Bulletin Number 96-1
February 1996

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This is a much condensed version of a paper delivered at the 1995 Annual Meeting of the A.P.S.A., the Hubert Humphrey Institute's seminar on Trade and Development, and on the Committee for Institutional Cooperation's political science, interactive video seminar. The author gratefully acknowledges the research assistance of Daniel Houser and Marcelo Veriacerto and the research support of the National Science Foundation. For useful comments and criticisms he thanks James Granato, John Jackson, George Krause, Eric Lawrence, and the participants in the above panel and seminars. The author is responsible for the papers contents.

Abstract

Despite much hard work in recent years, economics and political science remain largely separate disciplines. Few meaningful bridges have been build between them, and hence useful gains from intellectual trade between the two have not been realized. Some of the most recent efforts to construct such a bridge are critically evaluated. It is shown that this literature suffers 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.

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 which 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 (Lucas, 1984, Prescott, 1986, 1991, Kyland and Precott 1990, 1991) and political methodologists (Brady, forthcoming; Jackson, 1995)) the model is calibrated for the U.S. It is demonstrated that the calibrated model mimics the data for the U.S., that is, when simulated, the model produces time series which when appropriately detrended have properties which are very similar to those of detrended actual data for the sample period. Finally, the model is used to study some important counterfactuals. One of these is the impact of the increase in approval volatility that the new world order is likely to spawn; the other is an assessment of the impact of Presidents pursuing relatively high--nonminimum winning--levels of approval. In these ways, a better bridge is constructed between the two disciplines and valuable insights are gained into the interplay of democracy and markets.

Political science and economics today are largely separate intellectual communities. Clearly we would benefit if bridges could be constructed between the disciplines. Such bridges would help us realize gains from intellectual trade: enhanced abilities to explain political-economic anomalies and the causal connections between political and economic institutions as well as to analyze important counterfactuals about the relation between democracy and markets. Building such bridges entails fusing the theories in the two fields, for example, introducing the new dynamic and stochastic elements of modern macroeconomic theory into theories of politics on the one hand and allowing governments and other agents in economic theory to be motivated by political concerns like maintaining popular approval on the other. Constructing an interdisciplinary bridge also involves use of common approaches to model construction and evaluation; data analysis must be conceived in the same way by bridge builders or we will not agree about when political economic models are in need of refinement or even what such models teach us.

Unfortunately, few such bridges between economics and political science exist. 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 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); and, 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 tied to the behavior any rational agent, let alone the agents which appear in macroeconomic models. And the time series decomposition and other data analytic techniques that are used by the respective economists 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 result, possible gains from trade between these two bodies of work are not realized. Important questions about such things as the impact which the new world order might have on approval volatility and, in turn, on markets and economic welfare remain unanswered.[1,2]

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[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 uncertain. The behavior of the competitive economy is shown to be equivalent to that of a benign social planner who engages in stochastic optimization (Lucas, Stokey, and Prescott, 1989). That this school of economics largely ignores the political motivations of agents evident in such works as Chari et al., 1991: esp. 529, Barnett, 1993: 466; and McGrattan, 1994: esp. p. 9.

[2] Some approval theorists test for the exogeneity of selected economic variables (MacKuen, Erikson, and Stimson, 1992b). But, usually these theorists assume that the 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 is the notion of a moving equilibrium in approval, unemployment, and inflation as governed by an error correction (ECM) model; see Ostrom and Smith, 1993. Political scientists have not made any attempt to link the ECM to the behavior of any rational agents. This is in spite of the fact that such rationalizations have been known for some time (Nickell, 1985).

Of course, some scholars have attempted to build these bridges and to realize these gains. Table 1 summarizes some the most recent of these contributions. Consider, for example, the work under the second column.[3] 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 arguably is 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 coalition proof Nash equilibrium which connotes

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

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.[4]

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

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[4] 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).

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). With 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 show that the conventional wisdom about fiscal policy does not hold up when policy is treated as endogenous and equilibrium is of the political-economic kind. 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 where tax changes are not constrained by politics.[5]

These models are among the most promising interdisciplinary bridges 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.

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[5] 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 ($P = V_c^{\mu_c} V_w^{\mu_w}$ where $\mu_c + \mu_w = 1$). 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.

