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Testing the satisficing version of the political business cycle 1905–1984*

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Abstract. This paper develops a test of the satisficing version of the political business cycle. Previous tests have focused on maximizing models of political behavior and are not sufficiently general to test for satisficing behavior. Using annual U.S. data for the period 1905 to 1984, we find evidence supporting the satisficing version of the political business cycle model, but we reject the maximizing version. In accordance with the satisficing hypothesis, we find that increasing inflation or unemployment and decreasing monetary base growth in the third year of a presidential term are followed typically by reversals during the election year.

1. Introduction

Does knowing the date of the next Presidential election improve the forecast of economic variables? According to Nordhaus (1975) and MacRae (1977) the answer is 'yes' because incumbent politicians have a singular interest in gaining reelection. These politicians have no misgiving in manipulating the economy so as to create better economic outcomes in the sense of currently observed phenomena before elections. Assuming a myopic public and an economic structure described by a stable Phillips Curve, the incumbent is able to maximize reelection chances by choosing the vote-maximizing combination of inflation and unemployment.[1] This is the essence of the political business cycle (PBC). PBCs imply that knowledge about the dating of the next election can improve forecasts of economic variables such as inflation, unemployment and output. This political behavior also implies cycles in policy variables such as the monetary base. Recently, Rogoff and Sibert (1988) and Laechler (1984), among others, have shown that political business cycles can arise even if voters are not myopic and form expectations rationally.

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Let X be a variable the politician wants to influence for reelection purposes, e.g., the rate of unemployment. Most empirical tests of PBC in the literature follow McCallum's (1978) basic approach and assume that X follows a stationary autoregressive (AR) process. Restricting this process to an AR(1) for illustration purposes, the relevant test equation is stated as:

$$X_t = B_0 + B_1 X_{t-1} + B_2 V_{4t} + \epsilon_t, \tag{1}$$

where the Bs are fixed parameters, ϵ_t is a zero-mean stochastic variable uncorrelated with its own past and with X_{t-1}, and V_{4t} is an electoral cycle dummy variable with $V_{4t} = 1$ if t is an election year and $V_{4t} = 0$ otherwise. The test for PBC – i.e., that politicians keep X low in election years – is a test B_2 is strictly negative. If so, the mean of X shifts downward in every election year, which is consistent with PBC.

Using this methodology Richards (1986), Pack (1987), and Keil (1988), among others, find evidence in favor of PBC. In most instances, the political business cycle applies more to the behavior of policy instruments than policy targets. Other researchers, on the other hand, find no evidence of PBC (e.g., McCallum, 1978; Dinkel, 1981; Beck, 1982a,b; Hibbs, 1986, 1987). More recently, several authors have objected to tests based on equation (1) on the ground that it ignores partisanship.[2]

An important aspect of tests based on equation (1) is that they impose the same politically induced behavior across all business cycles. This assumption reflects the "maximizing" view of the politician who is portrayed as wanting to reduce X as much as possible in every election year without any regard to the more or less recent history of the economy and X itself. In this paper we propose, instead, a test of PBC based on an alternative behavioral hypothesis. Our reference points are the works by MacRae (1977), Frey and Schneider (1978a,b, 1983), Hibbs (1987) and Schneider and Frey (1988) who argue that politicians "satisfice." According to Schneider and Frey (1988: 258–259) a government satisfices because it is unable to solve "a dynamic maximization problem of when to undertake what kind of (fiscal) policy action in order to maximize utility." If its popularity is high, the government pursues its ideological goals; if its popularity is low, it concentrates on securing reelections. That is, politicians attempt to affect macroeconomic variables before election time *only if previous macroeconomic outcomes threaten their political popularity and their reelection chances.* According to this hypothesis, we would neither observe PBC behavior necessarily every four years, nor would the intensity of PBC behavior be constant across electoral periods. Consequently, equation (1) is not sufficiently general to test the satisficing version of PBC.

