Central Bank Laws and Monetary Policy Outcomes: A Three Decade Perspective

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The search for a relationship between central bank laws and monetary policy outcomes, which began three decades ago, is part of a larger enterprise to discover the monetary policy framework that delivers the best macroeconomic performance.

A *monetary policy framework* is a set of institutional arrangements under which monetary policy decisions are made and executed.[1] It includes central bank law and the degree of independence it gives the central bank. It also includes other formal and informal arrangements between the central bank, government, and other institutions. And it includes the custom and practice of the economists and decision-makers in the central bank and government.

The *best macroeconomic performance* that monetary policy can deliver remains controversial but a dispassionate and research-supported view is that it cannot influence the average level of output or unemployment and the best contribution it can make is to deliver low inflation at a point on the Taylor curve—the efficiency frontier between the variability of inflation and the output gap[2]—consistent with the preferences expressed through the political process. Points above the Taylor curve are inefficient and points below it are unattainable.

Within this broad research agenda, what has been discovered about the effects of central bank laws on monetary policy outcomes? Do central bank laws influence monetary policy and the inflation rate? Do independent central banks do the best job? What other features of the monetary policy framework matter for achieving low inflation and low variability? Does inflation targeting beat central bank independence as a source of good macroeconomic performance?

What follows is an attempt to answer these questions. Part I provides an overview of work that has measured central bank independence and looked for a (negative) relationship between independence and inflation or independence and other variables. Part II examines the main criticisms of this work and provides a new and expanded evaluation. Part III presents two natural experiments made possible by events over that past three decades that shed new light on the questions posed above. And Part IV offers some speculative thoughts about changing constraints on central banks that might challenge their independence and influence.

By way of brief preview, I will argue that most of the search for a relationship between central bank independence and inflation has found only modest additions to what we knew thirty years ago. But two natural experiments suggest that more independent central banks lower the variability of inflation and might lower average inflation, with no change in the variability of output; and inflation-targeting central banks lower inflation and might lower the variability of both inflation and real GDP growth regardless of the independence of the central bank.

[1] Fry *et al* (2000, p. 3).
[2] Taylor (1979, p. 1281) graphs the Taylor curve. The standard deviations of the inflation rate and the output gap measure variability.

I THE SEARCH FOR THE EFFECTS OF CENTRAL BANK INDEPENDENCE

The search for the effects of central bank independence (CBI) on inflation and other features of macroeconomic performance has employed five alternative CBI measures, one a classification and the others indexes. **Table 1** summarizes them in order of increasing complexity.[3] To set the scene for a critical appraisal and three decade perspective, it is necessary to summarize the alternative measures, the test performed using them, and the conclusions reached.

Table 1 Alternative Measurements of Central Bank Independence

Study	Inputs	Variables	Countries
Bade-Parkin 1978, 1982, 1988 (BP)	Central bank statutes	3	12
Grilli-Masciandaro-Tabellini 1991 (GMT)	Central bank statutes	16	18
Alesina 1988 and Alesina-Summers 1993 (AS)	Average of BP and GMT		16
Cukierman 1992	Central bank statutes and survey	26	68
Fry-Julius-Mahadeva-Roger-Sterne 2000 (FJMRS)	Bank of England survey of central banks	54	93

Bade-Parkin

The CBI measurement proposed by Bade-Parkin (1978, 1982, 1988) was guided by the positive theory of monetary policy,[4] which suggests that policies depend on whether the decision-maker is a discretionary, democratically-elected, and relatively short-lived government or a rule-governed, autonomous, and relatively long-lived central bank for which reputation is an important consideration. For twelve advanced economies[5], the laws that establish and govern the central bank were examined to determine whether:

1. The government or the central bank is the final monetary policy authority
2. Any government officials are members of the central bank board
3. The government appointed all or only some of the board members

[3] Arnone, Laurens, and Segalotto (2006) provide a useful summary of the literature reviewed here.
[4] Gordon (1975), Kydland and Prescott (1977), Barro (1983), Barro and Gordon (1983a, 1983b), Backus and Driffill (1985), and Meltzer and Cukierman (1986))
[5] Australia, Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, United States.

Of the eight possible central bank types resulting from combinations of 'yes-no' answers to these questions, only four were present in the central banks studied, so they were classified as being one of four types:

1. Least independent: Government is the final monetary policy authority, has an official on bank board, and appoints all board members.
2. Second least independent: Government is the final monetary policy authority, no government official on the bank board, but all board appointments made by government.
3. Second most independent: The central bank is the final monetary policy authority and all board appointments made by government.
4. Most independent: The central bank is the final monetary policy authority and some board appointments are made independently of government.

BP looked for the effects of independence by using dummy variables for each central bank type in regressions explaining cross-country inflation variability. They found that only type 4 central banks deliver significantly[6] lower inflation. It was not possible to separate types 1, 2, and 3. So in the 1978 paper they concluded that "there is strong evidence that central banks which are independent of central governments both in policy making and in the appointment of directors deliver a low rate of inflation but not necessarily low variability of monetary policy. … [and] … monetary policies do not appear to differ significantly as between 'independent' central banks and government-dominated central banks where the 'independent' central bank has a directorate entirely appointed by government."

Two later papers[7] confirmed these conclusions and additionally examined effects of CBI on policy reaction functions. The conclusion of this exercise was that "there do not appear to be any systematic differences in the macroeconomic variables that trigger policy reactions across different central bank types."

Parkin (1987) investigated the relationship between CBI and the government budget deficit process and found a further interesting CBI effect. For most of the countries investigated those with independent central banks had a smaller mean government budget deficit.[8]

All the subsequent work departed from the BP approach of classifying and ranking central banks and constructed a CBI Index with cardinal properties. The first of these was GMT.

[6] Unless otherwise noted, any statement about significance will mean at the 5 percent level.
[7] Bade and Parkin 1982 and 1988.
[8] France and the United States were exceptions and didn't fit the pattern of other countries.

Grilli-Masciandaro-Tabellini

Grilli, Masciandaro and Tabellini (1991) is a broad and comprehensive study of the relationship between politics and economic policy making and central bank independence is only a part of this broader study. Nonetheless, these authors provided the first comprehensive coding of central bank laws for a group of eighteen advanced economies and constructed the first CBI Index. Their index, which ranges from zero (least independent) to 16 (most independent), is the sum of the 'yes' answers to questions about appointments, policy formulation, statutory policy goals, and central bank financing of government[9]. GMT call the sum of the first 8 "yes" answers an index of political independence and the sum of the second 8 an economic independence index.

In cross-country regressions with the inflation rate as the dependent variable, both political and economic independence are significant (and of expected sign) during the 1970s and economic independence alone is significant during the 1980s. The estimates imply that a unit increase in the economic index lowers the inflation rate by 1.2 percentage points during the 1970s and by 1.9 during the 1980s; and a unit increase in the political independence index lowers inflation by 0.6 percentage points during the 1970s.