Unfortunately, as interdisciplinary bridges, 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--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.[6] Second, the conceptions of political-economic reality in these models are high temporally aggregated. Political-economic equilibria are realized only when Presidential elections occur; in this sense, "the world starts over every four years" (Alesina et al., 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 still is 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 bridges that

[6] 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 truly is state of the art. However, most of the articles in it study the polity in isolation of the economy. Alesina's models represent the economy as a single equation--the Lucas supply function. His models do not provide for optimization by economic agents.

can facilitate meaningful exchanges between economics and political science then these models are important advances but still in need of substantial improvements.[7]

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 et. al., 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

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[7] As regards 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" which are not in the formal model (see esp. Ibid., p. 21). There is no strategy for assessing the empirical accuracy of the van der Ploeg and Drissen and van Winden models. 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.

variables representing technological innovation, government spending shocks, and approval shocks. There emerges from this construction, a notion of computable political-economic equilibrium which 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 analysis techniques developed in parallel by real business cycle theorists (Prescott, 1986, 1991; Kyland and Prescott, 1990, 1991) and political methodologists (Brady, forthcoming; Jackson, 1995), the model is calibrated for the United States in the period 1977-1990. It is shown that the calibrated model mimics the data for the U.S., that is, when simulated, the model produces time series which when detrended have properties which are very similar to those of detrended actual data in the indicated period. To achieve comparability, the detrending method is that used by real business cycle theorists: 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 the new international order is likely to spawn. The other is an assessment of the political and economic implications of Presidents pursuing high approval levels or, of what is called euphemistically Presidents "loving dangerously" (The Economist, January 24, 1994: 21-4). In these ways, a better bridge is constructed between two important disciplinary communities and fruitful insights are gained into the interplay of democracy and markets.[8,9]

[8] My model thus is in the spirit of the work of Alesina, Londregan, and Rosenthal (1993), Brady (forthcoming), Brady and Ansolabehere (1989), and Jackson (1995). For instance, like Jackson's (1995) set-up, I have a formal model of the polity, a set-up with substantively meaningful stochastic elements. In addition, my model provides for equilibration relative to exogenously determined growth paths for output and for government spending. But this equilibration is not path dependent per se. On the other hand, in my 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, my parameterization is based on a calibration for a particular era of U.S. history. In comparison to the model of Alesina, Londregan and Rosenthal (1993), my set-up has a full blown economy with optimizing households and stochastic political and economic processes.

The theory of optimal fiscal policy makes no explicit provision for electoral or other political motivations of governments (nor do other works in the real business cycle literature such as Hansen and Prescott, 1992, cf. esp. pps. 22-23). The following model makes the political accountability problem explicit. It assumes that in addition to making consumption and labor decisions, households also dispense approval. The state of the political economy is defined in terms of two possible possible independent values each for productivity, government spending, and approval shocks or 8 states in all. A Markov process is assumed to govern the transitions between the states.

[9] 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 fequency). The mathematics and statistics of this decomposition are discussed in the Appendix. 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. To build a meaningful bridge between approval theory and real business cycle theory the same decomposition has to be employed. This is done and interpreted below; see fns. 23 and 34. For a fuller discussion of the HP filter in particular and decomposition in general see the Appendix and Freeman and Stimson, 1994.

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 1980-1990 the same party controlled the White House. This fact figures in the interpretation of the results.

A Computable Political-Economic Equilibrium Model

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

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

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, 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. Production technology is defined by

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

so that output is a function only of labor but via a stochastic process, z, representing productivity shocks. The term $(1+\rho)^t$ represents positive exogenous growth, $\rho \geq 0$. Assume that government spending grows in the same way.[10] Then the feasibility or resource constraint reconciles the level of consumption by the household and government spending, g:

$$c(s^t) + (1+\rho)^t g(s^t) \leq z(s^t)(1+\rho)^t f(\ell(s^t)). \quad (3)$$

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

[10] Again, s^t is defined below in terms of the joint realization of independent production, government spending, and approval shocks, and u( ) is a Markov transition matrix for these shocks. (cf. Stokey and Lucas, 1989, esp. Chp. 11). The growth factor, $(1+\rho)^t$, is interpreted as the effect of the sum of production augmenting technology shocks over time.

