

## Political Influence on the Central Bank: International Evidence

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*Political influence on the central bank is measured here by looking at the probability that a central bank governor will be replaced shortly after a political change of government. The governor changes about half the time within six months of a nonconstitutional or other radical change of government—a military coup or a restoration of democracy. The governor is much less likely to change within six months following a routine change in the head of government—about one-fourth of the time in developing countries and one-tenth in industrial countries. These indicators vary across countries and correlate statistically with inflation and its variability and with real growth and real interest rates. Differences in the vulnerability of the central bank to political instability, in political instability itself, and in central bank turnover in nonpolitical periods seem to be a major part of the explanation for why developing countries have, on average, higher and more variable inflation than industrial countries do.*

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Economists and policymakers generally feel that the degree of autonomy of the central bank from political authorities is an important determinant of policy choices and of economic performance. Empirical verification of these presumptions has been difficult, however, because the autonomy of the central bank is not easily quantified. Most previous studies have used legal indexes from central bank charters to quantify the autonomy of the central bank (Parkin 1986; Grilli, Masciandaro, and Tabellini 1991; Alesina and Summers 1993). These measures help account for cross-country inflation differentials within industrial economies but not within developing economies. Low inflation is not associated with the legal independence of central banks in developing countries because of the small degree of association between actual and legal independence among those countries. In industrial countries, the frequency with which a central bank governor is replaced within three months of the time designated by law is more than ten times higher than in other periods. In developing countries it is only 2.2 times higher.

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Hence, more behavioral indexes of independence are called upon. Cukierman, Webb, and Neyapti (1992) and Cukierman (1992) made an initial step in this direction by using the actual average term in office of the governor as a proxy for central bank independence in developing countries. They found a significant negative association between this proxy and inflation across developing countries. The use of this proxy is based on the presumption that below some threshold a shorter term in office of the chief executive officer (to whom we refer as "governor," although the actual title may be president or chairman) of the bank is associated with lower central bank independence. It should be noted, in this context, that actual terms in office in developing countries are substantially lower than in industrial countries. Cukierman (1994) shows theoretically how the expected length of tenure of the central bank governor relates inversely to inflation because of the governor's effective rate of time preference. This article presses the inquiry further by taking account of how turnover of the governor relates to political events.

Although considerable evidence now establishes the negative association between inflation and central bank autonomy, the reduction of political influence on the central bank is not the only institutional device for assuring price stability. Regardless of whether a country has a dependent central bank, the country may still enjoy price stability if it consistently pegs its currency to that of a country with stable prices. Examples include Argentina in recent years, Belgium, the Netherlands, and some francophone African countries. An even stronger commitment to maintain a fixed exchange rate is to use a foreign currency for legal tender, as in Panama. But it should be emphasized that central bank autonomy and various degrees of commitment to a fixed exchange rate are complementary institutional arrangements and are not mutually exclusive. This article focuses on the documentation and the effects of the varying degrees of political influence on the central bank. We and others have investigated the effects of exchange rate commitments elsewhere. Empirical investigations of the effect of exchange rate pegs on inflation appear in Cukierman, Rodriguez, and Webb (forthcoming) and in Anayadike-Danes (1995). Cukierman, Kiguel, and Liviatan (1992) offers a general discussion of dollarization.

A variety of research—theory, case studies, and statistical analysis—shows that political instability worsens macroeconomic policy and outcomes (Edwards and Tabellini 1991; Haggard, Kaufman, and Webb 1992; Haggard and Webb 1994). The effects are strongest on inflation, but other variables such as growth and the real interest rate are also affected. Some macroeconomic deterioration results from the direct effects of political change on policy, particularly fiscal policy. Some also come from the effect on institutions, such as the central bank, and on their ability and incentive to follow policies for the long-run benefit of the economy. So the research agenda includes the question of the relative importance of different channels through which political instability influences economic outcomes, as well as the underlying questions of whether and how political instability affects institutions such as the central bank.

It seems likely that different kinds of political instability would have quite different effects. If political changes reflected changes in basic attitudes toward economic policy or if they were traumatic and irreversible for the politicians involved, then the instability would motivate politicians to control the central bank tightly and keep it at their disposal to help them stay in power. If, however, the political changes were alternations in power of two or three parties that shared a consensus on many basic tenets of economic policy, then the parties might agree to grant the central bank considerable autonomy to pursue price stability, so that the aspect of economic policy on which they agreed would not suffer from the political contests over other issues. These questions motivated the research for this article, although the article does not answer all of them.

This article presents new behavioral indexes of political influence on the central bank. The indexes focus on the propensity of the governor of the bank to lose office following a political transition. The data base and the indexes derived from it were designed to address four specific questions derived from the broader questions in the previous paragraphs.

*First, is turnover at the central bank significantly different shortly after political transitions than in other periods?* To answer this question, we compare the frequency with which governors are changed in periods shortly after a political transition with that in other periods. We refer to these other periods as “nonpolitical,” although recognizing that even then some turnover may result from political influence. Nevertheless, in the presence of heavy political influence we should expect central bank governors to be changed with significantly higher frequency in periods immediately after political transitions, which we call “political periods,” than in the nonpolitical periods. The tests presented in the article suggest that this is indeed the case for the entire sample of sixty-seven economies, for the subgroup of developing economies, and, surprisingly, for the industrial economies as well. Given this result, the frequency with which central bank governors are changed in political periods can serve as an index of the extent of political influence over the central bank and thus lead to more refined indicators of central bank autonomy.

*Second, for how long does a political transition, after its occurrence, increase the probability of a change of the central bank governor?* To answer this question we examine a number of two- or three-month successive intervals following political transitions and calculate the frequency of changes at the central bank within each interval. The frequency of changes is high on average immediately after a political transition and usually decreases as more months go by. The cutoff between political and nonpolitical periods is obtained by considering the last interval within which the frequency of changes at the central bank is significantly higher than the average frequency at the ten-month-or-more lag. The demarcation line between political and nonpolitical periods is then defined as the upper bound of this critical interval. With this procedure, periods within six months of the latest political transition are defined as political in the overall sample, and any period beyond that is nonpolitical.

*Third, is the political vulnerability of the central bank systematically related to the level of economic development and the type of political regime?* We calculate a measure of the political vulnerability of the central bank and examine its relation with a country's level of development and the nature of its regime (whether it is always democratic, always authoritarian, or mixed). Vulnerability of the central bank is defined as the fraction of political transitions that are followed, within the subsequent political periods, by a replacement of the governor of the bank.

