
Australia	–3.688	–2.682	–6.313	–5.196	–8.289	–4.677	–7.047	–3.987	–11.294	–4.056	–9.704	–4.037
New Zealand	–3.620	–2.988	–5.440	–5.082	–8.829	–5.623	–8.249	–5.340	–11.495	–4.737	–10.548	–5.080
T60	3.732	5.016										
T61	2.282	3.077										
T62	2.214	2.924										
T63	1.818	2.434										
T64	3.164	4.255										
T65	0.919	1.242										
T66	0.840	1.137										
T67	0.248	0.339										
T68	1.528	2.101										
T69	2.484	3.374										
T70	0.899	1.220										
T71	–0.161	–0.218										
T72	1.178	1.618										
T73	1.885	2.576										
T74	–1.424	–1.943										
T75	–3.749	–5.177			–3.617	–5.831						
T76	0.977	1.347			0.879	1.409						
T77	–1.178	–1.624			–1.089	–1.751						
T78	0.117	0.161			0.386	0.616						
T79	0.431	0.593			0.575	0.920						
T80	–1.003	–1.381			–0.796	–1.275			–0.714	–1.186		
T81	–1.756	–2.398			–1.257	–1.970			–0.917	–1.449		
T82	–2.167	–2.940			–1.553	–2.396			–1.156	–1.752		
T83	0.129	0.175			0.766	1.175			1.156	1.724		
T84	1.231	1.679			1.659	2.597			1.866	2.910		
T85	0.550	0.750			1.018	1.593			1.276	1.994		
T86	0.359	0.491			0.702	1.112			0.867	1.394		
T87	0.162	0.223			0.470	0.749			0.646	1.063		
T88	0.690	0.952			0.849	1.366			0.923	1.556		
INV	0.237	5.502	0.270	6.192	0.430	7.086	0.428	6.593	0.572	6.320	0.573	6.719
GRPOP	–0.880	–2.783	0.427	1.447	–1.188	–2.640	–2.110	–3.945	–1.869	–2.887	–2.699	–3.772
Adjusted R-squared	0.438		0.180		0.460		0.180		0.412		0.224	
Standard error	2.046		2.472		1.740		2.150		1.653		1.899	

Second step Dependent variable: estimated coefficients of country dummies

	Period: 1960–89				Period: 1975–89				Period: 1980–89			
Explanatory variable	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.	Coeff.	T-stat.
Constant	11.389	1.391	6.941	0.674	13.731	0.332	13.878	0.335	0.424	0.008	1.874	0.034
CBI	0.464	0.266	0.220	0.100	2.316	0.548	2.257	0.534	–0.542	–0.100	–0.228	–0.042
INIEDU	0.388	1.060	–0.010	–0.022	1.160	0.979	1.507	1.269	0.313	0.170	0.689	0.370
YINI	–1.695	–1.712	–1.323	–1.063	–2.527	–0.541	–2.516	–0.538	–1.272	–0.207	–1.391	–0.224
Adjusted R-squared	0.110		0.196		–0.149		–0.069		–0.229		–0.220	
Standard error	0.778		0.978		1.588		1.591		2.216		2.232	

Note: Country names: country dummies
T60–88: time dummies
INV: ratio of investment to GDP
GRPOP: population growth

4. The use of central bank independence indexes

Thus far, the findings of this study suggest that it is too early to arrive at clear conclusions on the relationship between central bank independence and inflation/growth by relying solely on a simple correlation between average values of these variables.

Still, the findings of Alesina and Summers (1993) are useful in and of themselves and could be exploited in other ways. Take, for instance, a case of comparing growth rates cross-nationally to quantify the effects of inflation on growth by including inflation as one of the explanatory variables in equation (4), as Barro (1995) did. Inflation and growth, however, are simultaneously determined, and therefore, the OLS coefficient estimates may be biased if inflation is directly included in equation (4). In such an analysis, a variable that is correlated with inflation but not with the error term in equation (4) could be used as an instrumental variable to obtain an unbiased estimate of the effects of inflation on growth. This kind of approach can also be found in Fischer (1993) and others. Thus, the central bank independence indexes of the type in current use seem to enjoy a role as instrumental variables for inflation in the academic literature.

IV. Conclusion

This paper has, by means of a panel data analysis, reexamined the empirical regularities, strongly advocated by Alesina and Summers (1993), i.e., that (1) central bank independence and inflation are negatively correlated in industrialized countries, and that (2) central bank independence and real growth are not correlated in industrialized countries. The analysis here shows that both regularities become unstable when stricter conditions are imposed, and have not proved to be robust. Therefore, one may conclude that Alesina and Summers' results have not yet provided a reliable basis for policy recommendations.

Refinement of the analysis, as well as improvement of central bank independence indexes suitable for various analytical purposes, will be needed in the future. Also, as seen in Barro (1995) and Fischer (1993), central bank independence indexes seem to enjoy some academic support as instrumental variables determining inflation. In these respects, it would be desirable to construct various types of central bank independence indexes as tools in economic analysis.

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