In the GMT political independence index, some variables are similar to those used in the BP classification, so these results agree with and reinforce the BP finding for the 1970s but not for the 1980s. BP did not examine the variables that feature in the GMT economic independence index, so finding a significant effect for this range of variables is new and suggests an important omission from BP.

Alesina-Summers

Alesina (1988) used the BP classification but as a cardinal index by assigning a value to each type: 1 for the least independent to 4 for the most independent. Alesina also extended the sample[10] and used other information to give Italy a score of 0.5 (the least independent). This paper was the first to convert the BP ordinal types to an index with cardinal properties.

Alesina and Summers (1993) combined Alesina's BP index with the GMT political independence index to create their own CBI index, which they used in informal scatter diagrams to inspect the relationship between CBI and both the mean and variance of inflation, real GNP growth, per capita real GNP growth, unemployment, and the real interest rate.

[9] The sixteen questions are: (1) Is the governor not appointed by government? (2) Is the governor appointed for more than 5 years? (3) Are some of the board not appointed by government? (4) Is the board appointed for more than 5 years? (5) Is there no mandatory participation of government representative in the board? (6) Is no government approval of monetary policy formulation required? (7) Is there a statutory requirement that the central bank pursues monetary stability amongst its goals? (8) Is there a legal provision that strengthens the central bank's position in conflicts with the government? Are government direct credit facilities with the central bank (9) not automatic, (10) at a market interest rate, (11), temporary, and (12) of a limited amount? (13) Does the central bank not participate in primary market for public debt? (14) Does the central bank set the discount rate? (15) Is banking supervision not entrusted to the central bank alone, or (16) at all?

[10] Alesina added Denmark, New Zealand, Norway, and Spain to the BP twelve countries.

This informal analysis suggested that independent central banks deliver lower inflation but not deliver lower variability of either inflation or the real variables examined.

Cukierman

The scope of the studies reviewed above was restricted to sixteen advanced industrial economies. In contrast, the next wave of work started by Cukierman (1992) was broadly defined, detailed, and complex. The range of countries studied expanded to 68, so included a large number of developing and emerging economies.

Cukierman's CBI measurement used a set of sixteen variables[11] similar in scope to those of GMT but more finely graduated to take on a total of 69 different values. He set *a priori* reasonable but essentially arbitrary weights for each of his variables to combine them in a single CBI "legal variables index," (LVA) that ranges from zero (not independent) to one (maximal independent). His data lie in a range from 0.10 (Poland) to 0.68 (Switzerland).

Cukierman also distinguishes between *legal* independence and what he calls "actual independence" and measures the latter in two ways. For 24 countries, he conducted a survey of "qualified individuals in various central banks" seeking information on nine variables similar in scope to those for legal independence. The responses were used to construct a CBI "questionnaire variables index" (QVA) again that ranges from zero to one. For this index, the data lie in a range 0.12 (Ethiopia) to 1.00 (Germany). For the full sample of 68 countries, Cukierman measures actual independence as the turnover rate of central bank governors (TOR). This variable ranges between 0.03 or 33 years (Iceland) and 0.93 or 13 months (Argentina).

Treating his indexes and the sub-indexes from which they are constructed as cardinal measures of CBI, Cukierman undertakes an extensive statistical investigation. In a cross-country regression of all countries with the rate of depreciation of the real value of money[12] as the dependent variable and nine sub-indexes[13] of CBI, he finds that only the turnover rate of governors is significant. Nothing else remotely shows any significance and the overall explanatory power of the equation is weak with $R^2 = 0.28$.

Using the same variables but for only the sixteen countries of GMT and AS, a variable based on who decides loans to the government and TOR show significance. Again, the estimated coefficients are small but now R^2 gets to around 0.5.

[11] The variables are (1) term of office of CEO, (2) who appoints the CEO, (3) how the CEO may be dismissed, (4) whether the CEO may hold other office, (5) who makes monetary policy, (6) who may issue directives and resolve conflict, (7) the central bank's influence on the government budget, (8) the central bank's objectives, (9) limitations on advances, (10) limitations on securitized lending, (11) who decides lending terms, (12) who may borrow from the central bank, (13) limitations on loans, (14) restrictions on the maturity of loans, (15) restrictions on interest rates, and (16) restrictions on lending in the primary market

[12] The rate of depreciation of the real value of money equals $\pi/(1 + \pi)$, where π is the inflation rate.

[13] The nine sub-indexes measure objectives, properties of the governor, policy formulation, limitations on lending (five variables), and the governor turnover rate, TOR.

Cukierman suspects that multicollinearity is the source of insignificant parameter estimates and does a further set of regressions using LVA—his legal independence index—along with TOR, and a new variable, COMP constructed as the ratio of the governor's actual term to the legal term. In an all-countries regression, LVA is totally insignificant but COMP is significant (*t*-statistic = 2.7). In a developed-countries regression, LVA is on the edge of significant (*t*-statistic = 2.0). In a less-developed countries equation, nothing is significant.

Using the data from his questionnaire in a regression with seven sub-indexes[14], Cukierman finds a variable based on financial independence to be significant but of the wrong sign and quite large (+ 0.3). None of the other sub-indexes is significant. Using only the QVA index, that variable gets a large significant negative coefficient. But in the same regression, TOR has an even larger and wrong sign significant coefficient.

Cukierman completes his analysis with a Granger causality test that shows two-way causality between inflation and TOR.

The overall conclusion that emerges from Cukierman's work is that the evidence for a negative relationship between CBI and inflation is weak and that whatever TOR is truly measuring influences and is influenced by the inflation rate.

Fry-Julius-Mahadeva-Roger-Sterne

A monumental study by economists working at the Bank of England Centre for Central Bank Research built on but took much further the ideas of GMT and Cukierman. FJMRS "define an overall measure of independence over a range of characteristics covering legal objectives, goals, instruments, finance of the government deficit, and term of office of the Governor."[15] They also construct a number of other indexes designed to get at transparency and commitment to an inflation target.

The data that generates the FJMRS indexes come from a survey conducted in 1998 by the Bank of England Centre for Banking Studies and responded to by 93 central banks.[16] The survey and the resulting descriptive indexes map what these authors call "the monetary policy framework." Their measurement identifies the focus of a central bank's policy (the exchange rate, the quantity and growth rate of money, or the inflation rate), and constructs an "Independence score" as a weighted average of five sub-scores: Whether the bank (1) has a statutory or legal objective of price stability, (2) has target independence, (3) is instrument independent, (4) finances the government deficit, and (5) has a long term of office for its

[14] The seven sub-indexes measure tenure of governor, lending limitations, conflict resolution, financial independence, intermediate targets, the priority given to price stability, and subsidized credits.
[15] Fry *et al* (2000), Chapter 4, p. 68.
[16] A potential weakness of this approach is that central banks might report what they would like others to believe about them, rather than what an objective observer would see.

governor. Separately from their independence score, they code variables designed to capture transparency and the place of financial stability in setting monetary policy instruments.

