*A Computable Equilibrium Model for the Study of Political Economy**

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Theory: The need for the development and use of a concept of joint, political-economic equilibrium is increasingly recognized by students of democracy and markets. Yet, to date, no adequate theoretical and methodological synthesis of this kind has been produced. The few works which have attempted it suffer from a lack of theoretical balance between economic and political theory; unrealistic, temporally aggregated conceptions of political-economic equilibrium; failure to incorporate theoretically meaningful stochastic elements of economic and political processes; and the absence of a coherent methodology for gauging the empirical power of political-economic models.
Methods: In the spirit of the *AJPS* workshop, it is shown how these problems can be solved. An improved model is built, one which fuses a branch of real business cycle theory and the theory of presidential approval. This model produces a notion of computable political-economic equilibrium that provides for market clearing and simultaneous stochastic optimization by economic and political agents. Then, using data analysis techniques developed in parallel by real business cycle theorists (Hansen and Heckman 1996; Kydland and Prescott 1990, 1996; Lucas 1987; Prescott 1986a, 1986b, 1991; Sims 1996) and political methodologists (Brady 1996; Jackson 1995), the model is parameterized for the United States. More specifically, on the basis of estimates from economics and political science and some numerical experimentation, certain of its parameters are set so that, when simulated, the model mimics the United States political economy in the 1980s.
Results: The parameterized model is used to study some important counterfactuals. The first is the impact of increased approval volatility on political-economic equilibration. Such volatility is expected in view of America's likely involvement in the post Cold War era's increasing number of "low intensity" international conflicts. The second is the impact of presidents pursuing relatively high—nonminimum winning—levels of approval. This kind of behavior is attributed to certain presidents along with the claim that it has harmful effects on markets and hence on various facets of social welfare. The former

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analysis shows how "business cycle phenomena" (Lucas 1987) can be traced, in part, to government approval management in an increasingly volatile international polity, management which is associated with a slight drop in social welfare. The latter investigation demonstrates that the president's pursuit of a consensual approval target is not necessarily socially harmful.

At the heart of the study of democracy and markets are the development and analysis of concepts of economic equilibrium and political equilibrium. Recently, many scholars have argued that the two types of equilibrium are intimately related, market equilibrium depends to some extent on the outcomes of political processes and these outcomes hinge on market clearing and related economic processes. It is the *joint* or *simultaneous equilibration* of markets and democracy that must be understood. The counterfactuals that drive theory building in economics and political science can not be adequately analyzed with one equilibrium concept alone.

Unfortunately, few scholars have attempted the necessary theoretical and methodological synthesis. Take, for instance, two of the major advances of the 1980s: real business cycle theory and our theory of approval management. The motivation of agents in the former is defined solely in economic terms; the stochastic elements of the models are tied to economic processes alone; the notion of equilibrium has to do solely with market clearing with no provision for stability in the political strategies of government (representative agents). Improvements in the performance of real business cycle models are sought through the introduction of additional stochastic elements like fiscal shocks, the political origins of which are never explored. Meanwhile, approval theorists continue to build models without any equations for the economy. Rationalizations for approval specifications are not provided—reduced forms continue to be used and the stochastic terms in them usually are not interpreted in any substantively meaningful way; the notions of equilibration associated with these reduced form approval equations are not derived from the behavior of any rational agent, let alone the agents which appear in macroeconomic models. For example, the now popular error correction model is not shown to be the result of the rational strategies of any political agents. Methodologically, the time series decomposition and other data analytic techniques used by real business cycle theorists are nowhere to be found in the approval literature (Freeman and Stimson 1994). Real business cycle and approval theorists thus work in separate realms without any meaningful intellectual exchange. As a result, possible gains from trade between these two bodies of work are not realized. And important questions about such things as the impact which increasing United States involvement in "low intensity" international conflicts in the post Cold War world might have on approval volatility and, in turn, on markets and economic welfare remain unanswered.[1]

Of course, a few scholars have attempted such a synthesis. Table 1 summarizes some of the most recent of these contributions. Consider, for example, the work under the second column.[2] These models usually provide for two-party competition under majority or plurality rule. Each party and its constituency is assumed to have different objectives. Government is conceived either as a self-interested incumbent party, an agent which implements a bargain between parties, or an agent whose objective is to optimize the product of the parties' utility functions (see below). Government is constrained in these regards by a set of economic and political relationships or "laws of political and(or) economic motion." Policy thus is the solution to the respective constrained optimization problem.

The most well-known work in this genre is arguably Alesina's research (1987, 1988), including his paper with Londregan and Rosenthal, "A Model of the Political Economy of the United States" (1993). The Alesina, Londregan, and Rosenthal model incorporates key institutions of American representative government. For instance, it provides for presidential and congressional elections and for joint determination of policy outcomes by the two branches. Parties compete in a stochastic world; growth depends, in part, on shocks representing unanticipated economic events and fluctuations in "political competency" (administrations' abilities to avoid inefficiency; cf. Rogoff and Sibert 1988). The range of voters' preferences for inflation and growth varies randomly each electoral period. Party competition produces a

[1]The new macroeconomics in general and real business cycle theory in particular are reviewed elsewhere (Freeman 1993). Briefly, this work is associated with the research of Lucas (1980, 1987), Prescott (1991), and others. Among other things it introduces the notions of stochastic economies, e.g., economies with production functions in which the impact and evolution of technology is inherently random. The behavior of the competitive economy is shown to be equivalent to that of a benevolent social planner who engages in stochastic optimization (Stokey, Lucas, and Prescott 1989). That this school of economics largely ignores the political motivations of agents is evident in such works as Chari, Christiano, and Kehoe (1991, esp. 529); Barnett, Hinich, and Schofield (1993, 466); and McGrattan (1994, esp. 9). Some approval theorists test for the exogeneity of selected economic variables (MacKuen, Erikson, and Stimson 1992). But, usually these theorists assume that the (entire) economy is exogenous. With one or two exceptions (Durr 1993), there is no rationalization of the approval function. The notion of equilibration has to do with the time series properties of the approval data rather than any idea of market clearing and related conditions for competitive economic equilibrium. Illustrative of this is the notion of a moving equilibrium in approval, unemployment, and inflation as governed by an error correction model (ECM); see Ostrom and Smith (1993). Political scientists have not made any attempt to link the ECM to the behavior of any rational political (or economic agents. This is in spite of the fact that such rationalizations have existed for some time (Nickell 1985).

[2]To save space, only a subset of the works in Table 1 are reviewed here. The full review is in Freeman (1995).

Table 1. Typology of Political-Economic Models With Some Illustrative or Suggestive Works

	Conception of Government			
	Unitary Actor	Representative Democracy		Direct Democracy
		Two Parties	N Parties/Actors	
Deterministic Economy and Polity	Nordhaus (1975) Chappel and Keech (1983)	Alesina (1987, 1988)	Krusell and Ríos-Rull (1996)	Krusell, Quadrini, and Ríos-Rull (1994, 1996)
Stochastic Economy and/or Polity	Rogoff and Sibert (1988)	Alesina, Londregan, and Rosenthal (1993) Drissen and van Winden (1993) van der Ploeg (1987)		

coalition proof Nash equilibrium that connotes time consistent policies and particular patterns of growth. This equilibrium also implies a pattern of electoral outcomes which are consistent with key facts about such things as the recurrence of divided government.

Lesser known but equally important contributions in this genre have been made by European scholars. For instance, van der Ploeg (1987) uses a two-party competition model to explore the implications of rational expectations in small open economies with uncertain electoral outcomes. In his models, the domestic real interest rate is pegged to the foreign interest rate (which is exogenous), speculators are risk neutral with perfect information and foresight, and government is a Stackelberg leader whose incumbency is determined probabilistically through elections. Van der Ploeg compares policy choice when government is a benign planner to that when incumbents face possible electoral defeat, showing that in the latter situation politically induced swings in the economy can occur as government anticipates losing office and takes actions to offset the effects of its successors' policies.[3]

Another contribution is made by Drissen and van Winden (1993). They construct a model based on formal theories of two-party competition under majority rule and probabilistic voting. In particular, Drissen and van Winden exploit the result that when individual choice probabilities are proportional to their strength of preferences, government will maximize the Nash product of the implicit utility functions of the two parties' constituents (Coughlin and Nitzan 1981; Hinich 1977). Using this result, the assumption that the constituents of the two parties are labor and capital, and an augmented set of economic constraints—augmented in the sense that public sector production is added to the equations conventionally used to represent the competitive economy—Drissen and van Winden are able to challenge the conventional wisdom about fiscal policy. For instance, the impact of a tax increase need not lead to a reduction in private sector production as it does in partial equilibrium models in which tax changes are not constrained by politics.[4]

[3]In van der Ploeg's set-up foreign interest rates are treated as exogenous causes of changes in domestic real interest rates. Rational expectations are in the form of jump variables; that is, variables which are forward looking and not constrained by past history. Jump variables are determined in efficient financial markets and take into account expectations of future events so that credible announcements of changes in future economic policy affect the current state of the economy. Real competitiveness and real exchange rates are jump variables in the model. Parties maximize alternative objective functions, functions which are discounted over periods of electoral uncertainty in terms of the probabilities of reelection of incumbents. See also van der Ploeg (1984).