on the debt at rate, R, and taxes wages at rate, τ. The household then faces the following problem:

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

such that

$$c(s^t) + b(s^t) \leq (1-\tau(s^t))w(s^t)\ell(s^t) + R(s^t)b(s^{t-1}) + V(s^t);$$

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

that is, the household chooses consumption and labor to maximize the discounted present value of its utility subject to the 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. The household is assumed to own all firms. For these firms competitive equilibrium ensures that

$$V(s^t) = \max_{\ell}\ z(s^t)(1+\rho)^t f[\ell(s^t)] - w(s^t)\ell(s^t) \tag{5}$$

or, that the level of production is that which maximizes the difference between output and net wages where output is subject to the stochastic variable, $z(s^t)$, and the exogenous growth factor, $(1+\rho)^t$.[11]

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

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[11] 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.

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

$\bar{\beta}$ is the government discount rate and u( ) is defined as before.[12] Assume further that government faces two constraints. The first is expressly political in nature:

$$APP(s^t) = \alpha_0 + \alpha_1 c(s^t) + \alpha_2 \ell(s^t) + e(s^t) \tag{7}$$

where α_1 and α_2 represent the impact of consumption and labor input on approval, and e is a random or disturbance term representing rally and other essentially random shocks.[13] The second is government's 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:

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

In our model, then, government spending is, in effect, determined exogenously (Chari et al., 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 $\pi(s^t) \equiv (\tau(s^t), R(s^t))$. Thus the government policy is indexed by the state of the political-economic world, s^t. Abbreviate the government's policy as $\pi \equiv \pi(s^t)$. Similarly, let $x(s^t) \equiv (c(s^t), \ell(s^t), b(s^t))$ represent the allocation for the

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[12] Thus, in our temporally disaggregated set-up, government's time horizon is infinite. However, via $\bar{\beta}$ it may discount the future.

[13] The approval function and its relation to household optimization are described in more detail below in the calibration section.

representative household for s^t. Abbreviate this $x \equiv x(s^t)$. Now the household bases its allocation decisions on government policy choices, or $x(\pi) = (x(s^t|\pi))$. And market equilibrium implies for prices that $w(\pi)= w(s^t|\pi)$ and for profits that $V(\pi)= V(s^t|\pi)$. It follows therefore that a political motivated economic equilibrium is a combination of decisions, $\{\pi^*, x(\cdot), w(\cdot), v(\cdot)\}$ such that

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

$$\underset{\tau, R}{Min} \sum_t \sum_{s^t} \bar{\beta}^t u(s^t)[(APP(s^t)-APP*)^2] \tag{9}$$

subject to

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

and

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

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

III. For every π'

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

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

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

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

such that

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

$$\sum_{t} \sum_{s^t} \beta^t u(s^t)[U_c(s^t)c(s^t) + U_\ell(s^t)\ell(s^t)] = U_c(s_o)R(s_o)b_{-1} \tag{9.2}$$

$$APP(s^t) = \alpha_0 + \alpha_1 c(s^t) + \alpha_2 \ell(s^t) + e(s^t) \tag{9.3}$$

$$c(\cdot),\ \ell(\cdot) \geq 0,\ \ell(\cdot) \leq 1. \tag{9.4}$$

where U_c and U_ℓ are marginal utilities for consumption and labor and b_{-1} is the initial stock of debt.[14] The solution to the problem is derived in the Appendix. 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 (2x2x2=) 8 states. The optimal decision rule is eight pairs 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.

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[14] Time consistency is assumed here insofar as government chooses a decision rule for τ and R and then adheres to this rule in all subsequent periods.

Additional Specification and Calibration[15] The utility function is assumed to have a standard form, that is,

$$U(c,1) = \frac{\{c^{1-\gamma}(1-\ell)^{\gamma}\}^{\psi}}{\psi} \qquad \psi<1, \psi \neq 0. \tag{10}$$

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 which normally is used in real business cycle research. With it, the marginal utilities for consumption and labor are[16]:

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

Labor effort is operationalized as the percentage of available time net of sleep and personal care that is devoted to work. Following conventional practice, the available time--the household time endowment--each quarter is assumed to be 1369 hours (Christiano and

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[15] Daniel Houser's assistance in calibrating the model is gratefully acknowledged.