These authors use their independence score and other sub-indexes to conduct a thoughtful qualitative investigation of the relationships among features of the monetary policy framework and its possible effects on macroeconomic performance. They refrain from running regressions and they offer no simple conclusion. They title their chapter on measurement "The devil in the detail of monetary policy frameworks" and the devil doesn't allow them to stray far from detail. There is a lot of detail to devour and digest.

Although FJMRS don't run regressions using their indexes, Carlstrom and Fuerst (2009) do, and they obtain an amazing result. Using the AS-CBI index rescaled[17] for the period 1955 – 1988, and the FJMRS index for the period 1988 – 2000, they estimate *the same effect of* CBI *on inflation for both periods*. For each 10 percent points increase in the CBI index, the inflation rate falls by 0.65 percentage points. A CBI index value of zero delivers inflation of 9.5 percent per year and an index value of 100 (most independent) delivers 3 percent per year. The truly remarkable fact is that the two CBI index numbers are constructed on a different basis and are arbitrary and different in the weights attached to their underlying components.[18]

Carlstrom and Fuerst (CF) suggest that the 1990s had lower inflation than earlier decades because central banks became more independent and attribute nearly two-thirds of the fall in inflation to this cause. I return to CF below.

Meta Regression Analysis

The CBI indexes constructed by GMT, AS, and Cukierman were used in 59 empirical regression studies during the 1990s and 2000s all of which were revisited in a meta regression analysis conducted by Klomp and de Haan (2010),[19] who concluded that the particular measure of central bank independence used has little effect on its estimated effect and there does exist a significant negative relationship between CBI and inflation. Independent central banks do deliver lower inflation.

The work that I have described is large in volume, meticulous, somewhat rigorous, and apparently clear about its conclusion: Independent central banks deliver lower inflation rates. How credible and strong is this conclusion?

[17] The rescaling is multiplying by 25 to put it on a 0 to 100 range equivalent to the FJMRS index.
[18] I return to this finding and its interpretation below.
[19] Klomp and de Haan provide the details of the 59 studies.

II EVALUATING THE FINDINGS: WHAT DO WE KNOW?

Thomas Cargill and others have suggested that despite the work and claims that I have summarized, we don't know much about the relationship between CBI and inflation. They have questioned the robustness of the statistical findings, noted the difficulty of measuring independence, suggested that the CBI indexes are more appropriately regarded as ordinal rankings than cardinal measures suitable for econometric analysis, and emphasized non-legislated features of independence (contrasting *de facto* independence[20] with *de jure* independence) that better explain a central bank's monetary policy choices and inflation outcomes.

Before elaborating on these criticisms, it is helpful to think about the constraints on the search for the effects of CBI. We have data on *n* central banks whose independence is described by *k* differences that might be relevant for predicting the effects of CBI on inflation and macroeconomic performance generally. We can code each of these *k* characteristics 'yes' a central bank has it, or 'no' it doesn't. With this binary coding of *k* characteristics, there are 2^k possible central bank independence types. If *k* is small enough, we can *classify* central banks by independence type, rank the types, and look at mean inflation rates and other macro performance variables by central bank type. For this approach to work, we must have fewer independence types than central banks, so 2^k must be smaller than *n*. For the 12 central banks of BP, *k* can't exceed 3, and for the 93 central banks of FJMRS, *k* can't exceed 6.

To study the effects of independence with descriptions that exceed these small numbers of characteristics, it is necessary to construct a CBI index that combines the characteristics. Such an index cannot enjoy the rigorous properties of a price or quantity index and must of necessity be arbitrary. Nor can it enjoy unique mapping from characteristics to index and back to characteristics. Many different configurations of characteristics map to a single index number.

With these general considerations firmly in mind, I now examining Cargill's doubts and then offer some further reasons why caution is needed in interpreting the statistical findings.

Cargill Critical Assessment

Cargill (2013) presents a well-argued critical assessment focusing on the astonishing CF finding. He contrasts two statistical models of the effects of CBI on inflation:

$$(1) \quad \text{Inflation} = \beta_0 + \beta_1 \text{CBI} + \varepsilon$$

and

$$(2) \quad \text{Inflation} = \beta_0 + \beta_1 d_1 + \varepsilon$$

[20] Cukierman's "actual independence".

where CBI is the FJMRS index[21] and d_1 is a dummy variable = 1 for CBI > 90 and zero otherwise. Equation (1) is CF's and equation (2) is Cargill's alternative, which bifurcates central banks into groups of more independent and less independent. In the sample period 1988 – 2000, the second equation outperforms the first in explanatory power (R^2 = 0.19 for 1 and 0.31 for 2 and *t*-statistic on β_1 = 2.65 for 1 and 3.47 for 2).

Cargill also estimates a series of equations in which he successively drops the most independent, the next most independent, and so on until the ninth most independent central bank is dropped. As successive central banks are dropped, the estimated CBI index coefficient falls and its significance weakens, becoming insignificant after the three most independent central banks are dropped.

Cargill concludes from these exercises that the relationship between CBI and inflation is driven by the most independent central banks, a conclusion that is identical to that of BP at the start of this research program, and that "The dummy variable results reaffirm the standard result; however they also suggest that information content of the specific measure of independence is not great and can be approximated by a dummy variable."

Cargill's interpretation of his finding can be improved upon. It isn't that the dummy variable "approximates" a "specific measure". It measures something else. To see clearly what is going on, I am going to return to the simpler framework of the BP classification and its conversion to an index by Alesina. I will then return to CF and the FJMRS index.

Two Models of the Effects of CBI

The BP model of CBI is simple but powerful. Central banks are *classified*, not *measured*. And the classification comes from the answers to three questions with two possible answers about features of the relationship between central bank and government that are *a priori* relevant: final policy authority, whether government on bank board, and whether government alone appoints the board. All other matters, such as the length of term of board membership, term of the governor, policy objective, are assumed to be either irrelevant or subsumed in the combination of features determined by the three relevant questions.

BP then asks the question: Is the average inflation rate the same for all central bank types?

This question can be answered in two equivalent ways. It can be answered directly by computing means and *t*-statistics or it can be answered by a regression of inflation on three dummy variables for types 2, 3, and 4. BP took the second approach, which is the equivalent of Cargill's equation (1) above.

[21] Cargill also uses the AS index in regressions for 1955 – 1988 and in pooled regressions for 1955 – 2000, but the years 1955 – 1971 were dominated by the Bretton Woods fixed exchange rate system so these results have no useful meaning. Bretton Woods trumps central bank laws in determining inflation and departures of national inflation rates from the world average rate are properly interpreted as changes in relative prices.

When AS translated BP's classification into an index with cardinal properties, and when such an index is used in a regression like Cargill's equation (2) above, the question changes. The coefficient β_1 in equation (2) estimates the *change* in the inflation rate as we move from 1 to 2, 2 to 3, and 3 to 4. So the question posed by this approach becomes: Are the *differences* in inflation across the central bank types constant as we move between adjacent types?