[4]Stochastic elements are implicit in Drissen and van Winden's piece (1993). No expressions for probabilistic voting are made in the equation system. Government simply maximizes the weighted product of the two actor's utility functions (V_c,V_w); the weights are of the "influence" variety $\left(P = V_c^{\mu_c} V_w^{\mu_w} \text{ where } \mu_c + \mu_w = 1\right)$. Political economic equilibrium is defined as the joint maximization of household and government utility where the former treats policy as given and the latter treats household maximization as a constraint.

These models are among the most promising interdisciplinary syntheses constructed to date. Among other things, they expressly incorporate political motivations for agents. In some cases, their creators attempt to show that the models can explain empirical patterns of various kinds.

Unfortunately, as models of political-economic equilibration, these works are still deficient in a number of important respects. To begin with, the models often do not strike a meaningful balance between economic and political processes. For example, the polity in the Drissen and van Winden piece is underdeveloped in an important respect: the stochastic nature of the political behavior is implicit not explicit. In the case of the Alesina work, it is the economy which is underdeveloped—a simple supply function absent of any economic rationalization is all that is provided. In effect then, Alesina's models have no economic agents.[5] Second, the conceptions of political-economic reality in these models are highly temporally aggregated. Political-economic equilibria are realized only when presidential elections occur; in this sense, "the world starts over every four years" (Alesina, Landregan, and Rosenthal 1993, 26). Third, these models usually fail to provide for stochastic elements in the economy and polity. In almost all the cases, deterministic conceptions of production, voting, and other key processes are employed despite the fact that theory now stresses the importance of such factors as technological innovation and randomness in preferences. Concomitantly, there is still no relation between the formal models and reduced forms employed in this research. The most glaring examples of this problem are Alesina's papers (1987, 1988) where the rational expectations business cycle set-up bears no relation to the equations which are fit to data and no interpretation of the error term in the statistical set-up is supplied. As syntheses of economics and political science then, these models are important advances but still in need of substantial improvements.[6]

[5]Alesina's models represent the economy as a single equation—the Lucas supply function. His models do not provide for optimization by economic agents. The lack of balance is evident even in the newest and best contributions such as Barnett, Hinich, and Scofield's *Political Economy: Institutions, Competition, and Representation* (1993). This book is truly state of the art. However, most of the articles in it study the polity in isolation of the economy.

[6]As regards to the fourth point, Alesina, Londregan, and Rosenthal's model (1993) is genuinely stochastic. And there is a more direct relation between it and the estimation equations. But this relation is not one-to-one. Rather, their maximum likelihood function contains "mechanisms" that are not in their formal model (see esp. 1993, 21). Neither van der Ploeg nor Drissen and van Winden present any general strategy for using their model to explain the observed behavior of extant political-economic systems. In the case of the former, the author lifts parameters from a British Treasury model; he presents simulation results but does not attempt to show that the results explain the history of Britain or of any other country. Drissen and van Winden's analysis is purely abstract. They offer no parameter estimates for their model or statistical tests of its implications. In principle, the method presented below could be used to gauge the empirical power of both models.

In the spirit of the *AJPS* workshop, this paper shows how these improvements can be made. Real business cycle theory and theory of approval maintenance are fused in ways that incorporate rational economic *and* political behavior as well as key stochastic elements of political and economic processes. In particular, the modern theory of optimal fiscal policy (Chari, Christiano, and Kehoe 1990, 1991) is merged with political scientists' work on presidential approval. As in the former, tax rates and interest rates on public debt optimize the discounted present value of the return to a representative household in keeping with well- established economic constraints. Firms maximize profits. And prices and wages are such that markets clear. But here there also is provision for political accountability. As in our political theory, households dispense approval. And government is motivated to achieve a particular approval rating (Brody 1991; Ostrom and Smith 1993; Williams 1990). More specifically, there is an approval constraint and a politically motivated agent who minimizes the discounted present value of expected squared deviations from its approval target. In addition, the model is defined in terms of the joint realization of three random variables representing technological innovation, government spending shocks, and approval shocks. There emerges from this construction, a concept of *computable political-economic equilibrium* that describes market clearing and, simultaneously, stochastic optimization by economic and political agents. The corresponding, "politically motivated allocation problem" is solved for the decision rules of both agents. Then, using data analytic techniques developed in parallel by real business cycle theorists (Hansen and Heckman 1996; Kydland and Prescott 1990, 1991, 1996; Prescott 1986, 1991; Sims 1996) and political methodologists (Brady 1996; Jackson 1995), the model is applied to the United States in the period 1980–90. On the basis of estimates from economics and political science and numerical experimentation, certain parameters in the model are set so that it mimics the United States, that is, when simulated, the model produces time series which, when detrended, have properties that are very similar to those of detrended actual data in the indicated time frame. The detrending method is that used by real business cycle theorists and implicit in political scientists' analyses of citizens appreciation of economic feasibility constraints: the Hodrick Prescott (HP) filter (Hodrick and Prescott 1980). Finally, the model is used to study some important counterfactuals. One of these is mentioned above: the economic and welfare consequences of the increases in approval volatility which America's increasing involvement in the post Cold War's "low intensity" conflicts is likely to spawn. The other is an assessment of the political and economic implications of presidents pursuing high—nonminimum winning—approval levels or, of what is called euphemistically presidents "loving dangerously" (*The Economist,* January 24, 1994, 21–4). The former analysis shows how "business cycle phenomena" (Lucas 1987) can be traced, in part, to government approval management in an increasingly volatile international polity, management which is associated with a slight drop in social welfare. The latter investigation demonstrates that the president's pursuit of a consensual approval target is not necessarily socially harmful. In these ways, the desired theoretical and methodological synthesis is achieved and its value is demonstrated.[7]

A Computable Political-Economic Equilibrium Model

The Economy

Assume that the representative household orders stochastic streams of consumption and labor by:

$$\max_{c,\ell} \sum_{t} \sum_{s^t} \beta^t u(s^t) U\left[c(s^t), \ell(s^t)\right] \qquad [1]$$

where β is its discount rate, s^t is the state of the political economy at time t, $u(s^t)$ represents the probability that a particular state occurs at time t, and U[ ] is the household's strictly concave utility function increasing in consumption, c, and decreasing in labor, ℓ, where c and ℓ depend on the state, s^t.[8] Say, production technology is defined by

$$y = z(s^t)(1+\rho)^t f(\ell) \qquad [2]$$

or that output is a function only of labor but also of a "growth factor" and a stochastic process, z. The term $(1+\rho)^t$ represents positive exogenous

[7]Our model thus is in the spirit of the work of Alesina, Londregan, and Rosenthal (1993), Brady (1996), Brady and Ansolabehere (1989), and Jackson (1995). For instance, unlike Jackson's (1995) set-up, in our model, the behavior of political (and economic) agents are fully rationalized in terms of optimization theory; political economic reality is temporarily disaggregated—equilibration occurs monthly or quarterly not every four years; and, our parameterization is based on numerical experiments for a particular era of United States history. In comparison to the model of Alesina, Londregan, and Rosenthal (1993), our set-up has a full blown economy with optimizing households and stochastic political and economic processes.

Space restrictions do not permit a full description and evaluation of the Hodrick-Prescott (HP) filter. Briefly, this filter is used to decompose time series into a long-term component (roughly greater than 32 quarters or low frequency) and a medium/short term component (medium to high frequency). Real business cycle theory holds that the decomposition is essential because different forces determine each component (cf. Lucas 1980, 1987). Parallel ideas in the political economy literature are embodied in Alesina's (1988) and Alesina, Londregan, and Rosenthal's (1993) concept of natural growth rates. The filter is described in more detail in the Appendix to this paper. This Appendix is available at the Political Methodology Paper Archive (http://wizard.ucr.edu/polmeth/polmeth.html]. It also can be obtained from the authors.