[16] Some of the results of real business cycle studies are derived for an even more general class of utility functions (cf. Chari *et al.*, 1991). Also, some researchers make allowance for the intertemporal substitutability of leisure, more specifically, for valuation of lags of leisure (Kyland and Prescott, 1982: esp. 1351; Backus, Kyland, and Kehoe, 1992, 1993). Others do not make such provision or find that allowance for leisure durability makes no difference in their results (Backus, Kehoe, Kyland, 1992). Finally, it should be noted that while most researchers normalize leisure (labor) on the zero-one interval, some (Chari *et al.*, 1991) use absolute level of hours in their set-up ups. Still others maintain that both employment levels and hours are needed to capture labor volatility (Kyland, 1994). More complicated set-ups of these kinds will be evaluated in future research.

Eichenbaum, 1990; Chari *et al.*, 1991). For our initial analysis, 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 corresponds to a real quarterly interest rate of 1%.[17]

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 (Kyland and Prescott, 1982; Backus, Kyland, and Keohoe, 1992) 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

$$y = z(s^t)(1+\rho)^t f(\ell) = z(s^t)(1+\rho)^t \ell^{\theta}. \qquad (2)$$

It can be shown that with our set-up, θ is the labor share proportion or constant fraction of output that labor earns as income. Usually this number is assumed to be between .6 and .7. Following many real business cycle theorists we set θ to .64. 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 U.S. in

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[17] There is little consensus about the values of the curvature parameter. Hence, researchers sometimes study their models' behaviors for alternative values of psi (Chari *et al.*, 1991) or they impose a particular value which improves the behavior of their models (Backus, Kyland, and Kehoe, 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. Prescott, 1986, Backus, Kyland, and Kehoe, 1992). [Actually ψ was set to -.99 for computational purposes.] The value for gamma usually is assumed to be either .80 or .66. The latter value is assumed here since it is the one used in the studies from which we drew our value for ψ. Also, 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}.

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 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 calibration that mimicked important properties of U.S. 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 trend log-output matched those of actual U.S. data in the chosen time period (1977-1990). The final values for these parameters are π=.91, z_{low} = .97, and z_{high} = 1.03. [Note that the value for π is identical to that used in Chari *et al.*, 1991.][18,19]

[18] Various, related production functions are used by real business cycle researchers. The simplest of these posits output to be equal to the product of technology shocks and a weighted (multiplicative) combination of labor and capital inputs; see Backus, Kyland, and Kehoe (1993) for instance. Our function, (2), is a still simpler version of this set-up. More complex production functions include variables for inventories (Kyland and Prescott, 1982; Backus, Kyland, and Keohoe, 1992) or variables for deterministic growth in labor augmenting technological change (Chari *et al.* 1991). In the latter, technology shocks enter as factors which increase/decrease the rate of change in the growth variable (*Ibid.*, p. 529; see fn. 19 below). Calibration is by such methods as matching output ratios relative to key variables to those for actual data and matching covariances of per cent deviations from steady states for the model with the same statistics relative to long-run average values of actual economic variables (Kyland and Prescott, 1982). In other cases, parameters in the production function are estimated by the Generalized Moment Method (Christiano and Eichenbaum, 1990). Again, the parameters which have been calibrated with these approaches all are for models which, unlike ours, contain both capital and labor inputs.

In Chari *et al.* (1991) and related works, government spending is assumed to grow exponentially. In particular, it is assumed that $g_t = ge^{\rho t}$ where ρ is the deterministic growth rate in g_t and g is governed by another symmetric, two-state Markov chain. Our formulation is similar except we assume the growth factor is $(1+\rho)^t$. Hence we have g_t =

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[19](...continued)

[19] Data on average hours worked per quarter were obtained from 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 data is the Electronic Bulletin Board of the National Technical Information Service (Stimson Macropolity Data Set). Both the n hours series and real GNP series are seasonally adjusted.