Running a regression of inflation on a CBI estimates a coefficient that equals the least-squares estimator of the mean change in inflation as we move between adjacent types. This coefficient might be poorly determined and miss significant unequal differences across types. And it might be well-determined for either of two reasons: (1) the differences *are* constant and have small variance; or (2) at least one difference is significant and at least one other difference has large variance.

Inspection of the BP data reveals that reason (2) is correct. The variance of inflation in type 2 central banks is so large that it is not possible to say with any confidence what the change is from 1 to 2 or from 2 to 3. The variance of inflation in types 3 and 4 is very small and type 4 has a smaller mean than type 3, so the least-squares estimate of the change in inflation is dominated by the two most independent banks. But degrees of freedom are scarce. Only two central banks are type 3 and two are type 4. It is these facts that are the source of the appearance that the change in inflation across types is constant.

Inspection of the CF inflation data and FJMRS index reveals a similar pattern to that in the BP data. The variance of inflation at index values of 50 and 60 (about neutral independence) is large while the variance at 90 and 100 (most independent) is small and the inflation rate at 100 is smaller than at 90. But as in the BP data, only two central banks have in index of 100 and only one is at 90. So the appearance of significance is being driven by high variance and zero information at average and low values of the CBI index and low variance (and small sample) at high CBI index values.

Although there are parallels in the source of misinformation in estimated inflation-CBI index equations using the BP classes and the FJMRS index, there are crucial differences between them. The contrast in the GMT and BP approaches highlights the key difference.

Too Much Information to Classify: Construct an Index

As noted above, GMT construct two CBI indexes by counting the number of 'yes' answers to 16 questions. Four of those questions map to BP's three questions.[22] But that is the only similarity in the two approaches. Importantly, BP *classify* while GMT *measure*. And the measure

[22] Question (6) 'Is no government approval of monetary policy formulation required?' and question (8) 'Is there a legal provision that strengthens the central bank's position in conflicts with the government?' are similar to BP's 'final authority' and questions (3) 'Are some of the board not appointed by government?' and (5) 'Is there no mandatory participation of government representative in the board?' are also BP questions.

has the property that one more 'yes' raises the index by one unit regardless of what the question is. GMT can only measure. If they classified, all their central bank types would be different.[23]

Given the GMT indexes of CBI, what do we learn from an inflation regression that uses them? The answer noted earlier is that we learn that the variables ignored by BP in the GMT economic index seem to be important. But we don't learn *which* variables are doing the work. It is tempting, but unconvincing, to say they all work equally well, though that is the implication of the way the index is constructed. A more thorough scrutiny of the correlations among the components of the index and some aggregation to generate a manageable set of types might be possible and a source of greater insight.

The more detailed indexes of Cukierman and FJMRS have all the problems of the GMT index with the additional problem that the 'yes' answers are weighted so that arbitrary degrees of importance of various characteristics are imposed *a priori*.

Is the arbitrariness of the CBI indexes a problem? While Cargill says it is, the Klomp-deHaan finding provides support for the indexes. Recall that they conclude that the particular CBI measure has little effect on its estimated effect on inflation. Further, the astonishing finding of CF about the apparent robustness of the relationship between two entirely different CBI indexes across two time periods (not included in Klomp-deHaan) seems to deny that the indexes are a problem. How are these findings to be interpreted?

The meta-regression analysis merely reports that the significant negative relationship between CBI and inflation is robust across studies and is not influenced by the measure of CBI used. It doesn't control for the amount of data mining undertaken. Nor does the conclusion sit well with the details of the 59 studies included in the analysis. In Table A1[24] they summarize the 384 regression included in the studies and the percentage that find a significant negative relationship. There are 202 with a significant negative relationship and 182 with either no relationship or, as noted above, significant but of wrong sign.

The CF finding requires closer examination.

Carlstrom-Fuerst Evaluated

I have described Cargill's probing of the robustness of the CF results and his alternative model. I now describe some further probing of my own.

First, I replicated the CF result and checked that the relationship is robust with respect to time periods covered. **Table 2** shows the estimated coefficient on CBI, its *t*-statistic, and R^2 for a

[23] With 16 variables each with two possible values, GMT have potentially 2^{16} types. In the data, no two central banks share the same configuration of 'yes' answers although on economic independence, Portugal and Greece are the same and on political independence, Portugal and the United Kingdom are the same.
[24] Klomp and deHaan (1990, pp. 618 – 621)

regression like CF's with just a constant and the FJMRS CBI index. Using the World Economic Outlook[25] data base for October 2012, I was able to replicate the CF finding to a reasonable approximation for several sub-periods though for some, the CBI coefficient is not significant.

Table 2 CF for Different Time Periods

Period	Data	Coefficient	*t* - statistic	R^2
1988 - 2000	CF	-6.61	-2.66	0.23
1988 - 2000	WEO	-5.81	-1.48	0.08
1988 - 2011	WEO	-5.44	-2.08	0.15
2000 - 2011	WEO	-4.83	-2.54	0.21
2000 - 2001	WEO	-3.87	-1.23	0.06

Next, I explored the sub-indexes from which the FJMRS index is constructed and checked that the relationship between inflation and the sub-indexes is consistent with the relationship between inflation and the overall index. The FJMRS index is a weighted average of five sub-indexes. **Table 3** shows the coverage of these sub-indexes along with their weights. Given the construction of the CBI index, the regression of inflation on CBI can be regarded as a restricted version of a regression of inflation on *PS*, *TI*, *II*, *FG*, and *TG*. That is, in the more general regression, the coefficients on the sub-indexes should be their weights multiplied by the coefficient on CBI in the restricted regression.

Table 3 FJMRS Independence Index Components

Variable	Abbreviation	Weight[26]
1. Statutory/legal objectives focus on price stability?	*PS*	0.154
2. Target independence	*TI*	0.154
3. Instrument independence	*II*	0.308
4. Central bank financing of government deficit	*FG*	0.308
5. Term of office of governor	*TG*	0.077

To check whether this implication of the model is true, I calculated the more general regression using the CF inflation data for 1988 – 2000, the period used by CF. **Table 4** shows the result. The first column of estimates repeats the CF equation. The numbers in square brackets are *t*-statistics. The second column shows the coefficients in an unrestricted regression of inflation on the five sub-indexes. The final column shows what those coefficients would be if the CBI index were a true weighted aggregate of the sub-indexes.

[25] The World Economic Outlook (WEO) data are slightly different from the data used by Carlstrom and Fuerst (CF) for a few countries.
[26] FJMRS express the weights as values that sum to 6.5. I have converted them to weights that sum to one.