[8]Again, s^t is defined below in terms of the joint realization of independent productivity, government spending, and approval shocks, and u( ) is a Markov transition matrix for these shocks. Cf. Stokey, Lucas, with Prescott (1989, esp. Chp. 11).

growth, $\rho \geq 0$. In real business cycle theory it normally is interpreted as the sum of production augmenting technology shocks over time. z is an individual productivity shock which is strictly exogenous, for instance, the effect of an unexpected surge (decline) in the price of a critical input like oil. Assume that due to such things as nondiscretionary spending legislation, government spending grows at the same exogenous rate, ρ. Then the feasibility or resource constraint reconciles the level of consumption by the household and government spending, g:

$$c(s^t) + (1+\rho)^t g(s^t) \leq z(s^t)(1+\rho)^t f\big(\ell(s^t)\big). \qquad [3]$$

The household purchases a number of units of government debt at each period, b. And it earns interest on the debt as well as wages, w, and profits, V. Government pays interest on the debt at rate, R, and taxes wages at rate, τ. The household therefore faces the following problem:

$$\max_{c,\ell} \sum_t \sum_{s^t} \beta^t u(s^t) U\big[c(s^t), \ell(s^t)\big] \qquad [4]$$

such that

$$c(s^1) + b(s^1) \leq \big(1 - \tau(s^1)\big) w(s^1)\ell(s^1) + V(s^1) + R(s^1)b(s^0) + A \quad t = 1$$

$$c(s^t) + b(s^t) \leq \big(1 - \tau(s^t)\big) w(s^t)\ell(s^t) + R(s^t)b(s^{t-1}) + V(s^t) \ \mathrm{t} = 2, 3, \ldots,$$

$$c(\cdot), \ell(\cdot) \geq 0, \ell(\cdot) \leq 1.$$

That is, the household chooses consumption and labor to maximize the discounted present value of its utility subject to a condition relating its initial purchases and its initial wealth and the general constraint that the sum of its consumption and government debt purchases at time t is less than or equal to the total of its net wages at time t, previous earnings from holding debt at $t - 1$, and profits earned at the time t. A denotes the household's initial assets. The household is assumed to own all firms. For these firms competitive equilibrium ensures that

$$v(s^t) = \max_{\ell} \Big\{ z(s^t)(1+\rho)^t f\big[\ell(s^t)\big] - w(s^t)\ell(s^t) \Big\} \qquad [5]$$

or, that the profit level is that which maximizes the difference between output and net wages (where, again, output is subject to the stochastic variable, $z(s^t)$, and the exogenous growth factor, $(1+\rho)^t$).[9]

[9]The general equilibrium framework used here implies that firms optimize and that all markets clear for each s^t. The utility function for households and the production function for the economy are characterized more fully below.

The Polity

Government is an infinitely-lived agent who chooses tax rates, τ, and interest on public debt, R, so as to minimize the expected sum of deviations from its approval target, APP*. Specifically, government's preference is of the form

$$\underset{\tau, R}{Min} \sum_{t} \sum_{s^t} \bar{\beta}^t u(s^t) \left[\left(APP(s^t) - APP^* \right)^2 \right]. \qquad [6]$$

$\bar{\beta}$ is the government's discount rate and u( ) is defined as before. Now, assume further that government faces two constraints. The first is expressly political in nature:

$$APP(s^t) = \alpha_0 + \alpha_1 \frac{c(s^t)}{(1+\rho)^t} + \alpha_2 \ell(s^t) + e(s^t) \qquad [7]$$

where α_1 and α_2 represent the impact of what we will call "normed consumption" and labor input on approval, respectively, and e is a random or disturbance term representing rally and other essentially random shocks to approval. The first variable on the rhs of [7] captures the now well-accepted idea that approval depends on citizens' material well-being. It also captures the argument that as rational agents citizens take into account the fact that consumption levels change, in part, because of forces that are beyond the control of governments. Here this adjustment for "economic feasibility" amounts to dividing out of $c(s^t)$ the exogenously determined growth factor, $(1+\rho)^t$. The second variable on the rhs of [7] represents a non-material determinant of approval, specifically, the amount of labor the household contributes to production. Finally, the last variable, $e(s^t)$, represents approval shocks. In the approval literature, these usually are associated with one-time surprise domestic, and especially international, political events.[10]

[10]Political scientists have employed the notion of government approved targeting for some time. An illustration is Schultz's (1995) recent analysis of the British political business cycle. Like us, Schultz employs a target he calls the government's "security level." Unlike us, Schultz emphasizes electoral timing. We return to this distinction in the Conclusion. An example of the incorporation of citizens' appreciation for the macroeconomic constraints on government is Chappell and Keech's (1985) use of the expectations-augmented Philips curve in their "sophisticated" model of presidential approval. We here similarly assume citizens are sophisticated enough to realize that consumption grows in part due to the exogenous growth factor, $(1+\rho)^t$. Hence their willingness to dispense approval varies in relation to this trend.

As it turns out (see below), this simple formulation explains a large amount of the variance in approval. As regards $e(s^t)$, this term captures the common notions of "rally" or "extraordinary" ap-

The second constraint on government is its budget constraint. This constraint reconciles the number of units of debt government issues and its tax collections with the returns it pays and its expenditures:

$$b(s^t) + \tau(s^t)w(s^t)\ell(s^t) = R(s^t)b(s^{t-1}) + (1+\rho)^t g(s^t). \qquad [8]$$

In our model, then, government spending is, in effect, determined exogenously (Chari, Christiano, and Kehoe 1991, 522) and tax rates, public debt issues, and interest rates on public debt are adjusted to cover that spending level.

Political Economic Equilibrium

Government policy amounts to a mix of taxes and returns on debt. Define this policy as $\eta(s^t) \equiv (\tau(s^t), R(s^t))$. Thus the government policy is indexed by the state of the political-economic world, s^t. Abbreviate the government's policy as $\eta \equiv \eta(s^t)$. Let $x(s^t) \equiv (c(s^t), \ell(s^t), b(s^t))$ represent the allocation for the representative household for s^t. Abbreviate this $x \equiv x(s^t)$. Now the household bases its allocation decisions on government policy choices, or $x(\eta) = (x(s^t|\eta))$. And market equilibrium implies for prices that $w(\eta) = w(s^t|\eta)$ and for profits that $V(\eta) = V(s^t|\eta)$. It follows therefore that a *political motivated economic equilibrium* is a combination of decisions, $\{\eta^*, x(\cdot), w(\cdot), v(\cdot)\}$ such that

I. η^* solves the government's problem:

$$\underset{\tau,R}{Min} \sum_t \sum_{s^t} \bar{\beta}^t u(s^t)\left[\left(APP(s^t) - APP^*\right)^2\right]$$

subject to

$$APP(s^t) = \alpha_0 + \alpha_1 \frac{c(s^t)}{(1+\rho)^t} + \alpha_2 \ell(s^t) + e(s^t)$$

proval shocks (Brody 1991; Ostrom and Smith 1993). (Technically, α_1 embodies the initial consumption level $c(s^0)$, more specifically,

$$\alpha_1 = \frac{\tilde{\alpha}_1}{c(s^0)}$$

where $\tilde{\alpha}_1$ is the coefficient in the more complete expression

$$A(s^t) = \alpha_0 + \tilde{\alpha}_1 \frac{c(s^t)}{(1+\rho)^t c(s^0)} + \alpha_2 \ell(s^t) + e(s^t).$$

We do not attempt to parameterize $c(s^0)$ here, but rather subsume its value in α_1.)

and

$$b(s^t|\eta) + \tau(s^t)w(s^t|\eta)\ell(s^t|\eta) = R(s^t)b(s^{t-1}|\eta) + (1+\rho)^t g(s^t).$$

II. For every η', $x(\eta')$ solves the household's problem with policy η' and prices, w(η') and profits, V(η'), given.

III. For every η'

$$w(s^t|\eta) = z(s^t)(1+\rho)^t f'\left[\ell(s^t|\eta)\right]$$

$$V(s^t|\eta) = z(s^t)(1+\rho)^t f\left[\ell(s^t|\eta)\right] - w(s^t|\eta)\ell(s^t|\eta).$$

The corresponding programming problem or "politically motivated allocation problem" then is:

$$\underset{\tau,R}{Min} \sum_t \sum_{s^t} \bar{\beta}^t u(s^t)\left[\left(APP(s^t) - APP*\right)^2\right] \qquad [9.1]$$

such that

$$c(s^t) + (1+\rho)^t g(s^t) = z(s^t)(1+\rho)^t f\left[\ell(s^t)\right]$$

$$\sum_t \sum_{s^t} \beta^t u(s^t)\left[U_c(s^t)c(s^t) + U_\ell(s^t)\ell(s^t)\right] = U_c(s^1)\left[R(s^1)b(s^0) + A\right] \quad [9.2]$$

$$APP(s^t) = \alpha_0 + \alpha_1 \frac{c(s^t)}{(1+\rho)^t} + \alpha_2 \ell(s^t) + e(s^t) \qquad [9.3]$$

$$c(\cdot), \ell(\cdot) \geq 0, \ell(\cdot) \leq 1 \qquad [9.4]$$

where U_c and U_ℓ are marginal utilities for consumption and labor, $b(s^0)$ is the initial stock of debt, and profits are assumed to be zero by virtue of our use of the Constant Returns to Scale (CRS) production function below.