Frequent removal from office of the bank's governor following political transitions probably reflects gross political influence, because the governor's term in office is not shielded by law or custom from political changes. This type of influence has been common in developing economies, such as Botswana, China, Costa Rica, and Indonesia, and has been particularly high in countries that switch between democratic and authoritarian regimes, such as Brazil, Chile, India, the Republic of Korea, Nicaragua, Peru, and Uruguay. In Argentina before the 1990s, even though the law specified a four-year term, the governor was always replaced when the government changed. Among industrial economies gross political influence on the central bank is rare—Sweden appears to be an exception—but more subtle and mild influences are common. For instance, in the United States, the index of central bank vulnerability is zero, implying the absence of gross political influence. But, as documented in Havrilesky (1992), there are several other, milder, channels of political influence on the Federal Reserve.

*Fourth, is the political vulnerability of the central bank systematically related to measures of economic performance such as inflation, growth, and interest rates?* Cross-sectional and panel-data regressions provide evidence on this question.

The article is organized as follows. Section I presents the data set and discusses the conventions used to organize it. The procedure for distinguishing between political and nonpolitical changes of central bank governors is developed and applied in section II to the entire sample as well as to broad subgroups of countries. Section III discusses indexes of central bank political vulnerability for broad subgroups of countries and investigates the effect of different types of political transitions on central bank vulnerability. The effects of vulnerability and of nonpolitical turnover on inflation, growth, and real rates are briefly examined in section IV. Section V estimates empirically how much of the strong cross-sectional association between inflation and its variance is due to their common association with central bank vulnerability and nonpolitical turnover. Section VI follows with concluding remarks.

## I. THE DATA

To assess and quantify the degree of political influence on the central bank, we have put together a multicountry data set on political and central bank instability. Political instability is measured by counting political transitions of various types. Instability at the central bank is measured with data on the frequency

and timing of replacement of central bank governors. The research focuses on variables that were available for a large number of countries on a uniform basis.

The sample consists of sixty-seven economies with matched data on political and central bank instability. The economies are listed in table A-1. The sample includes all the major industrial and developing economies, but excludes most Eastern European economies. The data cover 1950–89, where possible, but start later for economies that achieved political independence or established a central bank after 1950. The data are divided into two subperiods: 1950–71, corresponding to the Bretton Woods era, and 1972–89. In each subperiod as well as in the total period, an economy is included only if data are available for at least ten years because data for shorter periods would often be unrepresentative.

### *Political Transitions*

Instability of the executive branch of government seems most relevant for central bank autonomy. Consequently, we selected four types of political change as indicators of political instability: change of the head of government, change of the party in government, change of the fundamental rules of government as embodied in switches from authoritarian to democratic regimes or vice versa, and irregular changes of government from one authoritarian ruler to another. These types of changes form a hierarchy, so that each political event is coded as a level of instability: a change of the head of government without a change of party (low instability); a nonviolent change of party without a change of type of government (medium instability); an irregular change of authoritarian government without a change of form of government—a coup—(type 2 authoritarian); or a change of the form of government between democratic and authoritarian—a coup against a democratic government or a restoration of democracy—(high instability).<sup>1</sup>

Our previous research indicated that the autonomy of the central bank differed markedly between industrial and developing countries (Cukierman, Webb, and Neyapti 1992). Here we examine whether this distinction is also important for the effects of political instability on the central bank. Within each economic group, countries are divided into subgroups with democratic regimes for the whole period, with authoritarian regimes throughout, and with regimes that alternate between democratic and authoritarian. We classified as democratic only the countries and periods in which the head of government was chosen as a result of competitive elections. All others were classified as authoritarian, covering a variety of systems in which the government did not face serious pressure from electoral politics. The classifications thus differ somewhat from what one would

1. Data come from and were checked against several sources. The most comprehensive single source, and usually the initial one, is *The Europa World Yearbook*. Changes of only the economic team (not necessarily including the central bank) are also events that may be relevant for assessing central bank autonomy. To investigate the relevance of these events, we have begun collecting data on changes of the Minister of Finance or Treasury. These data are less readily available than information on changes of the head of government, and we do not yet have information on a broad enough sample to report the results.

code as the degree of political liberty, such as with Gastil's indexes. We chose to exclude from our data political events that challenged and perhaps threatened to change a government but did not do so—strikes, riots, attempted coups, and elections in which the previous government was reelected. To assess the implications for an institution such as the central bank, it seemed better to focus on institutionally well-defined events that actually changed the government to which the bank reported.

### *Changes at the Central Bank*

The raw data on instability at the central bank consist of the actual dates of changes of the governors of the central banks in our sample of countries. The turnover of governors is only an imperfect indicator of actual central bank independence in developing countries (for more discussion of this proxy, see Cukierman, Webb, and Neyapti 1992; Cukierman 1992; and Cukierman and others 1993). Low turnover does not always imply a high level of central bank independence—relatively subservient governors may stay in office longer precisely because they do not stand up to the executive branch. This may be true for countries with exceptionally low turnover rates such as Denmark, Iceland, and the United Kingdom and for countries with stable authoritarian governments. In such countries, low turnover is probably unrelated to independence. Above some threshold turnover rate, however, higher turnover of the governor reflects lower central bank independence.

Sufficiently high turnover rates make the tenure of the central bank governor shorter than that of the executive branch and thus make the governor more susceptible to influence by the executive branch and more discouraged from trying to implement longer-term policies. Because the electoral cycle is at least four years in most countries, the threshold turnover rate is probably between 0.2 and 0.25 (implying a governor's tenure of four to five years). In addition, governors with very short terms of office, such as three years or less, generally have more difficulty in implementing long-term policies (for example, the maintenance of price stability) for any electoral cycle. One limitation of the turnover variable is that all the industrial countries have turnover rates at or below the threshold rate in the years we examine. Turnover rates in developing countries, however, span a range that goes well above the threshold point.

The measures of political influence on the central bank developed here consider the links between political instability and subsequent turnover at the central bank and hence appear to be relevant for both industrial and developing economies. They also make it possible to distinguish between the frequencies of changes at the central bank in political periods, as defined earlier, and in nonpolitical periods. A relatively high frequency of turnover in the political periods indicates substantial influence of political instability on the central bank. A relatively high level of turnover the rest of the time most likely indicates that the central bank is more dependent even in politically tranquil times.

## II. POLITICAL CHANGE AND THE TIMING OF CENTRAL BANK TURNOVER

To what extent does political instability translate into instability at the central bank? Are there systematic differences in central bank turnover between periods immediately following a political change and nonpolitical periods? If there are differences, how does their magnitude vary with country characteristics? To answer these questions, this section measures political instability by the frequency of political transitions, as defined in section I, and instability at the central bank by the turnover of the governors.