Table 4 Inflation and the FJMRS Sub-Indexes

	Estimated restricted	Estimated unrestricted	Implied by weights
Intercept	8.812	9.762	
	[4.21]	[3.09]	
CBI	-6.611		
	[2.66]		
PS		0.174	-1.017
		[0.16]	
TI		-2.196	-1.017
		[2.39]	
II		-0.797	-2.034
		[0.58]	
FG		-3.653	-2.034
		[1.31]	
TG		-1.644	-0.509
		[1.44]	
Sum of unrestricted coefficients		-8.115	
R^2	0.227	0.384	

Note that all but one of the sub-indexes has the expected negative effect on the inflation rate. But also note that only one of the sub-indexes has a significant effect. That is target-independence, *TI*. And the coefficient is a large – 2.196, which is more than twice the magnitude implied by its weight in CBI. Another large coefficient is that on financing government deficits, *FG*, but it is only weakly significant.

The point estimates of all the negative coefficients are absolutely larger than implied by the weights in CBI and, despite the wrong sign on the price stability focus, *PS*, variable, the unrestricted coefficients sum to – 8.115, a stronger overall effect on inflation than estimated in the restricted regression. The positive effect of a focus on price stability is presumably to be interpreted as casting doubt on the index rather than as showing a real effect.

An advocate of the CBI index approach might argue that looking only at CBI and its components is too narrow and that a wider set of variables must be used to control for the many legal and non-legal, and formal and informal arrangements. The FJMRS database provides an opportunity to test this view, though FJMRS clearly did not see this as its purpose.

Again, using the CF inflation data and time period, I regressed the inflation rate on all the indexes constructed by FJMRS and **Table 5** shows the result. Variable 5, Independence, is the CBI variable used by CF. It again has a significant negative effect on inflation and it is the only significant variable in the regression. Insignificant wrong signs are present on six of the variables

and almost significant wrong signs appear on accountability of central bank to government and the importance of analysis of the monetary and banking sector.

Table 5 All FJMRS Indexes and their Effects on Inflation

	Coefficients	*t*-statistics
Intercept	5.298	1.61
1. Exchange rate focus	0.011	0.70
2. Money focus	0.002	0.13
3. Inflation focus	-0.010	-0.58
4. Discretion (high score implies more discretion)	0.001	0.11
5. Independence (CBI)	-0.067	-2.02
6. Accountability of central bank to government	0.020	1.74
7. Policy explanations	0.004	0.23
8. Analysis of inflation expectations	0.007	0.46
9. Analysis using models and forecasts	0.004	0.27
10. Importance of analysis of money and banking sector	0.041	2.00
11. Importance of financial stability issues in setting instruments	-0.020	-0.80
R^2	0.531	

It might be expected that multicollinearity is the source of large standard errors and apparently insignificant effects. A check of the correlation matrix among the variables shows that the correlations are not large.

Interestingly, though expected and a consequence of the index approach, the larger number of variables in the equation lowers the average value of the estimated effects of any one of the variables. With the original BP classification into four central bank types, shifting between types could, in principle, have a large effect. In the event, a large effect was found for only the most independent type. Moving from BP's three variables to GMT's sixteen decreases the average effect of any one of the GMT variables to 3/16ths the average of BP's variables. And moving to the 54 variables of FJMRS decreases the average effect of each to almost zero.

These mechanical changes in importance stem purely from the index number approach and shine a spotlight on its inappropriateness. The approach has been carried to the point that it obscures the issues and leaves us with little progress beyond what BP discovered more than thirty years ago.

But we can do better. The events of the past thirty years have provided experiments from which we can learn. I now describe two of them.

III TWO NATURAL EXPERIMENTS

The cross-country data are contaminated by social and political variables that might influence both the nation's central bank law and its attitude toward inflation. For example, Germany's strong social memory of hyperinflation might be the cause of the independence of its post-war central bank and its low inflation rate and that given Germany's strong inflation aversion, even a government-dominated central bank might have delivered the same low inflation.

Similarly, the equivalent memory in the psyche of the United Kingdom is the Great Depression. This event might be the cause of the U.K. government taking over and running the Bank of England and of the country's pursuit of full employment at the cost of rising inflation and occasional devaluation. And given the British aversion to unemployment, it is possible that an independent Bank of England would have delivered the same inflation performance.

To control for these possible effects and isolate the effects of central bank law, we need some natural experiments in which some central banking arrangements change and some do not change. When the central bank laws literature started, such experiments were unavailable. But we now have several examples of changes in central banking arrangements that make it possible to examine the relationship between the *change* in inflation and the *change* in central bank independence. The only existing attempt at this exercise is CF, but as explained earlier this attempt is not convincing.

I am now going to describe two natural experiments that provide new insights into the effects of central bank legal arrangements on inflation and other macroeconomic outcomes. One experiment focusses on the effects of central bank independence and the other of the effects of formal and transparently implemented inflation targeting.

Sample Selection, Treatment Groups, and Control Group

I use annual data on CPI inflation and real GDP growth from 1980 through 2011 for 27 advanced economies[27]. I started with the 35 economies that the IMF classifies as "Advanced" and eliminated six (Czech Republic, Estonia, Malta, San Marino, Slovakia, and Slovenia) because their data runs were seriously incomplete and two (Iceland and Israel) because their 1980s inflation rates were well outside the range of all the others[28] and I didn't want these two economies to swamp the more normal variability present in the other the advanced economies.

I then examined the amendments to central bank law in the remaining 27 economies and divided them into three groups: those that at some identifiable date became more independent (legally independent); those that adopted formal and transparently implemented inflation targeting; and those for which there was no apparent change in independence status and that did

[27] The data source is the International Monetary Fund, World Economic Outlook Database, October 2012.
[28] Iceland's inflation averaged 40 percent per year during the 1980s and Israel's averaged 116 percent per year.

not adopt inflation targeting. There is overlap between the more independent and inflation targeting groups.

Table 6 lists the twenty-seven economies and their assignment to the three groups. The table also shows the years in which a country's central bank became more independent and/or adopted inflation targets. Of the twenty-seven listed, the central banks of fifteen became more independent during the past 30 years.

Table 6 Treatment Groups and Control Group

More Independent		***Inflation Targeter***		***Control***
Belgium	1999	Australia	1993	Austria
Cyprus	2008	Canada	1991	Denmark
Finland	1999	New Zealand	1990	Germany
France	1999	Sweden	1993	Hong Kong
Greece	2001	UK	1992	Netherlands
Ireland	1999			Norway
Italy	1999			Singapore
Japan	1997			Switzerland
Korea	1997			Taiwan
Luxembourg	1999			United States
New Zealand	1990			
Portugal	1999			
Spain	1999			
Sweden	1999			
United Kingdom	1999			

More Independent Central Banks

New Zealand made the first move toward greater independence when it enacted a sweeping new central bank law in the Reserve Bank of New Zealand Act 1989[29]. This Act created a truly independent but accountable central bank. It also declared a single-minded commitment to price stability.