In this paper we propose a suitable test of the satisficing version of PBC and apply it to annual U.S. data covering 20 electoral cycles from 1905 to 1984. In

Section 2 we develop the test equation of the satisficing model and contrast it to that of the maximizing version of PBC. In Section 3 we empirically test the model by nesting both maximizing and satisficing versions of the PBC. Summary and conclusions are in Section 4.

2. Satisficing behavior

2.1 *Satisficing versus maximizing PBC*

According to maximizing behavior, politicians would lower X, say the unemployment rate, every four years. In contrast, according to satisficing behavior, they would attempt to lower X only in those elections years which follow years of politically unacceptable unemployment performance. Furthermore, they would lower X the more, the less acceptable its performance had been previously. The occurrence of opportunistic economic policies is therefore conditional on the history of the variable X.

Figure 1 illustrates the main differences between the maximizing and the satisficing versions of PBC. Line M in the top panel depicts a time path of our variable according to maximizing behavior. Unemployment falls every fourth year and rises every first year of the election cycle. The average fourth-year realization is lower than the average across all remaining years, which is the hypothesis behind equation (1). Line S in the same panel depicts a satisficing version of PBC. Here, we define as politically unacceptable a rise in the unemployment rate in the third year of the electoral cycle. Therefore, the unemployment rate falls due to opportunistic policies in the fourth year only if it rose in the third year. The satisficing politician's behavior thus depends on the previous direction of change in the unemployment rate. The figure shows three election cycles under this hypothesis. In the first cycle, the unemployment rate is not considered a political threat in the fourth year, because it fell in the third year. In the second cycle, the unemployment rate rises by a small amount during the third year. The satisficing politician reacts by lowering X by a similarly small amount during the election year. In the third cycle, the unemployment rate rises by a large amount during the third year. This triggers a strong reaction by the politician in the fourth year, so that X falls by a large amount.

Alternatively, we may define as politically unacceptable an unemployment rate exceeding a critical threshold rate. This leads to the picture of the lower panel of Figure 1. Here, the politician tries to lower X in the fourth years of the first two cycles, because the rate exceeded the threshold rate in the respective third years. In contrast, he makes no attempt to manipulate X in the third cycle.