Before attempting to give precise answers to these questions, it is instructive to take a broad look at the data. Table 1 presents central bank turnover figures (measured as the number of changes of central bank governor per month) for various intervals following a political transition. Thus, the average frequency of changes of governor within one month following a political transition is 0.063 per month; within two to three months it is 0.026, and it is only 0.015 at ten months or more after a political transition.<sup>2</sup> These numbers correspond to governors' average terms of office of 1.3, 3.2, and 5.6 years, respectively.<sup>3</sup>

The numbers in table 1 can be interpreted as estimates of the probability per month of a change in central bank governor conditional on being within a time interval,  $i$ , that follows a political transition by  $i$  to  $i + 2$  (or by  $i$  to  $i + 3$ ) months.<sup>4</sup>

Table 1. *Frequency of Change of Central Bank Governor at Various Intervals by Economy Group, 1950-89*  
(number of changes per month)

Economy group	Number of economies	Interval (number of months since a political transition)				
		0-1	2-3	4-6	7-9	10 or more
All	67	0.063	0.026	0.025	0.013	0.015
<i>Industrial</i>						
All 20	24	0.008	0.013	0.013	0.003	0.009
Democratic only	18	0.020	0.009	0.015	0.002	0.009
Mixed	2	0.060	0.000	0.000	0.024	0.013
<i>Developing</i>						
All	47	0.096	0.041	0.034	0.022	0.018
Democratic only	9	0.046	0.016	0.065	0.011	0.025
Authoritarian only	16	0.089	0.017	0.006	0.025	0.015
Mixed	22	0.105	0.053	0.038	0.023	0.019

Source: Authors' calculations.

2. When a change in central bank governor occurs within a short time after two or more previous political transitions, the central bank change is attributed only to the most recent political transition.

3. In other words, let  $x$  be a turnover number from table 1; then, the corresponding average term in office, in years, is given by  $1/12x$ .

4. This interpretation requires the probability of two or more changes within a subperiod to be negligible. Because the time intervals considered are only two or three months, this assumption is supported by the data.

Table 1 reveals that, for the entire sample of economies, this probability decreases monotonically with the number of months that have elapsed since the last political transition. It is almost three times larger in the zero-to-one-month interval than in the two-to-six-month intervals. For seven-month intervals and beyond, this probability drops further—to about 60 percent of its value in the two-to-six-month intervals.

Central bank changes within one month of a political transition are highly likely to result directly from the political change, but central bank changes more than nine months after a political transition are unlikely to be the result of a change in government and are more likely to be largely nonpolitical. The challenge is to find the average elapsed time across countries, presumably between one and nine months, at which to set the cutoff between political and nonpolitical periods. We take the probability of turnover long after a political change (ten months or more) as a background rate against which to compare months in the intermediate range. The political period would then be defined to include months at intervals (after a political change) for which the average rate of central bank turnover is significantly higher than the background rate.

The appendix describes the tests for differences between the probability of a change of central bank governor ten or more months after a political change and the probability in each of the intervals with shorter lags, using the normal approximation to the binomial distribution. It shows that for the whole sample the probability of a turnover at the central bank is significantly larger in the zero-to-one-month, two-to-three-month, and four-to-six-month intervals than in the ten-month-and-more interval. The average probability of a change of central bank governor during the seven-to-nine-month interval following a political change does not differ significantly from the probability in the ten-or-more lag period. Hence, the evidence in the appendix supports a choice of six months following a political transition as the cutoff between political and nonpolitical periods in the overall sample.

In summary, for the entire sample of economies, the evidence supports the view that instability at the central bank rises in periods following political transitions and that this increase is significant. The estimated probability of a change of governor at the central bank is more than two times larger in periods within six months after a political transition than in periods that are more removed from political change. Thus, political instability increases instability at the central bank and weakens its independence from political authorities.

The profile of estimated probabilities of a change at the central bank varies between industrial and developing economies and between economies with different political regimes. We distinguish three types of political regimes: stable democracies, stable authoritarian regimes, and mixed regimes (those alternating between democratic and authoritarian regimes). Most industrial economies are stable democracies, none are authoritarian-only for the period under investigation, and only two (Spain and France) are mixed regimes. Developing

economies include all three political regimes—democratic only, authoritarian only, and mixed.

Table 1 also presents the estimated probability of a change of central bank governor at various intervals following a political transition for the different subgroups of economies. The probability of central bank turnover is higher in developing economies than in industrial countries at all intervals. The frequency declines monotonically for developing economies but has two peaks for industrial economies—one in the zero-to-one-month interval and a lower peak in the four-to-six-month interval. The tests reported in the appendix reveal that for developing economies the appropriate cutoff between political and nonpolitical periods is at six months as in the overall sample, and there is clear evidence of a link between political instability and instability at the central bank.

The average frequencies of central bank turnover within the three political subgroups of developing economies are summarized in the lower part of table 1. In the authoritarian and mixed subgroups, the two largest, the frequency in the zero-to-one-month interval is substantially higher than in the subsequent intervals. Statistical tests reveal that in all three cases the difference in frequencies between the zero-to-one-month interval and the ten-month-or-more interval is significant. Comparing the three subgroups, the average frequency of central bank instability in the zero-to-one-month and the two-to-three-month intervals is highest on average in the countries with mixed regimes, second highest in authoritarian-only countries, and lowest in democratic-only countries.

The evidence is less dramatic for industrial economies, but still supports the view that in those countries the average frequency of central bank changes in the zero-to-one-month interval after a political change is significantly higher than the background frequency in the ten-month-or-more interval. The frequencies in the two-to-three-month, four-to-six-month, and seven-to-nine-month intervals are not significantly different from the frequency for the ten-month-or-more lag. Thus, for industrial economies as a subgroup we locate the cutoff between political and nonpolitical periods after the zero-to-one-month interval. We present most of the results in the rest of the article for both the zero-to-one-month and zero-to-six-month cutoffs.

The tendency of mixed regimes to have higher frequencies of central bank changes than democracies in the zero-to-one-month interval also appears within the industrial countries, although this finding is based only on the experience of France and Spain. Also, as was the case for industrial democracies, there is a second peak in the four-to-six-month interval for democratic-only developing economies.

### III. POLITICAL VULNERABILITY OF CENTRAL BANKS

Computing the frequency of central bank turnover in intervals at various lags from political changes was important for assessing the size and duration of the effect of political changes on the propensity for central bank turnover. For a

summary measure of political influence, however, we compute an index of the political vulnerability of the central bank, defined for each country as the fraction of political transitions that are followed promptly by a replacement of the central bank governor:

$$V(i) = \frac{\text{Number of replacements of the central bank governor within } i \text{ months following a political transition}}{\text{Number of political transitions}}, i = 1, 6.$$

Table 2 reports average values of the index of central bank political vulnerability for industrial and developing economies as well as for democratic, authoritarian, and mixed regimes within each group. The overall average value of vulnerability is 0.24. That is, almost a quarter of all political transitions are followed by a replacement of the central bank governor within six months. As with the frequency of turnover, the vulnerability varies widely across country groups and subgroups. Political vulnerability is more than three times larger in developing economies than in industrial ones. A similar picture (not shown) emerges when the sample is broken into two subperiods (1950-71 and 1972-89). Central banks of developing economies with mixed regimes are the most vulnerable on average.