[29] Reserve Bank of New Zealand (1998)

Bank of Japan Act 1997[30], the Bank of Korea Act 1997[31], the Sveriges Riksbank Act 1998[32], and the Bank of England Act 1998[33] saw a similarly clear enunciation of a commitment to price stability by the policy decisions of an independent central bank.

The ECB became fully operational on 1 January 1999. Before that date, Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain had their own central banks. After 1 January 1999, these country's central banks ceded their monetary policy powers to the ECB. Other nations joined the eurozone and their central banks were replaced by the ECB in the years that followed (1 January 2001, Greece; 1 January 2007, Slovenia; 1 January 2008, Cyprus and Malta; 1 January 2009, Slovakia; and 1 January 2011, Estonia).

The ECB was established as an independent central bank with a mandate to achieve an inflation target of between zero and 2 percent. Most of the national central banks replaced by the ECB were not independent, so for most of the Eurozone economies, the change was to a more independent central bank. But there was no such change for Germany. The independence of the ECB is similar to that of the Bundesbank so the independence of Germany's central bank didn't change. For this reason, Germany is placed in the control group. Two other Eurozone economies join Germany in the control group: Austria and the Netherlands. These two economies were effectively locked together with Germany through the 1980s and 1990s with a rigidly fixed exchange rate[34]. With a fixed exchange rate, a country adopts the policy outcome of the central bank law of the country against which it fixes.

Transparent Inflation Targeters

When FJMRS conducted their survey of central banks, fifteen were declared inflation targeters. The number is larger today. But the original inflation targeters that started this approach to monetary policy during the early 1990s are those listed in **Table 6**. All five central banks use a similar approach. A price index and a target range for its inflation rate is agreed with government; the bank aims to achieve the mid-point of the range but flexibly moves toward either extreme to moderate fluctuations in the real economy. A frequent report (variously titled "inflation report" or "monetary policy report" provides a detailed account of the bank's forecasts and explanation for its policy decision.

Does a move toward greater central bank independence lower the inflation rate? Does formal transparent inflation targeting deliver a lower inflation rate? And do greater independence and

[30] Bank of Japan (1997)
[31] Cargill (2001)
[32] Sveriges Riksbank (1998)
[33] Bank of England (1998)
[34] The Austrian schilling was pegged at 7 D-marks and the Dutch guilder at 1.12 D-marks with almost no movement away from these values.

the pursuit of an inflation target bring greater real volatility? Or is there a free lunch with both inflation and real fluctuations subsiding?

Looking for the Effects

If central bank independence and inflation targeting influence monetary policy outcomes, these influences should be visible after countries modified the central bank laws and after countries adopted inflation targets.

To reveal these influences, we must control for other factors that act on inflation and macroeconomic performance that were different during the 2000s from the 1980s and 1990s. Listing and measuring all these potential influences is neither feasible nor necessary. Instead, we can regard the countries with more independent central banks as one treatment group and the countries that adopted inflation targeting as a second treatment group. We can compare the macroeconomic performances of the countries in these groups with those of a control group of countries, a group of otherwise similar countries in otherwise similar times that did not change their central bank law or adopt an inflation target. The natural choice for the control group is the advanced economies listed in **Table 6**.

Before and After

For a "before" and an "after," I calculated the mean inflation rates and the variability of inflation[35] and real GDP growth for the 27 countries listed in **Table 6**. For the two treatment groups, the break year for "before" and "after" was 1 year after the policy change date shown in the table for real GDP growth and 2 years after for inflation. The rationale for these lags is that they reasonably represent the types of time lags found in time-series studies. For the control group, I calculated two versions: breaks in 1993 (real GDP) and 1994 (inflation) for the inflation targeting comparison and breaks in 2000 (real GDP) and 2001 (inflation) for the more independent comparison.

What Do More Independence and Inflation Targeting Achieve?

The first answer to these questions is obtained by inspecting scatter diagrams, which show the average inflation and variability of inflation (**Figure 1**) and the variability of inflation and real GDP growth (**Figure 2**) for the central banks that became more independent, and for the control group (**Figures 3 and 4**); and the same variables for the inflation targeters (**Figures 5 and 6**) and their controls (**Figures 7 and 8**). More independent central banks dramatically lower inflation and its variability but spread out to higher levels the variability of real GDP growth. Inflation

[35] Variability is measured by the standard deviations of the inflation rate and the real GDP growth rate.

targeters deliver a similar outcome for inflation but slightly lower the variability of real GDP growth.

Table 7 shows summary statistics for the data plotted in the scatter diagrams.

Table 7 Summary Statistics for Two Natural Experiments

	Before			After		
1980 - 2011	Mean	Standard deviation		Mean	Standard deviation	
	Inflation	Inflation	Real GDP growth	Inflation	Inflation	Real GDP growth
More independent	6.42	4.71	2.25	2.24	1.07	2.75
Control MI	3.79	2.85	2.23	1.18	1.24	2.60
Inflation targeters	7.43	3.95	2.28	2.07	1.03	1.92
Control IT	4.55	2.90	2.30	1.81	1.30	2.46

Table 8 Before and After Changes

	Mean	Standard deviation	
	Inflation	Inflation	Real GDP growth
More independent before	6.42	4.71	2.25
More independent after	2.24	1.07	2.75
Change for more independent	–4.18	–3.65	0.51
Standard error	0.87	0.49	0.30
t-statistic	4.82	7.38	1.66
Inflation targeters before	7.43	3.95	2.28
Inflation targeters after	2.07	1.03	1.92
Change for inflation targeters	–5.36	–2.91	–0.36
Standard error of change	0.87	0.38	0.30
t-statistic	6.19	7.74	1.21

Absolute changes

The countries in which the central bank became more independent lowered their inflation rates, lowered the variability of inflation, but increased the variability of real GDP growth. The standard errors of the changes are small for inflation and its variability and these changes are strongly significant. Only the change in real GDP growth variability is insignificant. **Table 8** shows the changes and the significance tests.

The numbers for inflation targeters tell a similar story to those for more independent banks with one exception. These countries lowered their inflation rates, lowered the variability of inflation, *and* they lowered the variability of real GDP growth. Again, the standard errors of the changes are small for inflation and its variability and these changes are strongly significant. And again, the change in real GDP growth variability is insignificant.

Inflation in Controls Lower than in Treatments

Notice that the mean inflation rates in **Table 8** show that the control groups have lower inflation rates than the two treatment groups. Recall, however, that the controls are not all government dependent central banks. They are countries in which the central bank law didn't change, not those that have government dependent central banks. Indeed, the group includes three Eurozone economies and Switzerland, all of which have independent central banks. The group also includes the United States, Hong Kong, and Singapore, economies not noted for a lack of monetary discipline.

Changes Compared to Control?

The absolute changes in monetary policy outcomes don't tell us the effects of the policy change. To see that change, we need to ask how the two treatment groups compare with the controls.