The solution to the problem is derived in the Appendix to this paper (cf. fn. 7). It amounts to an optimal decision rule for the tax rate and interest on public debt in this stochastic political economic world. More specifically, the assumption that the three independent random variables (z,g,e) take on two values each implies that s takes on $(2 \times 2 \times 2 =)$ 8 states. The optimal decision rule is a pair of τ and R for each of these eight states. The use of these policy pairs in the face of the realization of the respective states minimizes the sum of the expected squared deviations in approval from the government's target while simultaneously solving the representative households optimization problem and adhering to the feasibility and competitive market constraints laid out above. Substantively, the sequence of events is that the state (3-tuple of shocks) is realized, government chooses its optimal pair of policies that imply, simultaneously, the choice of optimal consumption and labor inputs by the household, profits are maximized, and markets clear. In the simulation below, this entire sequence is interpreted as *one* episode of political-economic equilibration, an episode associated with the realization of the respective 3-tuple of shocks. The history of the political-economic system is the record of these episodes or the series of these equilibrations.[11]

Additional Specification and Parameterization

The utility function is assumed to have a standard form; that is,

$$U(c,l) = \frac{\left\{c^{1-\gamma}(1-\ell)^{\gamma}\right\}^{\psi}}{\psi} \quad \psi < 1, \psi \neq 0 \qquad [10]$$

where, once more, ℓ is the amount of effort devoted to labor so $1 - \ell$ is leisure, ψ is the so-called curvature parameter representing the relative degree of risk aversion of the representative household, and γ represents the weight given to leisure in relation to that given to consumption. This is the utility function that normally is used in real business cycle research. With it, the marginal utilities for consumption and labor are[12]:

$$U_c : \left\{c^{1-\gamma}(1-\ell)^{\gamma}\right\}^{\psi-1} \cdot \left(1-\gamma\right)c^{-\gamma}(1-\ell)^{\gamma}\}$$

$$U_\ell : -\left\{c^{1-\gamma}(1-\ell)^{\gamma}\right\}^{\psi-1} \cdot c^{1-\gamma} \cdot \gamma \cdot (1-\ell)^{\gamma-1}\right\}.$$

Labor effort is operationalized as the percentage of available time net of sleep and personal care that is devoted to work. Following conventional practice in real business cycle research, the available time—the household time endowment—each quarter is assumed to be 1,369 hours (Chari, Christiano, and Kehoe 1991; Christiano and Eichenbaum 1990); and, the curvature parameter, ψ is set equal to -1 and γ is set to .66. Finally we set the discount rate for the representative household, β, at .99; this implies that in nonstochastic steady state equilibrium the real quarterly interest rate is 1%.[13]

[11]The government chooses a decision rule for τ and R and then adheres to this rule in all subsequent periods. As regards to the household, its problem is not reducible to a series of two-period optimization problems because the state space does not include a variable representing the period.

[12]Some of the results of real business cycle studies are derived for an even more general class of utility functions (cf. Chari, Christiano, and Kehoe 1991). Also, some researchers make allowance for the intertemporal substitutability of leisure, more specifically, for valuation of lags of leisure (Kydland and Prescott 1982, esp. 1351; Backus, Kehoe, and Kydland 1992, 1993). More complicated set-ups of these kinds will be evaluated in future research.

[13] There is little consensus about the values of the curvature parameter. Hence, researchers sometimes study their models' behaviors for alternative values of psi (Chari, Christiano, and Kehoe 1991) or they impose a particular value that improves the behavior of their models (Backus, Kehoe, and Kydland 1992). In still other cases, some of the parameters are estimated with the generalized moment method (Christiano and Eichenbaum 1990). We use the value of –1 (cf. Backus, Kehoe, and Kydland 1992; Prescott 1986). The value for gamma is usually assumed to be .66 because, in nonstochastic economic equilibrium, this value yields a plausible result for work time of about 34%. In non-stochastic economic equilibrium the real quarterly interest rate is approximately β^{-1}.

Turning to the production function, recall that our model does not contain capital. Hence production is a function of labor input only. Also, concepts like inventory (Backus, Kehoe, and Kydland 1992; Kydland and Prescott 1982) are not applicable. Rather, for simplicity, we assume that the production function has the form $y = \ell^{\theta}$ hence $f'(y) = \theta\ell^{\theta-1}$. In terms of our stochastic model of the economy, [2], we have then

$$y = z(s^t)(1+\rho)^t f(\ell) = z(s^t)(1+\rho)^t \ell^{\theta}. \qquad [2']$$

Real business cycle theorists typically assume that the production function exhibits constant returns to scale (CRS). This implies, for example, that doubling factor inputs will exactly double output. The CRS assumption guarantees that profits are zero in equilibrium and that the set of equilibrium allocations in an economy with a representative firm is identical to an economy populated by a large number of such firms (Hansen 1985). We follow this tradition and assume that our environment includes a CRS production technology. Because our technology requires only labor as an input, the CRS assumption implies θ is equal to 1.0. As regards the growth factor, $(1+\rho)^t$, the rho parameter is the rate of exogenous, quarterly, labor-augmenting technological progress; it is the rate at which output grows in nonstochastic economic equilibrium. To match the observed rate of growth in the United States in our time frame of about .6% per quarter, we set ρ equal to .006. Recall that the production process is stochastic in that it is subject to exogenous technology shocks; these shocks are represented by the random variable z. This random variable also has properties similar to its counterpart in the real business cycle literature. That is, z is assumed to follow a symmetric, two state Markov chain; z takes on two values—one "low" (l) and one "high" (h); it has transition probabilities of the form $\text{Prob}\{z_{t+1} = z_i | z_t = z_i\} = \pi$ for i = l,h. Using this transition matrix for z, we experimented with different values of π and of $z_{l,h}$ until we found a parameterization that mimicked important properties of United States production. More specifically, we found values of π and $z_{l,h}$ such that the standard deviations and first order autocorrelations of the full model's simulated deviations from HP trends in log-consumption and log-output were similar to those of actual United States data in the chosen time period (1980–90). The final values for these parameters are $\pi = .91$, $z_{low} = .99$, and $z_{high} = 1.01$. (Note that the value for π is similar to that used in Chari, Christiano, and Kehoe 1991.)[14]

[14]Data on average hours worked per quarter were obtained from the Bureau of Labor Statistics *Employees, Hours, and Earnings, U.S. 1909–1990* volume 1, Bulletin 2370, March 91; estimates for quarters were constructed from estimates for average hours worked by respective months in total private non-farm establishments. The source of the Real GNP and other macroeconomic data is the

In Chari, Christiano, and Kehoe (1991) and related real business cycle studies, government spending is assumed to grow exponentially. We assume the growth factor is $(1+\rho)^t$. Hence we have $g_t = g(1+\rho)^t$ where Prob$\{g_{t+1} = g_i | g_t = g_i\} = \Theta$ for i = l,h. As in the case of our production function, we experimented with alternative values of the parameters until we found a parameterization that produced model simulations in which the government spending to output ratio and standard deviation and serial correlation of HP trend log-government spending matched those of United States data in the chosen period. This is the calibration $g_{low} = .074$, $g_{high} = .078$ and $\Theta = .95$.[15]

Recall that our approval function, [7], is a simple linear additive combination of consumption, labor input, and a stochastic term:

$$APP(s^t) = \alpha_o + \alpha_1 \frac{c(s^t)}{(1+\rho)^t} + \alpha_2 \ell(s^t) + e(s^t). \qquad [7]$$

Ideally, to follow the approach used by real business cycle theorists, we would parameterize [7] on the basis of microdata. We would tie down the alpha coefficients to micro observations by substituting coefficients into [7] that are estimates from the statistical analysis of relevant panels (see Freeman 1993; see also Brady 1996). Unfortunately, the micro observations required for this are not available. The NES data on approval for the 1972–76 panel do not contain questions about consumption and employment which are sufficiently comparable to the present variables. Nor are the statistical estimates one obtains from these panel data easy to interpret in relation to the coefficients in [7].[16]

A more heuristic method therefore was used. Some simple regressions were run to obtain initial estimates of the alphas. Then, using the Markov

Electronic Bulletin Board of the National Technical Information Service (Stimson Macropolity Data Set). The full data set is available upon request from the authors.

Again, the time period was chosen to take into account structural discontinuities in economic policy in the late 1970s (Miller and Roberds 1987) and unusual volatility in approval in early 1991 (Jackman 1995,19). Also in the period 1980–90 the same party controlled the White House. This fact figures in the interpretation of the model below.

[15] The same simulation procedures were used to parameterize the government spending component of the model as for the production component. All simulations were written in Mathematica. This code also can be obtained from the authors.