Table A-1 in the appendix presents the vulnerability of central banks to all types of political transitions for individual economies by subgroups. For economies with a small number of political transitions in a subperiod, the vulnerability ratios are highly sensitive to the effect of a truly nonpolitical central bank

Table 2. *Political Vulnerability of Central Banks by Economy Group, 1950-89*

Economy group	Vulnerability <sup>a</sup>		Frequency of political change (per year)
	Within six months	Within one month	
All	0.24	0.12	0.27
Industrial	0.10	0.05	0.32
Developing	0.35	0.18	0.24
<i>Industrial</i>			
Democratic only	0.10	0.04	0.32
Mixed	0.12	0.12	0.33
<i>Developing</i>			
Authoritarian only	0.22	0.17	0.14
Democratic only	0.30	0.09	0.18
Mixed	0.39	0.20	0.30

a. Average share of political transitions followed by a replacement of the central bank governor within the noted period.

Source: Authors' calculations.

change accidentally happening after a political change.<sup>5</sup> Although vulnerability numbers for individual economies in such cases should be viewed cautiously, they are still useful for the overall statistical analysis. Within each subgroup, central banks are arranged in descending order of their political vulnerability in 1972–89. By this measure, Sweden has the most politically vulnerable central bank among industrial democracies in that subperiod. Among democratic-only developing economies, the central bank of Botswana is the most vulnerable. Among developing economies with mixed regimes, the Argentine central bank is the most vulnerable, with sometimes more than one change of governor in the first six months after a political change.<sup>6</sup>

The last column of table 2 reports the average frequency of political transitions per year for each country group. Industrial economies have political transitions more frequently than developing economies, because they have much more frequent democratic changes of government, with and without party changes. Within developing economies, the subgroup with mixed regimes has a frequency of political transitions that is about twice that of either democratic-only or authoritarian-only regimes. Authoritarian-only regimes have the lowest number of political changes of any type.

We now have four indicators of central bank autonomy: the two developed in Cukierman, Webb, and Neyapti (1992)—the index of legal autonomy and the (total) turnover rate of the governor—plus vulnerability and its complement, the frequency of nonpolitical turnover of the governor. Of course the latter two can be reaggregated into the total turnover rate by making appropriate adjustments of units and multiplying vulnerability by the frequency of political transitions in each country. How different are these four measures? Table 3 shows the matrix of correlation coefficients for the four measures and the frequency of political turnover. Most of the various indicators are not closely correlated to one another, although total turnover is closely correlated with its two derivatives. The frequency of political transitions, an indicator of vibrant democracy or of more-fundamental political instability, is not significantly correlated with the various central bank variables.

How is the political vulnerability of the central bank affected by the type of political instability in a country? To answer this question, we regressed the indexes of central bank vulnerability at lags of zero to one month and zero to six months on various types of political transitions, on a dummy for developing countries, and on a dummy for purely authoritarian regimes. Table 4 summarizes the results. With the vulnerability index for the lag of zero to six months,

5. This has been the case at least once in Jamaica and once in the Netherlands. In the Netherlands the decision to replace the governor in 1967 was made prior to the adjoining political transition, but was implemented after it (de Haan 1995). Thus, vulnerability is a noisy measure of political influence whose quality rises with the number of political transitions in a country.

6. In the 1990s, Argentina has vastly increased its commitment to price stability by upgrading the autonomy of its central monetary institution and by endowing it with the authority to function as a currency board.

Table 3. *Correlation between Various Indicators of Central Bank Autonomy, 1950-89*

Indicator	Index of legal central bank autonomy	Total central bank turnover	Vulnerability	Frequency of political change
Total central bank turnover	-0.05			
Vulnerability (six months)	-0.11	0.78		
Frequency of political transitions	-0.05	0.06	-0.11	
Nonpolitical central bank turnover	-0.02	0.88	0.60	-0.21

Source: Authors' calculations.

the developing-country dummy has a significant positive impact on central bank vulnerability. But none of the indicators of political change had a statistically significant effect on vulnerability. Low- and medium-level changes clearly have no effect, which is consistent with the ambiguous theoretical priors. For high-level political change, the coefficient has a positive sign, as expected, but is not quite significant, although it was with some earlier versions of the sample.

The vulnerability of central banks to political influence depends on the type of political transition. Table 5 reports the indexes of political vulnerability by

Table 4. *The Impact of Political Change on Central Bank Vulnerability, 1950-89*

Explanatory variable	Estimates	
	For lag of 0-1 month	For lag of 0-6 months
Constant	0.09 (1.61)	0.16** (2.16)
High-level political change	0.73 (1.46)	0.96 (1.44)
Type-2 authoritarian transitions	-0.16 (-0.29)	-0.47 (-0.65)
Medium-level political change	-0.15 (-0.92)	-0.22 (-1.01)
Low-level political change	-0.09 (-0.52)	-0.19 (-0.78)
Dummy for purely authoritarian regimes	0.04 (0.55)	-0.08 (-0.79)
Dummy for developing countries	0.09 (1.48)	0.24*** (2.96)
Number of observations	110	110
Adjusted R <sup>2</sup>	0.059	0.143

\*\* Significant at the 5 percent level

\*\*\* Significant at the 1 percent level.

Note: The estimated equation is a pooled cross-sectional time-series regression in which there are two observations for each country, one for 1950-71 (where available) and one for 1972-89. The dependent variable is central bank vulnerability. *t*-statistics are in parentheses.

Source: Authors' calculations.

type of political transition for different economy groupings. The fraction 0.61 at the intersection of the mixed developing-economy row with the "high-level" column means that 61 percent of high-level political transitions in developing economies are followed within six months by a replacement of the central bank governor. The other numbers in the table are defined in a similar manner. There is generally little difference between the vulnerability to medium-level and to low-level political transitions within each country group. The vulnerability to medium- and low-level political transitions is more than twice as high in developing economies as it is in industrial ones. Furthermore, this difference seems to be due to a difference in the level of development, rather than to differences in regimes, because in democratic developing economies vulnerability to medium- and low-level political transitions is more than twice as large as that of industrial democracies. The vulnerability to these types of political transitions in mixed-regime developing economies is of the same order of magnitude as the vulnerability in democratic developing economies.