Table 9 provides the relevant data. It shows only two significant effects: The more independent central banks lowered the variability of inflation significantly more than did the control group. And the inflation targeters lowered the mean inflation rate significantly more than its decrease in the control group. The means of all the other effects are in the expected direction but the confidence in these changes is not a strong as it is for the two significant effects.

The conclusions that emerge from the experiment of more independence do not contradict earlier findings on the effects of CBI. Lower inflation variability, higher output variability, and maybe lower inflation are basically what earlier cross-country studies have shown. But the conclusions from the inflation targeting experiment cast doubt on the necessity of central bank independence. An inflation control contract with government transparently pursued can apparently do a very good job.

Table 9 Changes Relative to Controls

	Mean	Standard deviation	
	Inflation	Inflation	Real GDP growth
Change for more independent	–4.18	–3.65	0.51
Change for control MI	–2.61	–1.61	0.37
Difference	–1.57	–2.04	0.14
Standard error	1.03	0.63	0.29
t-statistic	1.52	3.24	0.47
Change for inflation targeters	–5.36	–2.91	–0.36
Change for control IT	–2.74	–1.60	0.16
Difference	–2.62	–1.31	–0.53
Standard error	1.01	1.00	0.38
t-statistic	2.61	1.31	1.37

IV CHANGING CONSTRAINTS ON CENTRAL BANKS

I conclude by speculating about changing constraints on central banks that might challenge their independence and influence. Four changes strike me as being important: (1) ideas, (2) deficits, (3) global integration, and (4) private, gold-like e-money. I reflect briefly on each.

Ideas

Ideas, as Keynes famously said, are dangerous for good or evil. Over the past thirty years, ideas about macroeconomics and money have played their role at both ends of the good-evil spectrum. The wide acceptance of the natural rate hypothesis and associated demise of the Phillips curve, the insight that a rule beats discretion, the emergence of the Taylor curve and rule, the move toward greater independence of central banks, and the adoption of transparent inflation targeting are all ideas that have contributed to improved monetary policy and the universal lower inflation rates so vividly seen in the scatter diagrams in this paper.

But we now have a good-ideas vacuum and a glut of bad ideas. Recession and slow recovery are tempting many influential people to advocate using monetary policy to pursue real goals that it is incapable of achieving. Targeting nominal GDP and setting an unemployment target are examples. Other troublesome ideas include expanding the central bank's mandate to include financial stability—financial regulation and identifying and pricking speculative bubbles.

Pursued vigorously enough, these ideas have the power to undo the good work of the past two decades in reigning in inflation.

Deficits

With an aging population and an increase in years of schooling, and a large part of the cost of health care and education funded by governments, it is difficult to see how government deficits can be avoided. The United States might introduce a European style value-added tax and get some relief from deficits for a few years. But even with its high taxes, France and some other European governments are unable to avoid ongoing and large deficits. No matter how independent they are, it is likely that central banks will be challenged by ballooning government debt.

Global Integration

We live in a world of multiple fiat monies. One country's monetary policy actions influence the monetary policies of other countries. Inflation targeters cannot focus only on inflation and must pay attention to the effects of their interest rate decisions on interest rate differentials and exchange rate movements. Independent central banks have limited independence from each other and interdependence is likely to increase as electronic currency trading spreads and becomes available in retail currency markets.

Private Gold-Like e-Money

A small revolution in private gold-like e-money has already started. Its name is Bitcoin. The quantity of Bitcoin grows as people 'mine' it, and like a real commodity, the cost of mining rises as the un-mined stock depletes, so the mined stock grows at a decreasing rate until it eventually stops growing. The price of a unit of Bitcoin is determined by market demand and supply. Bitcoin has PSP (payment services provider) status in Europe and the ECB has seen it necessary to write about it.[36] Bitcoin is actively traded against government monies and is increasingly widely accepted as a means of payment. If this private e-money and perhaps other competing private e-monies become more universal, central bank liabilities will lose what remnants of monopoly status they currently enjoy. And regardless of their independence from governments, central banks will be constrained by a potentially falling demand for their liabilities.

Research on central bank independence during the next three decades will be dominated by these changing constraints and be even more challenging than the past three decades have been.

[36] European Central Bank (2012)