The two examples show that satisficing behavior has no implications for the

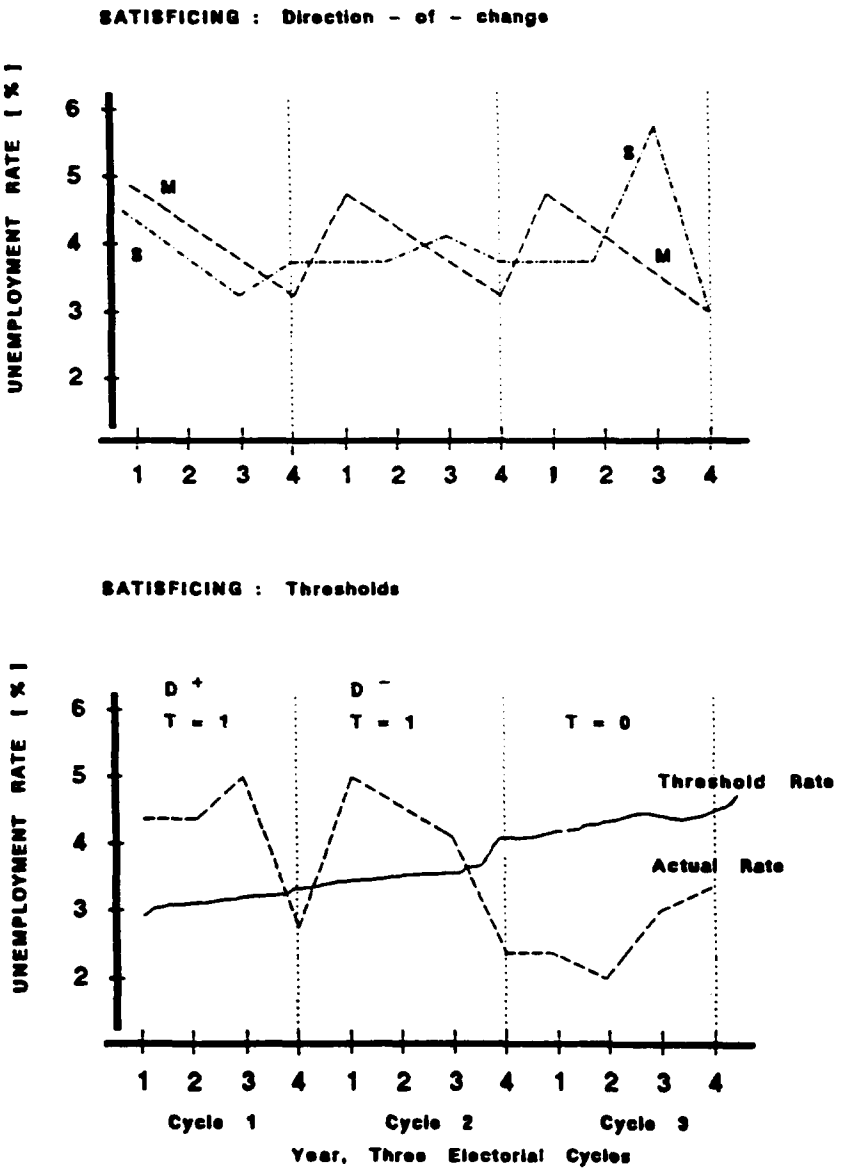

Figure 1. Satisficing versus maximizing version of the PBC.

average fourth year of the election cycle as compared to the remaining years. The satisficing version of PBC may hold even though the average fourth year is not statistically different from the average over the other years. Consequently, tests based on equation (1) are inadequate to detect PBCs if politicians satisfice. More information is required to discern "acceptable" and

"unacceptable" outcomes and identify election cycles in which satisficing PBC behavior would occur.

In a first empirical exercise, we examined 18 Presidential election cycles beginning with 1913 for casual evidence of satisficing behavior.[3] In 10 of those 18 cycles the unemployment rate in the third year exceeded its 10-year moving average rate. In 8 of those 10 cycles the unemployment rate fell in the fourth year.[4] As to the 8 cycles when the third-year unemployment rate was *below* its 10-year moving average, the fourth-year changes in the unemployment rate were evenly divided between 4 increases and 4 decreases. Similarly, the inflation rate was above its 10-year average in the third year ten times; six times it fell in the following year. If one accepts that an unemployment rate in excess of its 10-year moving average prompts incumbent Presidents to take corrective actions before elections, these outcomes can be interpreted as being compatible with satisficing behavior. Our more formal tests corroborate this interpretation.

2.2 *Statistical tests of the satisficing version of PBC*

There are three important aspects in the satisficing version of PBC. First, the unemployment rate need not fall in every fourth year. Hence, B_2 of equation (1) need not be significantly negative even if satisficing PBC holds. Second, the occurrence of PBC effects depends on the political acceptability of the recent history of the unemployment rate. The latter falls due to PBC considerations only if it is perceived to threaten the politician's survival. Finally, the strength of the PBC effect depends on past values of the unemployment rate. It follows that a forecast of the PBC effect in the fourth year involves more than a simple shift in the intercept.[5]

In light of this, a test of the satisficing model must allow that the coefficients of the model can change over time and PBC behavior can vary in intensity across cycles. We propose the following, general model:

$$X_t = B_0 + B_1 X_{t-1} + B_{2t} V_{4t} X_{t-1} + \epsilon_t, \tag{2}$$

where:

$$\begin{aligned} B_{2t} &= 0 \text{ if previous realizations of X were acceptable} \\ B_{2t} &< 0 \text{ if previous realizations of X were unacceptable} \end{aligned} \tag{3}$$

The specification of equation (3) captures the essence of the satisficing hypothesis: the politician manipulates X only after a bad outcome. Furthermore, the election-year effect is not constant, but depends on the past value of X.