The highest level of central bank vulnerability occurs in the face of high-level political transitions, which are all in developing economies (with mixed regimes, by definition). For developing economies as a whole, central bank vulnerability to type-2 authoritarian transitions (0.46) is larger than vulnerability to medium- and low-level transitions by a factor of almost two. The 0.46 figure, however, masks quite different tendencies in authoritarian-only regimes, which have an average vulnerability of 0.20, and in mixed regimes, where type-2 authoritarian transitions lead to an average vulnerability of 0.55.

Table 5. *Central Bank Vulnerability (within Six Months) by Type of Political Transition and Economy Group*

Economy group	Type of political transition			
	High level <sup>a</sup>	Type-2 authoritarian <sup>b</sup>	Medium level <sup>c</sup>	Low level <sup>d</sup>
All	0.58	0.46	0.15	0.19
Industrial	0.00	n.a.	0.11	0.08
Developing	0.61	0.46	0.24	0.26
<i>Industrial</i>				
Democratic	n.a.	n.a.	0.11	0.08
Mixed	0.00	n.a.	0.12	0.17
<i>Developing</i>				
Authoritarian only	n.a.	0.20	n.a.	0.23
Democratic only	n.a.	n.a.	0.24	0.25
Mixed	0.61	0.55	0.24	0.28

n.a. Not applicable, because there were no political transitions of that type for that category of country.

a. Change of regime, from democratic to authoritarian or vice versa.

b. Replacement of one authoritarian regime by another one.

c. Change of party without a change in regime.

d. Change of head of government without a change in regime or party.

Source: Authors' calculations.

Table 6. *Estimates for Central Bank Vulnerability and Inflation, 1950–89*

<i>Explanatory variable</i>	<i>Estimation with six-month vulnerability index</i>		<i>Estimation with one-month vulnerability index</i>	
	<i>Dependent variable is transformed inflation, D</i>	<i>Dependent variable is standard deviation of D</i>	<i>Dependent variable is transformed inflation, D</i>	<i>Dependent variable is standard deviation of D</i>
Constant	0.046* (1.73)	0.019 (1.28)	0.054** (2.16)	0.020 (1.53)
Vulnerability (lag 0–1 months)	—	—	0.164*** (3.95)	0.106*** (4.79)
Vulnerability (lag 0–6 months)	0.092*** (2.89)	0.070*** (4.02)	—	—
Nonpolitical turnover (lag over 1 month)	—	—	0.158** (2.12)	0.108*** (2.73)
Nonpolitical turnover (lag over 6 months)	0.239*** (2.60)	0.108** (2.14)	—	—
High-level political change	0.312 (1.50)	0.237** (2.08)	-0.208 (1.04)	0.193* (1.83)
Type-2 authoritarian transitions	0.308 (1.38)	0.190 (1.56)	0.268 (1.24)	0.167 (1.45)
Medium-level political change	0.044 (0.65)	0.010 (0.27)	-0.029 (0.44)	0.003 (0.09)
Low-level political change	0.126* (1.72)	0.041 (1.02)	0.109 (1.53)	0.028 (0.74)
Dummy authoritarian only	0.030 (0.98)	0.023 (1.37)	0.016 (0.52)	0.017 (1.08)
Dummy first period (1950–1971)	-0.087*** (-4.53)	-0.021** (-2.02)	-0.083*** (-4.44)	-0.019* (-1.95)
Dummy developing countries	-0.007 (-0.26)	-0.005 (-0.32)	0.006 (0.22)	-0.001 (-0.10)
Number of observations	110	110	110	110
Adjusted R <sup>2</sup>	0.34	0.34	0.37	0.41

—Not available.

\* Significant at 10 percent level.

\*\* Significant at 5 percent level.

\*\*\* Significant at 1 percent level.

Note: *t*-statistics are in parentheses.

Source: Authors' calculations.

#### IV. EFFECTS OF CENTRAL BANK VULNERABILITY ON THE ECONOMY

Besides being of independent interest, measures of central bank autonomy are useful for testing the effect of this autonomy, or its absence, on the economy. Such a project is largely beyond the scope of this article. Nevertheless, this section and the next briefly report evidence on the relation between some of our measures and the performance of the economy as reflected by inflation, real growth, and real interest rates.

Each of these variables is regressed in a pooled cross-sectional time series on central bank vulnerability, on nonpolitical turnover, and on other control variables. Nonpolitical turnover is measured as the average number of nonpolitical changes of central bank governor (more than one month or more than six months after the latest political transition) per year.

##### *Inflation*

Previous work has shown a significant positive relationship between inflation or the rate of depreciation in the real value of money ( $D$ ) and the (total) turnover of central bank governors for developing economies (Cukierman, Webb, and Neyapti 1992: tab. 7; Cukierman 1992: tab. 20.2).<sup>7</sup> Table 6 here extends the effort by relating  $D$  and its standard deviation to the index of vulnerability, nonpolitical turnover, various types of political instability, and three dummies: one for the Bretton Woods era, one for having only authoritarian regimes in the period, and one for being a developing country. This formulation makes it possible to evaluate the relative importance of lack of central bank autonomy and of political instability for the creation of inflation. Table 6 shows results with the zero-to-one-month and zero-to-six-month measures of vulnerability, and the results are very similar for the two different measures. The regressions in table 6 back the view that the first channel is more important.

The political vulnerability of the central bank as well as nonpolitical turnover at the bank have a positive and significant impact on inflation ( $D$ ) and its variability. Political instability, particularly of the high-level sort, contributes to increased inflation variability. Low-level political instability has a marginally significant effect in raising the level of inflation. Medium-level political instability—alternation between parties (in a democracy)—has essentially zero effect on inflation, probably because frequent transitions of this sort require fundamental consensus on policy issues. Also, worldwide inflation is lower during the Bretton Woods period, even after allowing for the effect of other variables. This is consistent with the view that fixed exchange rates have a stronger disciplinary effect on policy than flexible rates do. But the higher worldwide inflation after 1972 may also be the result of the larger shocks that affected the world economy in the post-Bretton Woods period. The insignificant authoritarian-only dummy means that having an authoritarian rather than a democratic

7.  $D = \pi/(1 + \pi)$ , where  $\pi$  is the annual inflation rate.

regime throughout does not help to explain differences in average inflation, once the central bank and political variables are taken into account. A dummy is not needed for mixed-regime countries, because the variable for high-level political changes is nonzero only in mixed-regime countries.

The most important result in table 6 is the insignificance of the dummy variable for developing economies. Inflation is significantly higher on average in developing economies, and this could not have been accounted for by just looking at the overall frequency of turnover at the central bank (Cukierman, Webb, and Neyapti 1992). Once turnover is disaggregated into its constituent parts, however, and account is taken of the different types of political instability, the distinction between developing and industrial economies no longer contributes to explaining differences in inflation outcomes. In other words, the differences in vulnerability of the central bank to political instability, in central bank turnover in nonpolitical periods, and in political instability can fully account for the developing economies having higher average inflation than industrial economies.