[16] The NES panel for 1972, 1974, and 1976 contains a record of approval decisions. However, the respective data have to do with personal finances, employment status of the respondent or of his or her family, and employment prospects for the economy as a whole. The personal finances questions may be related to aggregate consumption. But there is no question capturing the idea of hours worked in relation to time endowment. Also, the corresponding statistical estimates are of the logit variety, and it is not clear that they necessarily aggregate as easily as macroeconomists claim (cf. Prescott 1986a, 1986b: esp. 14).

chain for approval shocks described momentarily, simulations were run for these initial values. Next these alphas were adjusted to obtain simulated HP trend log approval series whose properties matched those of actual HP trend log approval series for the chosen period. In this initial analysis of our model, we assumed that approval is a function of normed consumption alone. Our value for α_2 therefore is zero; our final values for α_0 and α_1 are reported below.[17]

As regards the random variable *e*, while political scientists have begun to explore the usefulness of Markov transition set-ups (Jackman 1995), they have not estimated the transition probabilities for approval enhancing to/from approval diminishing shocks. Nor have they specified the magnitude of such shocks. However, study of standard works like Brody (1991, Table 3.1) and Ostrom and Smith (1993, Appendix B) is suggestive. In particular, the historical record constructed by these authors suggests the existence of two-state, nonsymmetric Markov chains like those in Table 2. Generally speaking, the two studies suggest similar probabilities for transitions from approval enhancing to diminishing shocks. Where they differ is that Brody's record suggests a somewhat greater tendency for approval diminishing events to be followed by approval enhancing events. Since these and related works are not clear about the magnitudes of these events net of the right-hand variables in [7], the respective values were determined in the same manner as for z and g; that is, the magnitudes of the high e and low e values were determined along with the alphas to create simulated approval series which when HP detrended had properties like those for the HP detrended, actual approval series. Since their time frame most closely matches ours, we use the Ostrom-Smith transition probabilities here. The rescaled parameterization is: $\alpha_0 = -.025$, $\alpha_1 = 2.5$, $e_{low} = -.0135$ and $e_{high} = .0135$. Again, in this initial investigation, α_2 is set to zero. This implies that the stochastic element of the polity produces shocks which cause shifts in approval in the range of about 3%.[18]

[17]Once more the HP trend in Approval is the long-term (low frequency) component in that series, Cf. fn. 7. Substantively, it corresponds to such things as generational shifts in support for the institution of the presidency, shifts which conceivably are tied to the HP trend in output. Creating such a decomposition is important here to achieve comparability in the time frame of the two theories. See Freeman and Stimson (1994).

[18]Clearly, the reported magnitudes of the shocks in Brody are not net of the effects of consumption and(or) labor. Nor do Ostrom and Smith offer any measure of the shocks; theirs is simply a list of approval enhancing and diminishing events during the Reagan years. A simple regression of approval on normed consumption for the chosen period produced a statistically significant positive correlation between the two variables. The unscaled regression coefficients were $\alpha_0 = -106.49$ and $\alpha_1 = 3.27$. The respective equation had a corrected R^2 of .54. The positive sign of α_1 is consistent with the conventional wisdom that citizens reward government for increases in material well-being and vice versa. After some experimentation we settled on scaled values of $\alpha_0 = -.025$ and α_1

Table 2. Implied Two State, Nonsymmetric Markov Chains Between Approval Diminishing (–) and Approval Enhancing (+) Events

Table 2.1				Table 2.2				Table 2.3			
BRODY (1947–86)				OSTROM & SMITH (1981–88)				BRODY (1964–86)			
		$t+1$				$t+1$				$t+1$	
		–	+			–	+			–	+
t	–	.32	.68	t	–	.50	.50	t	–	.33	.67
	+	.38	.62		+	.36	.64		+	.45	.55

Several parameters remain to be specified. As explained in the Appendix to our paper (Cf. fn. 7) our solution to the Political Motivated Allocation Problem requires that $\bar{\beta} = \beta(1+\rho)^{(1-\gamma)\psi}$. With the parameters described above this means that $\bar{\beta} = .988$, or that government is slightly more myopic than households. For our initial analysis, we set APP* equal to a value roughly equivalent to a "minimum winning" target of .55. In other words, we initially assume, following coalition and other branches of political theory, that government seeks to maintain majority support thus maximizing the gains to the groups of which it is composed. (We relax this particular assumption in the counterfactual analyses below.) Recall that s represents the joint realization of the productivity, government spending, and approval shocks, and Π denotes the transition probabilities between the states. Treating these shocks as independent, using the transition probabilities from our Markov chains, and defining s as before we have:[19]

	s_1	s_2	s_3	s_4	s_5	s_6	s_7	s_8
s_1	.43225	.04275	.43225	.04275	.00275	.00225	.02275	.00225
s_2	.04275	.43225	.04275	.43225	.00225	.02275	.00225	.02275
s_3	.31122	.03078	.55328	.05472	.01638	.00162	.02912	.00288
s_4	.03078	.31122	.05472	.55328	.00162	.01638	.00288	.02912
s_5	.02275	.00225	.02275	.00225	.43225	.04275	.43225	.04275
s_6	.00225	.02275	.00225	.02275	.04275	.43225	.04275	.43225
s_7	.01638	.00162	.02912	.00288	.31122	.03078	.55328	.05472
s_8	.00162	.01638	.00288	.02912	.03078	.31122	.05472	.55328

= 2.5. This parameterization produced for the independent Ostrom and Smith transition matrix, simulated approval series whose HP trend-log values mimicked those of the HP trend-log of actual approval series in the 1980–90 period. Also, all simulated approval values were in the interval [0,1].

[19]The values in the Π matrix are rounded to five decimal places. Recall that s is defined in terms of the joint realization of the three shocks, s = (z,g,e). So, for example, with the symmetric Markov chains for technology and government spending shocks and the nonsymmetric Markov chain derived from the Ostrom-Smith data for 1981–88, the probability for the transition from $s_1(z_{low}, g_{low}, e_{low})$ to $s_2(z_{high}, g_{high}, e_{high})$ is $.09 \times .05 \times .50 = .00225$.

Finally, the return on inherited debt in the initial state, $R(s^I)$, and the inherited level of inherited debt, $b(s^0)$, are both set to one. And, initial assets, A, are set to 2.0.[20]

The right-hand panel of Table 3 reports the parameters for the baseline model. The fourth and fifth columns of Table 4 report the corresponding optimal policy rule; that is, how government responds in this political economic world to the joint realization of the respective sets of productivity (z), public spending (g), and approval (e) shocks. For example, the optimal decision rule implies that when s_8 (z_{high}, g_{high}, e_{high}) obtains, public authorities adopt a tax rate of .304 (row 8 of Table 4). In contrast, when faced with s_6—high productivity and high government spending shocks but *an approval diminishing shock* (row 6 of the Table), government chooses a *lower tax rate* of .281. This is because, *ceteris paribus*, lower taxes are needed to encourage more work, increase consumption, and hence increase approval (in the face of a surprise decrease in that variable). The negative real interest rate reflects the need for less borrowing from households in these circumstances. Together the eight pairs of policies constitute a contingency plan which minimizes government's discounted expected deviations from its target, in the baseline case, 55% approval.[21]

Figure 1 displays the results of a single simulation of this model. The solid lines in the figure are the HP trends. Each time point represents one of our political-economic equilibria.[22] In this particular simulation, tax and in-

[20]Recall that $R(s^1)b(s^0)$ is defined as the return on inherited debt in the initial state, s^1. One could think of the parameter A as capturing the fact that consumer net wealth is about eight times annual income. But the values of this parameter and of $R(s^1)$ and $b(s^0)$ usually are adjusted for computational purposes. Cf. Chari, Christiano, and Kehoe 1991.

[21]Insofar as interest rates are concerned, recall that households also optimize subject to the transition matrix for the different states and that government must finance its exogenously determined spending stream. The eight interest rates ensure that both things happen simultaneously. Households take the government's interest rates into account in making optimal consumption and labor input choices which maximize their expected rate of return given Π. And given these household choices and the spending path, the optimal interest rates (together with the optimal tax rates) allow government to minimize the expected sum of approval target deviations and also to finance its spending. (If we were analyzing a steady-state, or if our utility function were linear, the negative real interest rates might be counter intuitive. However, in our set-up, the marginal utility of consumption is decreasing and the environment is stochastic. Therefore there will be a point at which the household prefers to save for tomorrow, rather than consume more today [even though it is possible that the future return will be negative]. Another way to interpret the negative real interest rates is as "storage costs." Even in the presence of uniformly positive storage costs [always negative returns] there will be a point at which a maximizing consumer will prefer to pay the cost and consume tomorrow rather than accrue the very low marginal utility of consuming today.)

[22]In all, 200 observations were produced in *each* of the 1,000 simulations. The first 156 of these observations were deleted leaving 44 like those depicted in the Figure 1. The idea of a sequence of political-economic equilibria is akin to that which Prescott (1986a, 13) calls a sequence of market equilibria.