2.3 *Tests using non-stationary series*

Like many other macroeconomic variables, the variables we use in this study exhibit non-stationarity and require differencing before subjecting them to statistical analysis. It should be noted, however, that while statistical requirements force us to redefine the variables, the hypothesis is stated in terms of levels of the variables. Our basic model in equations (2) and (3) needs to be adapted to differenced data.

To illustrate, let X be mean-stationary in the first difference and let us assume that the differenced series follows an AR(1) process described by equation (2):

$$\Delta X_t = B_1 \Delta X_{t-1} + B_{2t} V_{4t} \Delta X_{t-1} + \epsilon_t, \tag{4}$$

The level of X_t, therefore, varies according to:

$$X_t = B_0 + X_{t-1} + B_1 \Delta X_{t-1} + B_{2t} V_{4t} \Delta X_{t-1} + \epsilon_t. \tag{5}$$

According to (5), if the hypothesis is that the politician wishes to decrease the value of X_t, the coefficient B_{2t} must be negative or positive depending on whether ΔX_{t-1} is positive or negative.

To implement the test, we need to define our empirical criterion of political unacceptability. We use two specifications.

(i) *Direction-of-change test*: The satisficing politician takes actions to lower X in the fourth year in response to a change in X occurring in the third year of the electoral cycle. Using again the unemployment rate as an example, the unacceptable outcome is defined by an increase in the unemployment rate in the third year. We define the following auxiliary variables:

$$D^+_{t-1} = \begin{cases} \Delta X_{t-1} \text{ if } \Delta X_{t-1} > 0 \\ 0 \qquad\quad \text{otherwise} \end{cases} \tag{6}$$

$$D^-_{t-1} = \begin{cases} -\Delta X_{t-1} \text{ if } \Delta X_{t-1} < 0 \\ 0 \qquad\quad \text{otherwise} \end{cases} \tag{7}$$

With these definitions we can rewrite equation (5) as

$$X_t = B_0 + X_{t-1} + B_1 \Delta X_{t-1} + B_{21} V_{4t} D^+_{t-1} + B_{22} V_{4t} D^-_{t-1} + \epsilon_t \tag{8a}$$

By construction D^+ and D^- are both positive. The satisficing version of PBC implies that restrictions $B_{21} = 0$ and $B_{22} < 0$, whereas the restrictions implied by the maximizing version are $B_{21} = B_{22} < 0$. Therefore, we can use (8a) to

test the satisficing version of PBC against the alternative hypotheses of no PBC or maximizing PBC.

(ii) *Threshold test*: The politician takes action to lower X in the fourth year if the level of X falls below (or above, depending on the variable) an acceptable level. We assume that the acceptable level is given by a moving average over recent years. Let the auxiliary variable be:

$$T_t = \begin{cases} 1 \text{ if } X_{t-1} > \text{moving average of X} \\ 0 \text{ otherwise} \end{cases}$$

To facilitate the interpretation of the threshold test refer to the third electoral cycle in the lower panel of Figure 1 where the unemployment rate is below its threshold and, hence, $T_t = 0$. In contrast, $T_t = 1.0$ in the first two presidential cycles. In turn, when $T_t = 1.0$, two mutually exclusive events can emerge: either $\Delta X > 0$ (first electoral cycle) or $\Delta X \leq 0$ (second cycle). Consequently, variable T_t always must appear jointly with D:

$$X_t = B_0 + X_{t-1} + B_1 \Delta X_{t-1} + B_{21} T_t V_{4t} D^+_{t-1} + B_{22} T_t V_{4t} D^-_{t-1} + \nu_t \quad (8b)$$

If X is less than its moving average in the year before election, there will be no election effects. If, however, X in year 3 exceeds its moving average, then PBC behavior in year 4 is predicted. Variables D^+ and D^-, in conjunction with T, test whether or not threshold effects depend on the sign of *changes* of X in the previous year. If, for example, $B_{21} = B_{22}$ and both are negative, then threshold effects work regardless of the sign of past changes in X. If $B_{21} < 0$ and $B_{22} = 0$, then we cannot distinguish threshold from direction-of-change effects: satisficing behavior cannot be rejected but the threshold version adds nothing to the direction-of-change version of the model.