### *Growth*

Recent empirical literature on growth has identified several variables, such as initial gross domestic product (GDP) and education, that are significantly related to real growth (see Barro 1991, for example). Does the degree of anti-inflation commitment by the monetary authorities, for which our indexes of central bank autonomy are a proxy, have any significant impact on growth after controlling for these variables? Table 7 answers this question by presenting growth equations that take account of initial GDP, initial primary and secondary education enrollment ratios, a decade-by-decade change in terms of trade, and our indexes of central bank autonomy. With a full sample of countries, nonpolitical turnover of central bank governors has a marginally significant positive sign, contrary to priors. Brazil, Korea, and Botswana are outliers, however, because they achieved high growth despite high rates of central bank turnover and high vulnerability. With those countries excluded, the six-month vulnerability indicator has a significantly negative sign.<sup>8</sup> This finding supports the view that, other things being equal, higher political dependence of the central bank tends to retard growth in most countries. It is possible that political vulnerability of the central bank is a proxy for general economic and political instability, both of which deter growth, possibly by slowing down investment and innovation. There is some evidence that in developing countries, higher central bank vulnerability is associated with lower levels of investment (Cukierman and others 1993). Sorting out the channels through which political vulnerability of the central bank affects growth clearly deserves further work.

8. Botswana could legitimately be discarded from the sample, because its growth was primarily due to the discovery of diamonds, not to good macroeconomic policy. Brazil and Korea seem to be simply countries where lack of central bank autonomy was not a hindrance to growth, at least not in the period covered here. Further justification for the exclusion of these countries appears in Cukierman and others (1993).

Table 7. *The Impact of Central Bank Vulnerability and Nonpolitical Turnover on Economic Growth, 1960–88*

Explanatory variable	Estimate	
	Full sample	Sample minus three <sup>a</sup>
Constant	-0.15 (-0.15)	0.73 (0.77)
Initial GDP	-0.22** (-2.46)	-0.25*** (-2.83)
Change in terms of trade	28.9*** (4.87)	28.1*** (5.01)
Initial primary education enrollment ratio	2.03** (1.98)	2.53*** (2.55)
Initial secondary education enrollment ratio	1.59 (1.22)	1.34 (1.04)
Nonpolitical turnover of central bank governors	5.80* (1.80)	-2.39 (-0.66)
Political vulnerability of central bank	-0.78 (-1.15)	-1.51** (-2.30)
Dummy for the 1960s	1.69*** (3.01)	1.42*** (2.61)
Dummy for the 1970s	1.39*** (2.74)	1.11** (2.26)
Number of observations	129	120
Adjusted R <sup>2</sup>	0.23	0.26

\* Significant at the 10 percent level.

\*\* Significant at the 5 percent level.

\*\*\* Significant at the 1 percent level.

Note: The sample consists of, at most, three observations (one for each decade) for each country. The estimated equation is a pooled cross-sectional time-series regression. The dependent variable is real per capita GDP growth. Central bank vulnerability is characterized in terms of changes in central bank governors that occur within six months of a political transition. *t*-statistics are in parentheses.

a. Botswana, Brazil, and the Republic of Korea are excluded.

Source: Authors' calculations.

### *Real Interest Rates on Deposits*

Previous evidence (Alesina and Summers 1993; Cukierman and others 1993) suggests there is a negative relation between the variability of ex post real interest rates and central bank independence. In our work, we have used as proxies for central bank independence the bank's legal independence for industrial economies and the bank's turnover of governors for developing economies. We now reexamine the relation between central bank independence and real interest rates by using central bank vulnerability and nonpolitical turnover as proxies for a lack of central bank independence. The second column of table 8 presents the effect on the variability of real rates. It appears that both central bank vulnerability and nonpolitical turnover significantly increase the variability of ex post real deposit rates. This further supports and amplifies the conclusion that the variability of ex post real deposit rates is lower in countries with more independent central banks. Although it has the expected negative sign, the coefficient on legal independence is not significant.

Table 8. *The Impact of Alternative Measures of Central Bank Autonomy on the Ex Post Real Deposit Rate*

Explanatory variable	Estimate	
	Dependent variable is real ex post deposit rate, R	Dependent variable is standard deviation of R
Constant	1.98 (0.64)	1.04 (0.3)
Vulnerability (lag 0-6 months)	-5.56* (-1.89)	8.68** (2.1)
Nonpolitical turnover (lag more than 6 months)	-1.98 (-0.15)	36.24*** (3.0)
Legal independence of central bank	-3.26 (-0.48)	-5.60 (-0.7)
Number of observations	34	34
Adjusted R <sup>2</sup>	0.05	0.52

\* Significant at the 10 percent level.

\*\* Significant at the 5 percent level.

\*\*\* Significant at the 1 percent level.

Note: *t*-statistics are in parentheses.

Source: Authors' calculations based on data from Easterly, Rodriguez, and Schmidt-Hebbel (1992), Cukierman, Webb, and Neyapti (1992), and Cukierman (1992: ch. 19).

The first column in table 8 relates the average level of the ex post real deposit rate to measures of central bank independence. The higher the political vulnerability of the central bank, the lower the average real deposit rate, which corroborates a similar finding in Cukierman and others (1993). The effect of lowering the real deposit rate probably reflects the higher implicit taxation of financial savings in countries with more politically dependent central banks.

#### V. CENTRAL BANK INDEPENDENCE AND THE MEAN AND THE VARIABILITY OF INFLATION

The strong cross-country association between the mean and the variability of inflation is a well-known empirical regularity. When legal independence and the total turnover of central bank governors are used as proxies for central bank independence, up to a quarter of this association is accounted for by their common association with central bank independence (Cukierman 1992: ch. 18, 22). For this article, the same experiment was repeated with central bank vulnerability and nonpolitical turnover as indexes of central bank autonomy. Legal independence was added as a regressor in industrial economies. To calculate the fraction of the correlation between the mean and the standard deviation of inflation that results from their common association with central bank independence, we proceeded as follows. First, the cross-sectional covariance between *D* (the rate of depreciation in the real value of money) and its standard deviation was calculated. Second, both *D* and its standard deviation were regressed on central bank vulnerability, nonpolitical turnover, and (for industrial economies)

legal independence. The predicted values of  $D$  and of its standard deviation were also calculated. Third, the covariance between those predicted values was calculated and compared with the overall covariance between  $D$  and its standard deviation.

The experiment was done for the entire 1950–89 period and for the subperiods 1950–71 and 1972–89. The fractions of the covariability between  $D$  and its standard deviation that are the result of their mutual link to central bank independence are 0.30 for the whole period and 0.40 and 0.31 for the two subperiods. Thus, with the more refined measures of central bank autonomy presented in this article, about one-third of the association between inflation and its variability is attributable to their common association with central bank independence.