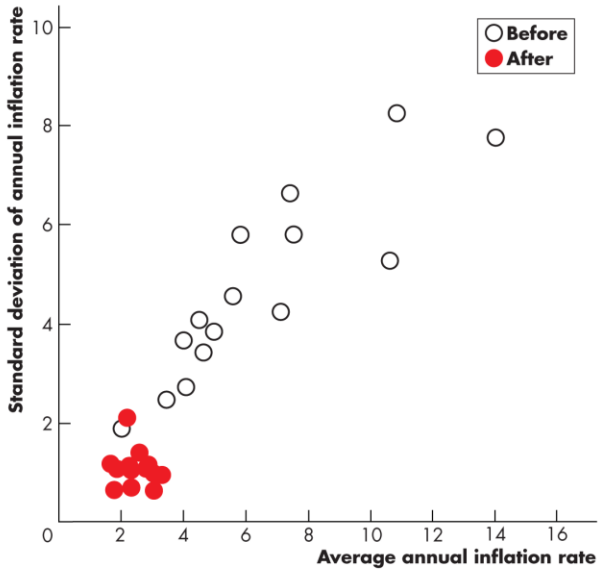

Figure 1 More Indepenent: Inflation

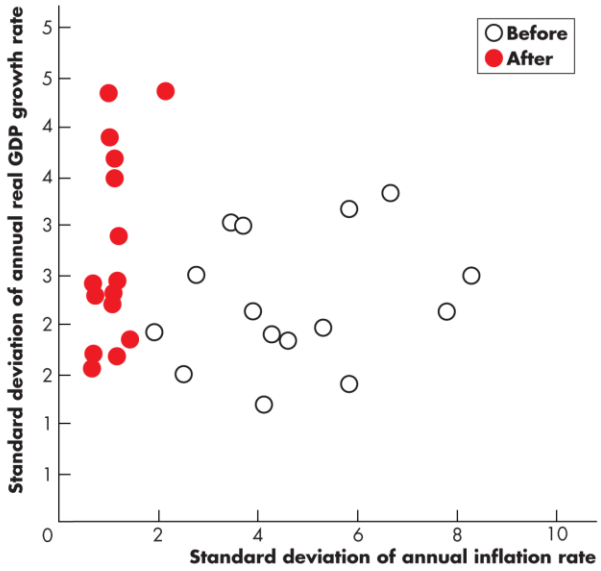

Figure 2 More Independent: Real GDP Growth

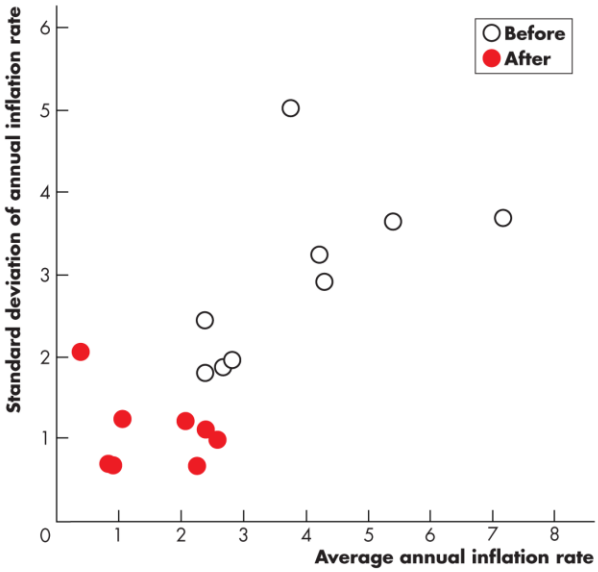

Figure 3 More Indpendent Control: Inflation

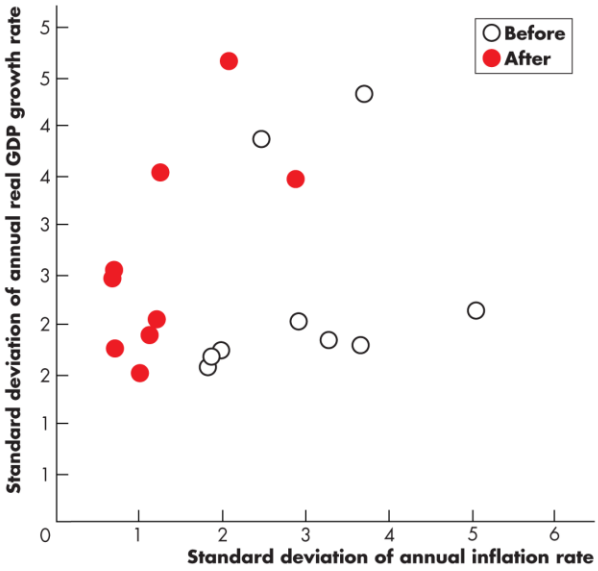

Figure 4 More Independent: Real GDP Growth

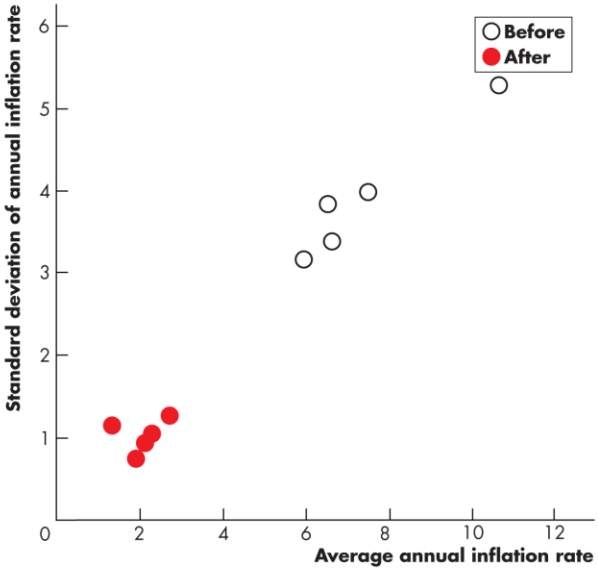

Figure 5 Inflation Targeters: Inflation

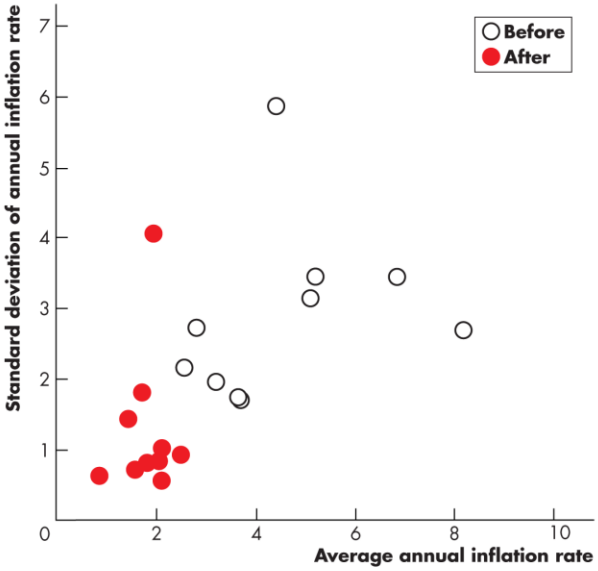

Figure 7 Inflation Targeters Control: Inflation

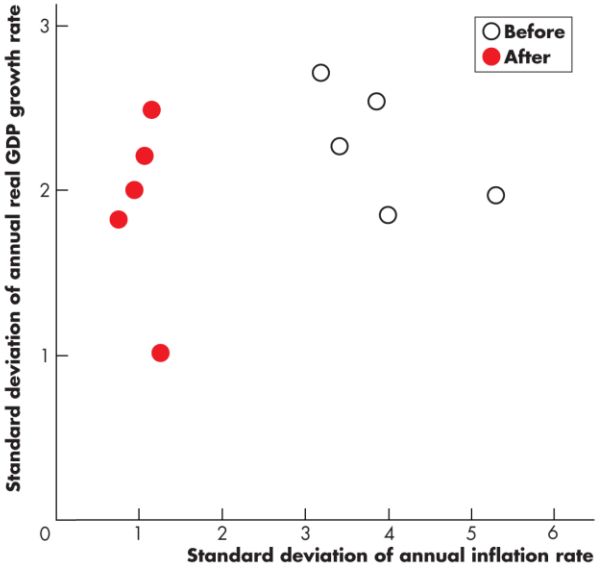

Figure 6 Inflation Targeters: Real GDP Growth

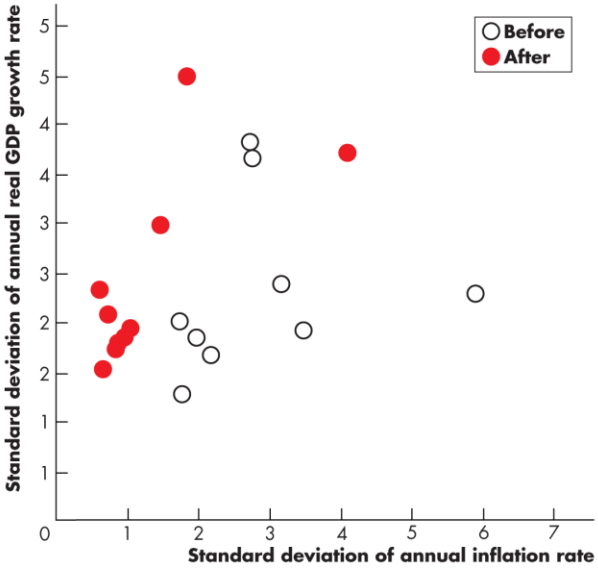

Figure 8 Inflation Targeters Control: Real GDP Growth

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