3. Empirical tests

This section tests the maximizing version and the two satisficing versions of PBC. We apply our tests to four U.S. variables: the unemployment rate, the inflation rate, the growth rate of real per-capita GNP, and the growth rate of the monetary base. The data have an annual frequency and were transformed appropriately to be used in regression analysis. For details refer to the Appendix. We begin by estimating benchmark time series models under the assumption of no PBC effects. Next, we use the residuals of these models in an omitted variables test to evaluate if PBC effects are significant. Finally, we estimate time series models of the form of equations (8a) and (8b) to characterize PBC effects.

Table 1. Benchmark ARIMA models. Annual data 1905–1984

Variable	Model	AIC	SE	Q(6)	x_1	x_2	x_3
Real GNP	$x_{1t} = .29x_{1t-1} + e_{1t}$ (2.7**)	−333.7	.03 (5)	6.0 (1)	.1 (1)	.2 (1)	2.7 (1)
Unemployment	$\Delta x_{2t} = -.32\Delta x_{2t-2} + e_{2t}$ (2.9**)	−19.5	.21	2.8 (5)	.8 (1)	.9 (1)	.2 (1)
Inflation	$\Delta x_{3t} = -.38\Delta x_{3t-2} + e_{3t}$ (3.6**)	−293.6	.034	8.2 (5)	.3 (1)	3.0 (1)	.1 (1)
Monetary base	$\Delta x_{4t} = -.26\Delta x_{4t-2} + e_{4t}$ (2.3*)	−342.2	.026	5.8 (5)	2.0 (1)	.7 (1)	.0 (1)

Notes. AIC is Akaike's measure of entropy; SE is the estimated standard error; Q(6) is the Box-Ljung portmanteau statistic for serial correlation of the residuals estimated at lag 6. χ_1 is White's (1980) statistic for heteroskedasticity before and after 1947; χ_2 and χ_3 are the LM statistics for structural breaks in the coefficients in 1947 and 1913, respectively. Q(6) and χ_1 through χ_3 are all Chi-square distributed under their nulls, with their degrees of freedom as indicated in parentheses. Numbers in parenthesis below model coefficients are absolute t-ratios with * and ** indicating 5% and 1% significance.

3.1 *Benchmark models and omitted variables tests*

The AR benchmark models for real per capita GNP (X_1), the unemployment (X_2), the inflation rate (X_3) and the monetary base (X_4) for the 1905 to 1984 time period are found in Table 1.

The structure of the models turned out to be relatively simple, being either AR1 or AR2. The residuals leave no trace of significant autocorrelation.

The residuals of the benchmark models are now used in an omitted variables test to identify PBC effects. Let the estimate of X be given by

$$\Delta X_t = \hat{B}_1 \Delta X_{t-1} + \hat{\epsilon}_t. \tag{9}$$

The test for the threshold version of satisficing PBC is

$$\hat{\epsilon}_t = a_0 + a_1 \Delta X_{t-1} + a_2 V_{jt} T_{t-1} D^+_{jt-i} + a_3 V_{jt} T_{t-1} D^-_{jt-i} + u_t \tag{10a}$$

The subscripts j and i here are timing operators. A value of j = 3 or 4 means that PBC behavior is displayed in the third or fourth year of the election cycle. The subscript i refers to the time lag dating past changes in X or past deviations from threshold values with respect to year j. For example, in equation (10a)

$$\hat{\epsilon}_t = a_0 + a_1 \Delta X_{t-1} + a_2 V_{4t} T_{t-1} D^+_{3t-1} + u_t, \tag{11}$$