## VI. CONCLUDING REMARKS

Stability and other characteristics of government institutions have always been recognized in economic history and in country studies as crucial determinants of macroeconomic stability. Recently this recognition has spread to theoretical work on macroeconomics and has been the focus of some cross-country statistical analysis (Fischer 1991; Edwards and Tabellini 1991; Cukierman, Edwards, and Tabellini 1992; Alesina and others 1995; Haggard, Kaufman, and Webb 1992). A survey appears in Alesina and Perotti (1994). As one would expect, political instability is positively related to inflation and negatively related to growth. There are various theories for how political instability causes macroeconomic instability, most of them not mutually exclusive. One contender is that political instability shortens time horizons of policymakers and that it decreases the ability of the political system to efficiently resolve disputes over real incomes.

This article has demonstrated that political instability causes instability at the central bank as well. But the spillover from political instability to instability at the central bank varies across country groups and types of political transitions. It is particularly large when the political regime changes from democratic to authoritarian or vice versa. This finding supports the view that when political change is deep enough to involve fundamental rules of the game and in other circumstances where political change would probably mean the party in power would not be back soon, if ever, then the expected effect of greater political instability would be shortened time horizons, as discussed above, and therefore less autonomy and stability for the central bank. Each new government would want to use the central bank to try to stay in power as long as possible and would have little concern for the associated detrimental longer-run effects. However, greater frequency of low- and medium-level political change, such as just changing the head of government or the party, does not on average lead to reduced central bank autonomy as proxied by its political vulnerability. Actually, in democratic governments in which the party changes frequently, the ruling party might typically lack the strength to impose its will unilaterally and

might thus agree to a compromise that would endure changes of party. This was explicit in the setup of the reformed Chilean central bank in 1989 (Arriagada and Graham 1994). An analysis of the effect of political instability on central bank independence in countries with democratic and stable rules of the political process appears in Cukierman (1994).

An important issue for future work is the possibility of reverse causality between the performance of the economy and our measures of gross political influence on the central bank. The largely cross-sectional nature of the variables in this article precludes the use of Granger-Sims and other methods to test the exogeneity of our measures of political instability with respect to the performance of the economy. Hence, strictly speaking, it is possible that some of the significant relationships between these two groups of variables are due to causality running from the economy to political influence. This is probably less likely to be the case for real interest rates than for real growth. There is evidence that real growth is affected by political instability (Barro 1991; Alesina and others 1995) which may, in turn, cause instability at the central bank.

The measure of central bank vulnerability, however, is more likely to be exogenous with respect to the economy than other behavioral indexes of political influence on the central bank. Even if political instability responds to the performance of the economy, vulnerability—defined as the ratio between instability at the central bank and political instability—depends on slowly changing institutions and sociopolitical norms, and thus may be largely exogenous to the current economic performance.

Because the main contribution of this article is in the extraction of empirical regularities by matching two new data sets, our approach has been inductive rather than deductive. We deliberately avoided committing to and testing a particular model because we believe that at this early stage the broad regularities in the data can be uncovered more efficiently without positing a particular model. Our hope is that the regularities uncovered here will encourage the construction of more precise models and further empirical testing of hypotheses.

Table A-1. Political Vulnerability of Central Banks for Individual Economies by Subgroup, 1950-71 and 1972-89

Economy	1950-71				1972-89			
	Vulnerability (within six months)	Number of political transitions	Number of central bank turnovers		Vulnerability (within six months)	Number of political transitions	Number of central bank turnovers	
			Total	Nonpolitical			Total	Nonpolitical
<i>Industrial, democratic</i>								
Sweden	0.000	1	2	2	0.500	4	4	2
Ireland	0.000	5	3	3	0.286	7	3	1
Japan	0.200	5	4	3	0.222	9	4	2
Belgium	0.000	9	2	2	0.167	6	3	2
Switzerland	0.059	17	2	1	0.167	18	3	0
Finland	0.105	19	3	1	0.125	8	2	1
Italy	0.071	14	1	0	0.077	13	2	1
Australia	0.333	3	1	0	0.000	3	3	3
Austria	0.000	4	3	3	0.000	2	3	3
Canada	0.000	3	2	2	0.000	4	2	2
Denmark	0.143	7	2	1	0.000	4	0	0
Germany, Fed. Rep.	0.333	3	2	1	0.000	2	2	2
United Kingdom	0.000	6	2	2	0.000	3	2	2
Iceland	0.000	3	1	1	0.000	7	0	0
Netherlands	0.143	7	1	0	0.000	3	1	1
New Zealand	0.250	4	2	1	0.000	5	4	4
Norway	0.000	6	2	2	0.000	7	1	1
United States	0.000	4	2	2	0.000	4	3	3
<i>Industrial, mixed</i>								
France	0.056	18	2	1	0.500	2	4	3
Spain	n.a.	0	5	5	0.167	6	3	2
<i>Developing, authoritarian</i>								
Egypt	0.000	3	8	8	1.000	1	4	3
Mexico	0.250	4	2	1	0.667	3	4	2
China					0.500	2	4	3

(Table continues on the following page.)

Table A-1. (continued)

Economy	1950-71				1972-89				
	Vulnerability (within six months)	Number of political transitions	Number of central bank turnovers		Vulnerability (within six months)	Number of political transitions	Number of central bank turnovers		
			Total	Nonpolitical <sup>a</sup>			Total	Nonpolitical <sup>a</sup>	
South Africa	0.000	4	2	2	0.500	2	3	2	
Taiwan (China)	0.000	3	2	2	0.500	4	2	0	
Ethiopia	n.a.	0	0	0	0.400	5	5	3	
Hungary	—	—	—	—	0.333	3	2	1	
Yugoslavia (former)	n.a.	0	5	5	0.100	10	4	3	
Kenya	n.a.	0	2	2	0.000	1	2	2	
Morocco	0.167	6	4	3	0.000	4	2	2	
Romania	—	—	0	0	0.000	1	3	3	
Tanzania	n.a.	0	1	1	0.000	1	2	2	
Uganda	—	—	0	0	0.000	4	2	2	
Indonesia	1.000	1	5	4	—	0	3	3	
Qatar	—	—	0	0	—	0	0	0	
Singapore	n.a.	0	1	1	n.a.	0	6	6	
Zaire	0.000	1	2	2	—	0	4	4	
<i>Developing, democratic</i>									
Botswana	—	—	—	—	1.000	1	6	5	
Costa Rica	0.400	5	10	8	0.750	4	11	8	
Malta	0.000	1	1	1	0.500	2	5	4	
Jamaica	1.000	1	3	2	0.333	3	7	6	
West Samoa	—	—	—	—	0.333	3	3	2	
Barbados	—	—	—	—	0.000	4	2	2	
Israel	0.000	3	2	2	0.000	6	3	3	
Bahamas	—	—	—	—	n.a.	0	3	3	
<i>Developing, mixed</i>									
Argentina	1.714	7	20	8	1.111	9	16	6	
Brazil	0.500	8	9	5	1.000	5	11	6	