Note that the Chari *et al.* (1991) production function is of the form

$$y = F(k, \ell, z, t) = k^{\alpha}[e^{\psi t+z}\ell]^{(1-\alpha)}$$

so

$$\log y = \alpha \log k + (1-\alpha)\log[e^{\psi t+z}\ell]$$

$$= \alpha \log k + (1-\alpha)\psi t + (1-\alpha)z + (1-\alpha)\ell$$

We have, in contrast,

$$y = z(1+\rho)^t \ell^{\theta}$$

$$\log y = \log z + t(1+\rho)^t + \theta \log \ell.$$

In the calibration analysis one thousand 200 quarter simulations were run. The first 145 observations of each simulation were dropped. The parameters were determined on the basis of the average values of the statistics for the remaining 55 observations (in the one thousand simulations).

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 1980-1990 the same party controlled the White House. This fact figures in the interpretation of the model below.

$g(1+\rho)^t$ 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 calibration which 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 U.S. data in the chosen period. This is the calibration $g_{low} = .077$, $g_{high} = .11$ and $\Theta = .95$. [Once more the transition probability is the same as that which Chari *et al.* 1991 employ.][20]

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

$$App(s^t) = \alpha_0 + \alpha_1 c(s^t) + \alpha_2 \ell(s^t) + e(s^t). \tag{7}$$

Clearly the literature in political science contains more complex functions. But this simple one still captures basic claims about the importance of the two variables in determining citizens willingness to dispense approval. The approval function is unique in that it contains a labor variable which, for the first time, bears a direct connection to the standard form of the production function in modern macroeconomics; the labor variable is an input--hours worked as proportion of time endowment--not an outcome like unemployment. Also the fact that the function contains a stochastic term is consistent with the fact that

[20] The same simulation procedures were used to calibrate the government spending component of the model as for the production component. Cf. fn. 19.

virtually all students of approval include variables for "special moments," "rally events," "extraordinary and ordinary events" and the like.[21]

Ideally, to follow the approach used by real business cycle theorists, we would calibrate (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, forthcoming). Unfortunately, the micro observations required for this are not available. The NES data on approval for the 1972-1976 panel do not contain questions about consumption and employment which are sufficiently comparable to the present variables. Nor are the

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[21] The claim that approval depends on the performance of the labor market is well established (Hibbs, 1982; Beck, 1991, Ostrom and Smith, 1993; Mackuen, Erikson, and Stimson, 1992). However, most scholars focus on unemployment, a market outcome, rather than on labor inputs. This is in spite of the fact that modern business cycle theory is largely couched in terms of the latter, and there is much anecdotal evidence that approval is related to labor inputs. For example, see "The Year of Loving Dangerously" The Economist January 15, 1994: 23-4. The present set-up allows for the possibility that households disapprove when hours increase (hence leisure declines),

$$\frac{\partial APP}{\partial \ell} < 0,$$

or that households approve when hours increase seemingly in some sociotropic fashion,

$$\frac{\partial APP}{\partial \ell} > 0.$$

[It may be possible to express the model in terms which are closer to the unemployment formulation which many political scientists use, that is, in terms of the employment lottery households face (Hansen, 1985). However, note that recent comparative studies of this and other formulations of real business cycle models indicate that the employment lottery interpretation worsens the performance of these models in a number of important respects (McGrattan, 1994).]

statistical estimates one obtains from these panel data easy to interpret in relation to the coefficients in (7).[22]

The more heuristic calibration method therefore was used. Some simple regressions were run to obtain initial estimates of the alphas. Then, using the Markov chain for approval shocks described momentarily, simulations were run for these initial alphas. The alphas then were adjusted to obtain simulated HP trend log Approval series whose properties matched those of actual HP trend log Approval series for the period 1977-1990. In this initial analysis of the model we assumed that Approval is a function of labor input alone. Our value for α_1 therefore is zero; our final values for α_0 and α_2 are reported below.[23]

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

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[22] 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 are related to consumption certainly. 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, 1986: esp p. 14). For example, logit coefficients for 1972 data on approval and personal finances are .617 (constant) and .061. A regression of aggregate approval on consumption with the corresponding coefficients set at these values yields nonsensical results like residuals in aggregate approval on the order of 4000.

[23] Once more the HP trend in Approval is the long-term (low frequency) component in that series, Cf. fn. 9. 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 economic growth. Creating such a decomposition is important here to achieve comparability in time frame of the two theories. See Freeman and Stimson, 1994.