Table 2. Summary of LM tests of PBC

Variable	Test statistic[1]	Significant at lag $i = 1, \ldots, 4$	Conditional on previous change[2] $\Delta X_{t-i} \gtrless 0$	Year of election cycle $i = 3, 4$
Direction-of-change model: D^+, D^-				
Real GNP	No significant PBC effects			
Unemployment	4.4*	2	Positive	3
Inflation	3.7*	1	Positive	4
Monetary base	10.3**	2	Negative	3
	9.3**	4	Negative	3
Threshold model[3]: T				
Real GNP	No significant PBC effects			
Unemployment	6.9*	2		3
	4.2*	4		3
Inflation	3.4*	4		3
Monetary base	2.7*	1		4

Notes

1. The test statistic is the LM statistic for test regressions like (10a). It is Chi-square distributed with 1 degree of freedom in all cases. +, *, and ** denote significance at the 10%, 5%, and 1% levels, respectively.
2. In column 4 the term "positive" means the test uses $V_{jt}D^+$; negative means the test uses $V_{jt}D^-$ as the omitted variable.
3. Threshold values are four-year moving averages. Tests were also run using longer moving averages. Results did not differ substantially and are not reported here.

we would test the hypothesis that politicians reduce the unemployment rate in year 4 when they are faced with a *rise* in unemployment which puts its level in year 3 above its threshold value.[6] Similarly, the omitted variables test for the directions-of-change version of PBC is

$$\hat{\epsilon} = a_0 + a_1\Delta X_{t-1} + a_2 V_{jt} D^+_{jt-i} + a_3 V_{jt} D^-_{jt-i} + v_t \qquad (10b)$$

For all tests, the test statistic is the regression R^2 multiplied by the number of observations. The statistic follows a Chi-square distribution under the Null hypothesis with the number of degrees of freedom equal to the number of omitted variables tested.

Table 2 presents the results of the identification stage of both the direction-of-change and threshold versions of the satisficing model. As to the former – see the upper half of the table – here is the salient evidence:

(1) Increases in the inflation rate and the unemployment rate, with a lag of 1 or 2 years, have predictive content over the benchmark models for the

Table 3. Final time series models with PBC behavior

Variable	ARMA component	Direction of change variable	Threshold variable 4 year moving average	AIC	SE	Q6
Unemployment rate (X_2)	$-.24\Delta X_{2,t-2} + \epsilon_{2,t}$ (2.0*)	$-.68V_{3t}D^{+}_{t-2}$ (2.0*)	NA	−21.2	.210	1.8
	$-.25\Delta X_{2,t-2} + \epsilon_{2,t}$ (2.5*)	NA	$-.20V_{3t}T_tD^{+}_{t-2}$ (2.2*)	−24.7	.203	2.6
Inflation rate (X_3)	$\epsilon_{3t} - .53\epsilon_{3t-2}$ (5.3**)	$-.54V_{4t}D^{+}_{t-1}$ (2.7**)	NA	−315.7	.032	7.4
	$\epsilon_{3t} - .48\epsilon_{3t-2}$ (4.5**)	NA	$-.21V_{4t}T_tD^{+}_{t-1}$ (2.2*)	−304.6	.032	6.0
Monetary base (X_4)	None	$1.01V_3D^{-}_{t-2} - 1.03V_{3t}D^{+}_{t-2}$ (4.0**) (1.5)	NA	−350.0	.025	6.6
	$\epsilon_{4t} - .30\Delta X_{4,t-2}$ (2.7*)	NA	$-.15V_{4t}T_tD^{-}_{t-1}$ (1.8+)	−336.3	.026	3.8

Note. All terms are defined in the text. NA means not applicable. The t − i subscripts with D^+ and D^- indicate the lag with respect to j, where j is the subscript on V. Tests of structural change of the parameters in 1947 were rejected. Results are available from authors.

inflation rate and the unemployment rate near election (years 3 or 4).