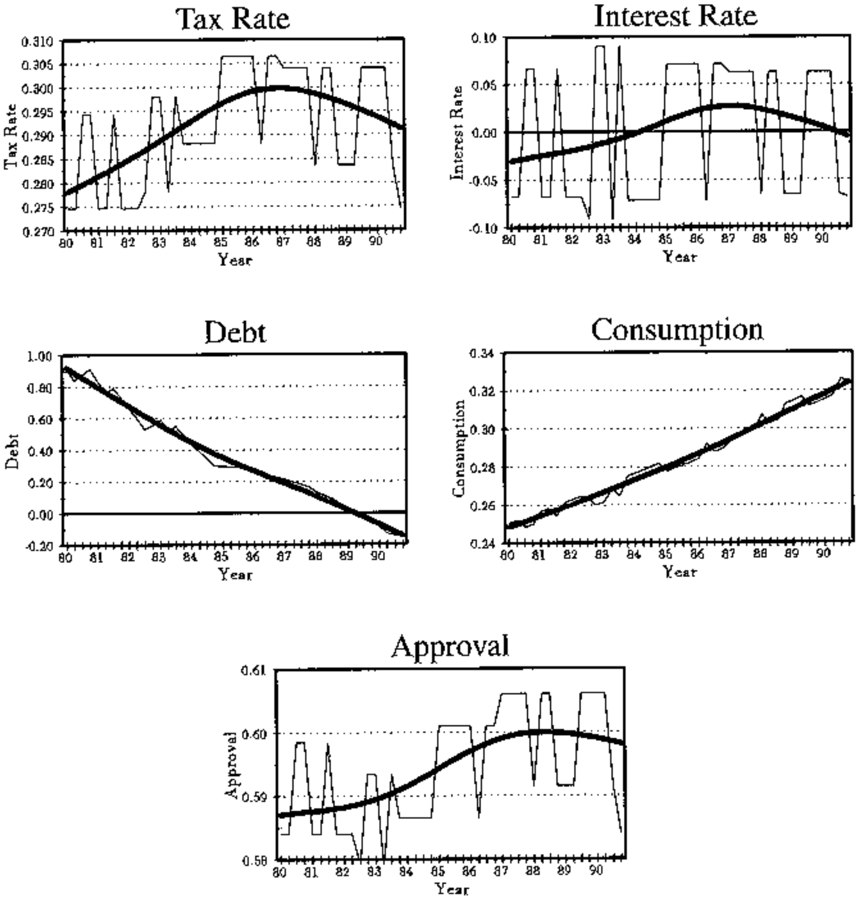
Table 3. Baseline Parameterization

Parameter	Value
ρ	0.006
β	0.990
$\overline{\beta}$	0.988
γ	0.660
θ	1.000
ψ	−1.000
$\alpha 0$	−0.025
$\alpha 1$	2.500
APP^*	0.550
b(0)	1.000
R(1)	1.000
A	2.000
Technology Shock	
Low	0.990
High	1.010
Transition Probabilities:	
Low to Low	0.950
Low to High	0.050
High to High	0.950
High to Low	0.050
Gov Spending Shock	
Low	0.074
High	0.078
Transition Probabilities	
Low to Low	0.910
Low to High	0.090
High to High	0.910
High to Low	0.090
Approval Shock	
Low	−0.014
High	0.014
Transition Probabilities:	
Low to Low	0.500
Low to High	0.500
High to High	0.640
High to Low	0.360

Table 4. Government Income Tax and Interest Rate Policy Rules

State			Model					
			Baseline		High App. Volatility		High App. Target	
(1) Productivity	(2) Gov Spending	(3) Approval	(4) Income Tax	(5) Interest Rate	(6) Income Tax	(7) Interest Rate	(8) Income Tax	(9) Interest Rate
Low	Low	Low	0.272	–0.067	0.260	–0.169	0.123	–0.076
Low	High	Low	0.275	–0.091	0.263	–0.169	0.122	–0.099
Low	Low	High	0.291	0.067	0.303	0.136	0.155	0.074
Low	High	High	0.298	0.090	0.307	0.140	0.157	0.094
High	Low	Low	0.281	–0.065	0.269	–0.168	0.138	–0.106
High	High	Low	0.285	–0.072	0.272	–0.168	0.141	–0.080
High	Low	High	0.301	0.063	0.312	0.131	0.171	0.091
High	High	High	0.304	0.071	0.315	0.136	0.171	0.077

Figure 1. A Single Simulation with Baseline Parameterization



terest rates slowly rise and then fall. Debt steadily decreases. Consumption increases as expected. All this occurs while approval is maintained within approximately 5% of the government's target.

For the overall set of 1,000 simulations, the model mimics the United States actual data rather well (Table 5). The deviations from HP trend in actual and simulated log consumption and government expenditure have similar standard deviations. The same is true of the deviations in HP trend in the actual and the simulated log output. The first order autocorrelations for deviations in HP trend of the log of government expenditure and of approval

Table 5. The Baseline Model and the Data

Variable	Standard Deviation*		Serial Correlation*	
	Actual	*Model*	*Actual*	*Model*
Log Consumption**	0.011	0.011	0.755	0.122
	—	(0.001)	—	(0.156)
Log Government Expenditure**	0.013	0.017	0.464	0.575
	—	(0.004)	—	(0.156)
Log Approval**	0.063	0.012	0.855	0.971
	—	(0.001)	—	(0.005)
Log Output**	0.015	0.008	0.798	0.012
	—	(0.001)	—	(0.152)
Government Expenditure to Output Ratio	0.233	0.235	—	—
	—	(0.003)	—	—

*Statistics for model based on 1,000, 44 quarter simulations. Empirical standard deviations are in parentheses. Figures in row nine are actual ratios.

**Deviation from Hodrick-Prescott trend.

match those for the actual data as well. The ratio of government expenditure to output is the same in the actual and simulated data. The only discrepancies are the serial correlations of the deviations from HP trend in log consumption and output; there is more persistence in the actual data than in the simulated data for these variables. But, overall, the model explains the "objective facts" which emerge from applying the decomposition methods of real business cycle theory.

Further evidence of the adequacy of the model is provided by simulation results for labor input. The model was parameterized *without* any attempt to match the properties of the simulated labor input series to those of the actual data for hours. Once the final parameterization was decided, this comparison was made. The results were reassuring. In 10,000 simulations the actual and simulated HP trends in log hours matched well. The standard deviation of the HP deviations in log hours was .00717 for the actual data and .00810 in the simulated data. This is independent confirmation of the adequacy of our model in the sample period.[23]

[23]Again, the evaluation of the model in terms of its ability to mimic actual labor input data was done *after* the parameterization was decided. From the standpoint of political science, an additional confirmation might be to check the simulated approval data for unit roots (e.g., Ostrom and Smith 1993). However, note that as a consequence of the way we conceive of approval management, the respective series simply jumps between a small number of values (Figure 1). Hence such a check is not meaningful.

Counterfactual Analyses

The value of an investigation such as this lies in what it tells us about theoretically significant counterfactuals. The baseline model allows us to gauge the importance of various structural features of the political economy in ways that are not possible with reduced form set-ups like VARs and ECMs, for example (Freeman 1993; cf. also Backus, Kydland, Kehoe 1992: esp. 765ff). We show this here by examining two questions of substantial interest to students of American political economy. The first has to do with the impact of approval volatility on policy choice and welfare. The impact of presidential consensus building is the second. Together these inquiries bear on the larger question of whether political accountability is compatible with market processes.

Approval Volatility

There is much agreement that approval is subject to unexpected, seemingly random shocks. And, many of these shocks are international events (Brody 1991; Ostrom and Smith 1993).[24] The political economic models that are used to study approval management include variables that capture these shocks (cf., for example, Alesina, Londregan, and Rosenthal 1993, 20). But none of these investigations analyze the consequences of approval volatility per se. There is good reason to do so: the nature of international relations is rapidly changing and the prospects for such shocks—and for shocks of increasing magnitudes—is a defining feature of the present world system. For example, the 1990s already have witnessed more violent international conflicts than any decade since the second world war, conflicts that by their non-state character constitute a "transformation of war" (Gantzel and Schwinghammer 1994; Jung, Schlitche, and Siegelberg 1994; van Creveld, 1991). United States involvement in international conflicts is therefore not only likely to continue to produce approval shocks, but also approval shocks of increasing magnitudes. What impact will the increased volatility in e have on political-economic equilibrium? What does such volatility mean for the ability of government to achieve its approval target? What are the welfare consequences of such efforts?