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 existence of two-state, nonsymmetric Markov chains like the following:

BRODY (1947-1986)

$$t \quad \begin{array}{c} \\ - \\ + \end{array} \overset{t+1}{\begin{array}{cc} - & + \\ \hline .32 & .68 \\ .38 & .62 \end{array}}$$

Table 2.1

OSTROM & SMITH (1981-1988)

$$t \quad \begin{array}{c} \\ - \\ + \end{array} \overset{t+1}{\begin{array}{cc} - & + \\ \hline .50 & .50 \\ .36 & .64 \end{array}}$$

Table 2.2

BRODY (1964-1986)

$$t \quad \begin{array}{c} \\ - \\ + \end{array} \overset{t+1}{\begin{array}{cc} - & + \\ \hline .33 & .67 \\ .45 & .55 \end{array}}$$

Table 2.3

where the + and - denote approval enhancing and diminishing events, respectively. 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 calibration is: $\alpha_0 = 1.6$, $\alpha_2 = -4.5$, $e_{low} = -.02$ and $e_{high} =$

.02 (α_1=0). This implies that the stochastic element of the polity produces shocks which cause shifts in Approval in the range of 4%.[24]

Several parameters remain to be specified. As explained in the Appendix our solution to the Political Motivated Allocation Problem requires that $\bar{\beta} = \beta(1+\rho)^{(1-\delta)\psi}$. With the parameters described above this means that $\bar{\beta}$ = .988, or that government is slightly more myopic than households. For our calibration, we set APP* equal to a value roughly equivalent to a "minimum winning" target of .55. Recall that s represents the joint realization of the technology, 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:[25]

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[24] 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 labor input for the period 1977-1990 produced a statistically significant negative correlation between the two variables; see Figure A-1 in the Appendix. The regression coefficients were α_0=3.2 and α_1 = -8.6. Unfortunately, the optimization algorithm did not yield a solution for these values (Cf. Appendix, fn. 4). After some experimentation we settled on values of α_0 = 1.6 and α_2 = -4.5. The solution algorithm converges for these values. And, as noted in the text, this calibration 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 1977-1990 period. Also with our calibration all simulated Approval values were in the interval [0,1].

[25] The values in the Π matrix are rounded to four 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 1981-1988, the probability for the transition from $s_1(z_{low}, g_{low}, e_{low})$ to $s_2(z_{high}, g_{high}, e_{high})$ is .09x.05=.00162.

	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

Finally, the parameter for the return on inherited debt in the initial state, $R(s_0)b_{-1}$, is set to zero.[26]

The right hand panel of Table 3 reports the parameters for the calibration. 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 technology (z), public spending (g), and approval (e) shocks. For example, the optimal decision rule implies that when s_1 (z_{low}, g_{low}, e_{low}) obtains, public authorities adopt a tax rate of .29 and a real interest rate on public debt of .15. In contrast, when faced with s_3--low productivity and low government spending shocks but an approval enhancing shock (row 3 of the Table), government chooses a lower tax rate of .25 and a negative interest rate of -.08. This is because, ceteris paribus, a higher labor input and hence less leisure induced Approval is needed to achieve the target (in the face of the larger surge in e). The negative interest rate reflects the need for less borrowing from households in these circumstances. Together the eight pairs of policies constitute a

[26] Recall that $R(s_0)b_{-1}$ is defined as the return on inherited debt in the initial state, s_0. This parameter usually is set to zero (Chari *et al.*, 1991). [In the actual computations it is set to .001.]

contingency plan which minimizes government's discounted expected deviations from its approval target, here 55% Approval.[27]

Figure 1 displays the results of a single simulation of the calibrated model. The solid lines in it are the HP trends (cf. fn. 23). Each time point represents one of our political-economic equilibria.[28] In this particular simulation, taxes and interest rates fall initially and then increase. Debt oscillates peaking in the mid-1980s. Consumption increases as expected. All this occurs while Approval is kept in a narrow range approximately 2% below the government's target.

For the overall set of 1000 simulations, the model mimics the actual data rather well (left panel, Table 3). The deviations from HP trend in actual and simulated log output have similar standard deviations. The same is true of the deviations in HP trend in the actual and the simulated log government expenditure. The first order autocorrelations for deviations in HP trend of the log of government expenditure and of Approval match those for the actual data well. The ratio of government expenditure to output is the same in the actual and simulated data. The only discrepancy is the serial correlation of the deviations

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[27] Recall that our calibration indicates that Approval is inversely related to labor input, suggesting that citizens dispense more approval the more leisure they enjoy (fns. 21,24). 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) allows government to minimize the expected sum of Approval target deviations and also to finance its spending.