(2) Decreases in the growth of the monetary base, with a lag of 2 or 4 years, add to the explanatory power of the growth of the monetary base near election (year 3).

(3) The growth of real per capita GNP does not display statistically significant PBC behavior.[7]

Similar conclusions hold for the threshold version of the satificing model – see lower half portion of Table 2. The strongest case for PBC behavior can be made for the unemployment rate. Here the findings suggest that if the unemployment rate in the first year of the election period exceeds its 4-year moving average, then it will change again in the year *before* (year three) elections.[8] The same is true for the inflation rate and the growth of the monetary base.

3.2 *Final time series models with PBC dynamics*

From the previous section we find that we cannot reject the Null hypothesis of no PBC effects for the growth rate of real per capita GNP; however, we do reject the hypothesis for the unemployment rate, the inflation rate, and the

growth of the monetary base. The rejections support both versions of the satisficing PBC model. We complete the presentation of our empirical findings by submitting in Table 3 the estimates of the models identified above.

The results in the table are generally consistent with the satisficing PBC. Consider the direction-of-change hypothesis first. The negative signs of the $V_{3t}D^{+}_{t-2}$ coefficient of the unemployment rate and the $V_{4t}D^{+}_{t-1}$ coefficient of the inflation rate indicate that these two variables *fall* the year before election, if they *increased* two years or one year before, respectively. The term $1.01V_{3t}D^{-}_{t-2} - 1.03V_{3t}D^{+}_{t-2}$ in the monetary base equation means that its direction of change in the year before election is opposite to that of the first year, regardless of how it changed previously.[9]

Threshold effects are also in evidence but they add little to our understanding of satisficing PBC behavior. While the estimated parameters are quantitatively different from the coefficients of the direction-of-change variables, the overall conclusion remains the same. The findings confirm that increases in the inflation and unemployment rates and contractions in the growth of the monetary base early in the electoral cycle are generally reversed later.

4. Summary and conclusions

This paper has considered the hypothesis of politicians acting as satisficers rather than maximizers. The bulk of the literature on the political business cycle has taken the view that politicians, at least in the United States, are unbending maximizers who manage key macroeconomic and policy variables with an eye on the timing of presidential elections. The empirical tests have employed static equations and searched for PBC effects which are constant across administrations and independent of the size and direction of past changes in the variables being tested.

If, on the other hand, politicians satisfice, then tests must be conducted with models that allow policy actions to respond to past economic events with varying intensity and only when these events threaten the reelection chances of the incumbent President. We propose such tests and conclude from our results that the satisficing version of PBC is consistent with 80 years of U.S. data. Because of the nested nature of the tests, our results imply that the maximizing version of PBC is refuted by the data. We find that increases in inflation and unemployment rates and decreases in the growth rate of the monetary base early in the presidential term, on average, are followed by reversals later in the term. Thus, the timing of the election, the size and the sign of previous changes of the variables are valuable information in that one can exploit them to improve simple ARMA model predictions. The threshold variant of the satisficing PBC model, which postulates that politicians react to critical levels rather than to

undesirable changes in variables, did not offer additional insights about the nature of PBC behavior.

In an empirical study of this kind, there is always the danger that the statistical significance of a coefficient results entirely from a few exceptional episodes in the sample. If true, it would obviously limit our message. To explore this issue, we counted the cases in which the critical PBC variables contributed to the actual estimation of the PBC effects. With regard to the direction-of-change criterion, we found six such instances out of twenty presidential cycles for the unemployment rate; seven for the inflation rate; and fourteen for the monetary base growth rate. For the threshold criterion, there were five cases for the unemployment rate; nine for the inflation rate; and twelve for the monetary base growth rate. In sum, our evidence is not anecdotal.