This counterfactual was studied by reanalyzing the model with the range of approval shocks increased by about 220%, more specifically, by setting $e_{\text{low}} = -.03$ and $e_{\text{high}} = +.03$. The new decision rules for this counterfactual are reported in columns 6 and 7 of Table 4. Notice that the optimal tax rates are different from those for the baseline case. For the larger ap-

[24] For example, in the Ostrom and Smith data on which Table 2.3 is based, about two thirds of the approval shocks are due to international events. In the case of the Brody data (1991: Table 3.1) *all* the events are international in character.

proval diminishing shocks, e_{low}, the tax rates are lower; for the larger approval enhancing shocks, e_{high}, the tax rates are higher. The range of the interest rates is larger in the case of greater approval volatility as well. Why is this so? Consider the case of the larger, approval diminishing shocks. These shocks lead governments to lower tax rates to encourage a comparatively greater amount of work. This creates more output and consumption and hence a greater, offsetting increase in approval. Because there is more output, there is less need for borrowing to finance the exogenously determined, government spending levels. So interest rates are comparatively lower. The converse is true for the larger approval shocks associated with the high volatility case.

Figure 3 depicts a single simulation for the high approval volatility counterfactual. To establish comparability to the baseline case, the same sequence of states is used that produced Figure 1. First, notice that in the face of greater volatility in e government has more difficulty achieving its target. Within five to six years, the level of approval is about 6% above the .55 value. As regards the economic variables, tax and interest rates behave as before, rising slowly and then falling. Debt again decreases steadily while consumption steadily increases. Figure 1 suggests then that higher approval volatility may not have a substantial impact on political-economic equilibration.

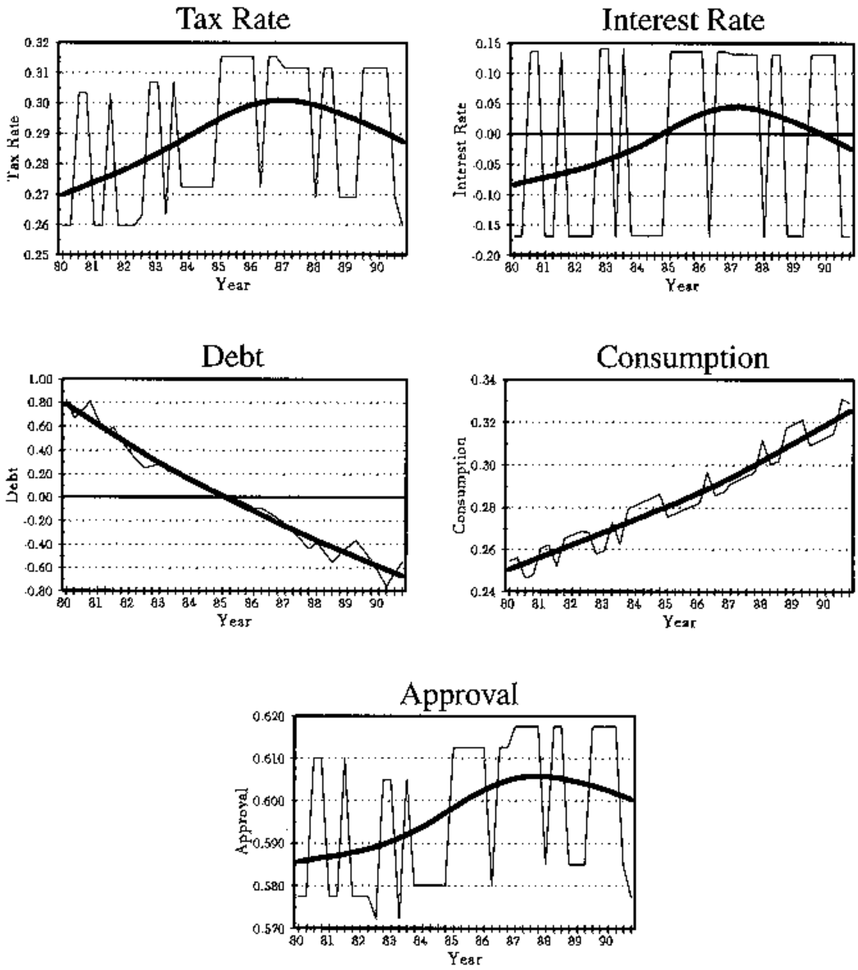
Closer study of the counterfactual model reveals otherwise, however. Simulation of it (Table 6) shows that high approval volatility produces socially harmful fluctuations in certain macroeconomic variables. In particular, the standard deviation of deviations from HP trends in log consumption and log output are *double* those for the baseline case. As a result, the welfare of the representative household is slightly lower in the counterfactual. To be specific, high approval volatility produces about a .01% drop in the welfare of the representative household.[25] In this way, the analysis shows that important "business cycles phenomena" (Lucas 1987) can be traced, in part, to government approval maintenance in an increasingly volatile international polity.

Presidents Who "Love Dangerously"

The baseline model assumed that governments strive to create what is essentially a minimum winning coalition of 55% approval. But some governments strive for more support than this, for presumably excessive, consensual levels of support. These governments often are criticized for being too attached to their approval rating and hence for "Loving Dangerously" (*The*

[25] The welfare of the representative consumer is calculated by evaluating its objective function in the simulations, more specifically, by summing its realized, discounted present utility at each point in time.

Figure 2. A Single Simulation with High Approval Shocks



Economist January 24, 1991, 21–4). What is the consequence of such behavior? Is consensus building socially harmful? If so, in what way?

This counterfactual was studied by setting APP* equal to .70 rather than to the baseline value of .55.[26] The resulting decision rule is reported in col-

[26] For this counterfactual A was reset to –3.25. Technically, this was done for computational reasons (cf. fn. 20). Substantively, it means the representative household was assumed initially to hold personal debt roughly nine times its income. In relation to our design, this revised value of A provides a stringent evaluation of the Loving Dangerously argument—an assessment of whether a society with a large initial level of indebtedness can afford a president who strives for political consensus.

Table 6. Large Approval Shocks and Baseline Models

Variable	Standard Deviation*		Serial Correlation*	
	L.A.S.	*Baseline*	*L.A.S.*	*Baseline*
Log Consumption**	0.021	0.011	0.044	0.122
	(0.001)	(0.001)	(0.152)	(0.156)
Log Government Expenditure**	0.017	0.017	0.575	0.575
	(0.004)	(0.004)	(0.156)	(0.156)
Log Approval**	0.026	0.012	0.971	0.971
	(0.001)	(0.001)	(0.005)	(0.005)
Log Output**	0.016	0.008	0.048	0.012
	(0.001)	(0.001)	(0.150)	(0.152)
Government Expenditure to Output Ratio	0.235	0.235	—	—
	(0.003)	(0.003)	—	—

*Statistics based on 1,000, 44 quarter simulations. Empirical standard deviations are in parentheses. Figures in row nine are actual ratios.

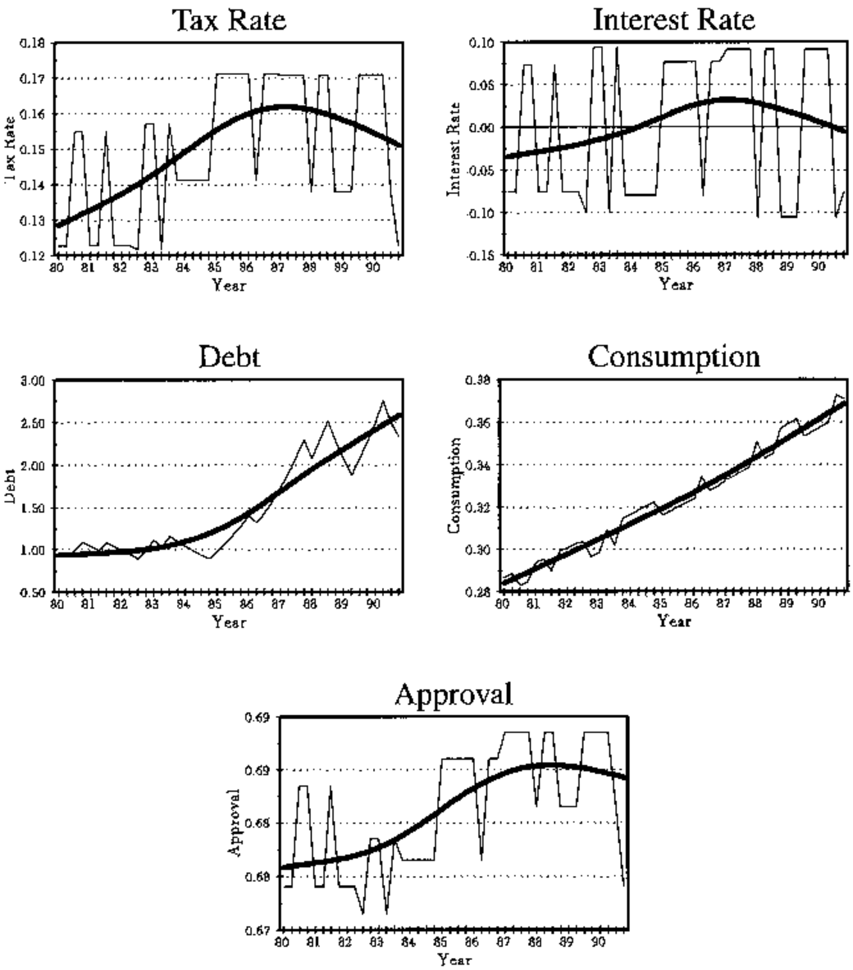
**Deviation from Hodrick-Prescott trend.

umns 8 and 9 of Table 4. The indications are that for a target of 70% approval governments adopt much lower tax rates and a wider range of interest rates than in the baseline case. In terms of our model, the lower tax rates encourage households to work. This increases output and consumption; in turn, approval is augmented. For example, for the state of low productivity and low government shocks and approval diminishing shocks (s_1), the tax rate now is .123 as compared to the baseline tax rate of .272. In the high productivity and government expenditure shocks and approval enhancing shock state (s_8), the tax rate is only .171 for the counterfactual whereas the corresponding rate was .304 in the baseline. According to the solution, adjustments are needed in the interest rates for the different states to enable government to finance its spending in the face of this new tax schedule (fn. 21).