Chile	0.750	4	6	3	1,000	1	12	11
India	0.000	2	6	6	0.667	6	7	3
Korea, Rep. of	n.a.	0	2	2	0.667	3	6	4
Peru	0.333	6	11	9	0.667	3	6	4
Uruguay	1.000	2	6	4	0.600	5	6	3
Colombia	0.167	6	5	4	0.500	4	3	1
Poland	0.000	1	0	0	0.500	6	6	3
Venezuela	0.167	6	5	4	0.500	4	7	5
Honduras	0.200	5	2	1	0.400	5	3	1
Portugal	0.000	1	4	4	0.385	13	7	2
Turkey	0.600	5	7	4	0.273	11	7	4
Greece	0.053	19	2	1	0.250	8	5	3
Ghana	0.000	4	2	2	0.200	5	4	3
Nigeria	0.000	2	2	2	0.200	5	3	2
Nepal	0.250	4	3	2	0.143	7	3	2
Panama	1.500	2	4	1	0.125	8	2	1
Thailand	0.250	4	4	3	0.111	9	3	2
Malaysia	0.000	3	0	0	0.000	2	2	2
Pakistan	0.167	6	4	3	0.000	3	5	5
Philippines	0.000	4	3	3	0.000	2	2	2

—Not available. Vulnerability is not available when data on either the number of political transitions or the number of central bank turnovers are not available.  
n.a. Not applicable.

Note: Within each subgroup, central banks are arranged in descending order of vulnerability during the 1971-89 subperiod.

a. The nonpolitical turnover is defined as the number of changes in the governor of the central bank that occurred more than six months after a political transition.

Sources: Authors' calculations.

APPENDIX. TESTS FOR THE DETERMINATION OF THE CUTOFF BETWEEN  
POLITICAL AND NONPOLITICAL PERIODS

To test for possible differences between the probability of a change of central bank governor in the ten-month-or-more intervals and in each of the other intervals in table 1, we use the normal approximation to the binomial distribution. More specifically, let  $c_i$  be the number of changes of central bank governor in interval  $i$  following a political transition. As in table 1,  $i$  may assume the interval values (0-1), (2-3), (4-6), (7-9), and (10 or more). We denote each of these intervals by its lower bound. Thus  $i$  assumes the values 0, 2, 4, 7, and 10. Let  $n_i$  be the number of intervals of type  $i$  in the sample. This number is determined by the total number of political transitions in the sample. The frequency of central bank governor changes within interval  $i$  is given by

$$(A-1) \quad f_i = c_i/n_i \text{ for } i = 0, 2, 4, 7, 10.$$

Let  $P_i$  be the true conditional probability of a change of central bank governor in interval  $i$  following a political transition. The null hypotheses to be tested are

$$(A-2) \quad H_0: P_i = P_{10} \text{ for } i = 0, 2, 4, 7$$

against each of the alternative hypotheses that  $P_i$  is significantly larger than  $P_{10}$ . The specification of the alternative hypotheses accommodates the possibility that the probability of a turnover at the central bank is larger at shorter lags following a political transition. Under each of the null hypotheses the values

$$(A-3a) \quad z_i = \frac{f_i - f_{10}}{\sqrt{\bar{f}_i(1 - \bar{f}_i) \left[ \frac{1}{n_i} + \frac{1}{n_{10}} \right]}}, \quad i = 0, 2, 4, 7$$

where

$$(A-3b) \quad \bar{f}_i = \frac{c_i + c_{10}}{n_i + n_{10}}, \quad i = 0, 2, 4, 7$$

have approximately a standard normal distribution, provided both  $n_i$  and  $n_{10}$  are larger than 30.<sup>9</sup> (See, for example, Huntsberger, Croft, and Billingsley 1980: 302.) The null hypotheses should be accepted for small values of the  $z_i$ 's and rejected for large positive  $z_i$ 's. Table A-2 displays these statistics.

9. These conditions are always satisfied for the entire sample of economies and the two main subsamples. For  $i = 0, 2$ , the terms  $n_i$  and  $n_{10}$  are the numbers of two-month periods in the appropriate intervals. For  $i = 4, 7$ , they refer to the number of three-month periods. This variation in the length of the basic time unit is introduced to make its length identical to the number of months within each interval (two months for  $i = 0, 2$  and three months for  $i = 4, 7$ ). In either case, the value of  $n$  is sufficiently large to make the normal approximation to the binomial valid.

Table A-2. Values of the Test Statistic  $Z_i$  for the Null  $H_0: P_i = p_{10}$ 

Economy group	Interval (number of months)			
	0-1	2-3	4-6	7-9
All economies	12.0	2.8	2.9	-0.6
Industrial	3.2	-0.2	1.1	-1.6
Developing	13.0	4.0	3.3	-0.7

Note: Sample size is sixty-seven economies.

Source: Authors' calculations.

Because a  $z_i$  of 1.96 implies that the null is rejected at the 0.05 level, we conclude that the probabilities of a turnover at the central bank are significantly larger for the 0-1, 2-3, and 4-6 intervals than for the 10-or-more intervals. However, there is no significant difference in the probability of a change of central bank governor between the seven-to-nine-month and the ten-or-more-month intervals. The evidence in table A-2 therefore supports the conclusion that for the whole sample the cutoff between political and nonpolitical periods occurs at a lag of six months following a political transition. Accordingly, we define periods of up to six months following a political transition as political and periods seven or more months after the latest political transition as nonpolitical. The respective frequencies are 0.037 and 0.015, respectively. The  $z$  statistic testing the significance of the difference between these two estimated probabilities is a huge 9.6.

A replication of these tests separately for each of the two economic categories of countries reveals that for developing countries the appropriate cutoff between political and nonpolitical periods is still at the upper end of the 4-6 interval. For developing economies the  $z$  statistic also very significantly rejects the null hypothesis that the frequency within the entire period of zero to six months is no different from the frequency in periods that are seven or more months after a political transition.

In the industrial economies, the probability of a change at the central bank in the 0-1 interval is significantly higher than in the 10-or-more interval. The frequencies in the two-to-three-month, four-to-six-month, and seven-to-nine-month intervals, however, are not significantly different from frequencies in the 10-or-more interval. Thus, for industrial economies we should locate the cutoff between political and nonpolitical periods after the 0-1 interval.

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