Do politicians manage the economy for reelection purposes? This is a difficult question to answer since one must be able to distinguish between what politicians try to do and what actually happens. While this paper does not explore the informational asymmetries between politicians and the public, our results suggest that key macroeconomic and policy variables behave in accordance with the satisficing version of PBC.

Notes

1. It is not our purpose to describe how governments affect real variables. In Davidson, Fratianni and von Hagen (1990) we review the PBC literature concerning the validity of the short-run Phillips Curve to describe the transmission mechanism from policy actions to the real economy. This literature encompasses, among others, McRae (1977) who emphasizes myopic behavior and Chappel (1983) who relies on "unsophisticated" voters. McCallum (1978), on the other hand, rejects both the PBC and the short-run Phillips Curve on the ground that voters form expectations rationally. Laechler (1984), Rogoff and Sibert (1988), Keil (1988), Richards (1986) and Grier (1989), among others, rely on informational deficiency in the economy to produce tradeoffs between inflation and unemployment.
2. Partisan theories stress that it is the incumbent's political party and not years until reelection which primarily determines economic outcomes. See Davidson, Fratianni, and von Hagen (1990). This paper empirically tests the interactions between PBC and Partisan theories. Chappel and Keech (1988), Havrilesky (1987), Alesina and Sachs (1988), Hibbs (1986, 1987) and Grier and Neiman (1987) find significant partisan effects in economic and policy variables. Grier (1987, 1989) and Haynes and Stone (1989, 1990) test for the presence of a cycle across the full election period. Grier (1987) finds that the monetary cycle does not vary across parties, whereas Haynes and Stone (1990) find that the unemployment cycle does.
3. A description of the data is provided in the Appendix. The first two Presidential periods (1905–1912) were employed for the computation of the 10-year moving average.
4. In one of the two other cycles the unemployment rate rose in both the third (1931) and fourth years (1932).
5. Where it not for this third aspect, equation (1) could be used to test the satisficing hypothesis by redefining V_{4t} to equal unity in those fourth years when political popularity is low.

6. In the context of time series analysis, equations (8a) and (8b) belong to the class of models with non-homogeneous dynamics (see Tiao and Grupe, 1980). For such models, Lagrange multiplier tests are used. In our case we test a particular partial autocorrelation coefficient of X. The results of this test should, therefore, be regarded similar to the usual identification stage of time series modeling.
7. Note that the test for the undifferenced GNP growth variable is based on the model in (2) and (3).
8. Threshold variables with longer lags than 4 years were tried. Results did not differ substantially from those presented here.
9. Of course the small t-value for D^+ implies less reliability for previous increases than for decreases in the rate of change of the annual monetary base.

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Appendix

Data

The sources for the rate of unemployment, the consumer price index and the per-capita real GNP are the *Historical Statistics of the United States: Colonial Times to Present*, the *Survey of Current Business* (various issues), and the *Economic Report of the President, 1986*. The unemployment rate from 1931 to 1943 comes from Darby (1976) and it is lower than the official statistics. For the monetary base up to 1975 we relied on Friedman and Schwartz (1982); after 1975 on the *Federal*

Reserve Bulletin and the *Annual Report of the Board of Governors of the Federal Reserve System*.

Since all four variables are percentage rates, we take a logic transformation of the rate of unemployment and transform the remaining ones (which can be negative) as $x' = x/(100-x)$ to make normal linear regression analysis applicable. The resulting series exhibit the large positive and persistent spikes in the autocorrelation function typical of non-stationarity data. To determine the appropriate transformation to achieve stationarity we applied the test proposed by Dickey and Fuller (1981). The differenced series and the GNP growth rate showed a significant break in variability after 1947. Based on preliminary estimates of the "baseline" models, the series were reweighed as follows to remove heteroskedasticity: 1 after 1947, 0.34 before 1947 for real per-capita GNP growth and the unemployment rate, 0.59 for the inflation rate and 0.28 for the growth of the monetary base. As discussed in the text, we could not reject the hypothesis of mean non-stationarity of all variables except for the transformed per-capita real GNP.