Figure 3 reports the results of the comparable simulation for this model. Note that government is more successful in achieving its objective in this case. Approval gets within 1% of the higher target value. The trend in consumption again is increasing. But, interestingly, the trend in debt is increasing as well. In this respect, the pursuit of the higher approval target has a different impact on the macroeconomy than the pursuit of the minimum winning approval target.

The results of the 1,000 simulations of this second counterfactual model are reported in Table 7. They indicate that the pursuit of the higher approval target (H.A.T.) has no substantial effect on the volatility of consumption and of output. Deviations in HP trend log consumption and in HP trend log output have essentially the same standard deviations as in the baseline case. The

Figure 3. A Single Simulation with High Approval Target



degrees of persistence in these deviations are slightly different. The main difference is in the ratio of government expenditure to output. The average value of this ratio is slightly lower for the simulations of the high approval target model. Again, this lower average ratio of government spending to output is associated with budget shortfalls rather than surpluses. As for welfare consequences, in the high approval target simulations the representative household's discounted expected utility is 7–8% *higher* than in the baseline

Table 7. High Approval Target and Baseline Models

Variable	Standard Deviation*		Serial Correlation*	
	H.A.T.	*Baseline*	*H.A.T.*	*Baseline*
Log Consumption**	0.013	0.011	0.067	0.122
	(0.001)	(0.001)	(0.150)	(0.156)
Log Government Expenditure**	0.017	0.017	0.575	0.575
	(0.004)	(0.004)	(0.156)	(0.156)
Log Approval**	0.006	0.012	0.970	0.971
	(0.001)	(0.001)	(0.006)	(0.152)
Log Output**	0.010	0.008	0.079	0.012
	(0.001)	(0.001)	(0.150)	(0.152)
Government Expenditure to Output Ratio	0.213	0.235	—	—
	(0.002)	(0.003)	—	—

*Statistics based on 1,000, 44 quarter simulations. Empirical standard deviations are in parentheses. Figures in row nine are actual ratios.

**Deviation from Hodrick-Prescott trend.

case. So the indications are that for the living generation at least, "Loving Dangerously"—presidential pursuit of near consensual approval targets—is not socially harmful.

Conclusion

As a means of connecting economic and political equilibration, the model in this paper has many virtues. First and foremost it achieves a genuine theoretical synthesis. The model fuses a general equilibrium economy with a rational, optimizing household to an approval-oriented polity with a rational, optimizing government. It thus is more balanced and complete than many of its counterparts. In addition, for the first time, we have a political economic set-up which explains quarterly (and potentially monthly) equilibration. Unlike others in the literature, our model does *not* imply that equilibration occurs only every several years, e.g., that the political economic world "starts over every four years." In this regard, it is much more realistic and useful than its competitors. Third, the stochastic natures of economic and political processes are expressly incorporated in our analysis. The constraints or "laws of economic and political motion" include random variables for productivity, government spending, and approval shocks and, concomitantly, agents engage in stochastic optimization. Finally, the investigation is a methodological advance. The analyses of the formal model and of the data are consistent. For example, the stochastic elements of the model are interpreted in the same way in the derivation of the agents' optimal decision rule as in the decomposition, simulation, and statistical analysis. The investigation thus has the added payoff of answering Bartels's and Brady's (1993) and others' call for a better marriage of formal theory and political methodology.[27]

Of course the model can be improved in a number of ways. Like the Alesina, Londregan, and Rosenthal formalism (1993, 14) and early contributions to the real business cycle genre (Lucas and Stokey 1983), it does not include capital. Output is solely a function of labor input. Among other things, this weakens the intertemporal content of the model.[28] More complex approval functions ought to be studied; the assumption that $\alpha_2 = 0$ ought to be relaxed so that approval depends on both normed consumption and labor input. More generally, our approval function is disembodied insofar as it is not connected analytically to household decision-making. We need a set-up in which households choose consumption and level of work effort and dispense approval simultaneously. What we have now is essentially an approval technology rather than a fully rationalized approval function. There is also no provision for heterogeneity in our set-up. Clearly, different types of households make economic and political choices differently. And presidents care more about the approval of some subsets of constituents than that of other subsets. This needs to be incorporated somehow.

The polity in the model could be enriched in other ways. At present, there is obviously no provision for the separation of powers among different political institutions or for elections. To the extent that economic policymaking and the effects thereof can be traced more to the executive than to the legislative branch (Alesina, Londregan, and Rosenthal 1993, 13) and the objective facts with which we are concerned have to do with macroeconomic trends, the former is not serious. Nor is it clear that the absence of electoral forces is problematic. It is important to remember that the present model does quite well in mimicking the American political economy at least in the virtual single party era we study. Table 5 shows that, without any provision for the elections of the 1980s, when a theoretically consistent decomposition method is employed, the behavior of our political-economy matches that of the United States. Also there is no evidence of any electoral pattern in the short and medium term fluctuations in approval; for instance, these fluctuations are below, above, and roughly equal to the long-term trend

[27]The nature of this methodological contribution is explained elsewhere. See Freeman (1993, 1995).

[28]Among other things, adding capital to the production function will create an arbitrage condition that will limit government's ability to use the interest rate to finance its spending. Of course, this change in the model will also introduce another decision variable: investment. Practically speaking, adding capital will necessitate the application of even more complex solution methods. Cf. Chari Christiano, and Kehoe (1991, esp. fn. 2).

in approval in different election years (cf. Figure A-2 in the Appendix to our paper; cf. fn. 7). Provisions for electoral forces eventually ought to be made; for instance, the usefulness of allowing APP* to vary over time ought to be explored. But, it may well be that the political accountability that is most important for the study of democracy and markets occurs, over the long-term, through some connection between low frequency trends in economic and political variables like those which the HP filter captures and, over the short and medium terms, through surveys of approval and related popular evaluations of government, not through what are infrequent elections.[29] Finally, the claim that unitary agent set-ups can be useful notwithstanding (Lalman, Oppenheimer, and Swistak 1993, 80), there is very little basis for this aspect of our model. Incorporating differences in the preferences of parties and administrations therefore seems essential, especially if we want to analyze political-economic equilibria across partisan eras. In this context it is essential that provision be made for the endogeneity of approval, particularly for the returns which accrue to presidents in terms of legislative (policy) outcomes by virtue of their approval rating.

It is not clear to exactly which tasks future work ought to be dedicated. Simply adding capital to the present model and allowing for some heterogeneity of households creates some technical challenges. Yet these are the natural next steps insofar as the economic part of the model is concerned. Developing a set-up in this context whereby households choose consumption, labor input, and approval simultaneously and approval yields policy returns is also a challenging task. This is necessary, however, to achieve a better synthesis between economics and political science. The next step then is to modify the model in these ways and to determine if our findings about the effects of approval volatility and consensus building hold up. It is conceivable that such augmentations will add not just to our understanding of political reality but of macroeconomic reality as well.[30]

In the spirit of the *AJPS* workshop, the present effort has laid the groundwork for these extensions. It has shown how a theoretically balanced,

[29]To reiterate, it is common in approval studies to focus on a single party/administrative era as we have (e.g., Ostrom and Smith 1993). And, while early works such as those of Nordhaus (1975), Tufte (1978), and Hibbs (1977) claimed that elections had marked and lasting effects on the macroeconomy, the current thinking (Alesina 1988) holds that these effects often are minor and short-lived. This is especially true if, as is usually the case, there is little or no uncertainty about who will win the election. We are indebted to Michael Alvarez for the point about the possible connection between low frequencies trends in approval and in macroeconomic variables like growth.

[30]It should be true that by introducing political elements into real business cycle models the performance of those set-ups will improve. For instance, the low variability of labor productivity in these models might be a result of the failure to consider the political correlates of fiscal shocks. Cf. McGrattan, (1994).

temporally disaggregated, genuinely stochastic, and methodologically coherent political-economic model can be built. And it has introduced a new and improved conception of political-economic equilibrium.

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