[28] In all, 200 observations were produced in each simulation. The first 144 of these observations were deleted leaving 56 like those depicted in the Figure 1. The idea of a sequence of political economic equilibria is akin to that which Prescott (1986: 13) calls a sequence of market equilibria.

from HP trend in log output; there is more persistence in the actual data than in the simulated data. 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 consumption. The model was calibrated without any attempt to match the properties of the simulated consumption series to those of the actual consumption series. Once the final calibration was decided, this comparison was made. The results were mixed. In 10,000 simulations the actual and simulated HP trends in log consumption match well. The model exhibits more fluctuations about this trend, however. Detrended c in the model has a standard error of .17 (std. deviation .01) whereas for the actual data this statistic is .01; the first order autocorrelation for detrended c is .38 (std. deviation .03) for the simulated data and .82 for the actual data. See Table A.1 in the Appendix.[29]

Counterfactual Analyses The real value of an investigation such as this is lies in what it tells us about theoretically significant counterfactuals. The calibrated 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 (Freeman, 1993; cf. also Backus, Kehoe and Kyland, 1989: esp. pps. 765ff). We briefly 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

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[29] Again, the evaluation of the model in terms of its ability to mimic actual consumption data was done after the calibration 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 two values (Figure 1). Hence such a check is not meaningful.

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 (Ostrom and Smith, 1993; Brody, 1991).[30] The few political economic models which allude to the Approval management problem include variables which 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 new world order. What then is the impact of increased volatility in Approval 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 250%, more specifically, by setting $e_{low} = -.05$ and $e_{high} = +.05$.[31] The new decision rules for this condition are reported in columns 8 and 9 of Table 4. Notice that the optimal tax rates are different from those for the low volatility (calibrated) case. For the larger approval diminishing shocks, e_{low}, the tax rates are greater; for the larger approval enhancing shocks, e_{high}, the tax rates are smaller. The range of the

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[30] 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.

[31] In order to obtain a mathematical solution for this counterfactual, the psi parameters was changed slightly to the value of -.986 (cf. fn. 17).

interest rates is larger in the case of greater approval volatility as well. Why is this so? Consider the case of larger, approval diminishing shocks. These shocks lead governments to raise tax rates to discourage work (increase leisure). This creates less output and hence the need for more borrowing (higher interest rates) to finance the exogenously determined government expenditure pattern. The converse is true for the larger approval enhancing shocks.

Figure 2 depicts a single simulation for the high Approval volatility case. While the range of realized Approval values is a bit larger, the target continues to be achieved; Approval still stays near the desired value of 55%. The HP trend in consumption continues to be increasing at roughly comparable levels. Interestingly, the HP trend in debt follows a similar path as in the calibration case ($e = \pm .02$). The actual level of debt is much lower, however. This implies that the increased uncertainty about Approval does not have socially deleterious consequences in this sense. The new world order is not harmful insofar as consumption trends and the accumulation of public financial obligations are concerned.

Results of 1000 simulations of the high volatility model are reported in Table 5. Comparing these results to those in the upper left of Table 3 we see that Approval volatility creates almost two times more volatility in output; the standard deviation for the deviations from HP trend in log output is .019 for the calibrated case and .032 for the counterfactual. The degree of persistence in these deviations is lower in the counterfactual as well. This is not surprising. What is surprising is that the ratio of government expenditure to output is the same for the simulations of the calibration and Approval volatility models. This implies that the new world order may not be associated with relative increases in government spending.

The evidence for the relative size of the debt is less definitive. To analyze the debt to output ratios, we ran 500 simulations of the models from each initial state (8x500=4000 simulations for each model). The initial debt was set to zero in each simulation. Table 6 reports the average debt to output ratios that resulted for the indicated number of quarters. Briefly, the results indicated that the initial state was important. In particular, the results differed depending on whether the simulation started with the random variable e in a state of low (-.02,-.05) or high (+.02,+.05) Approval. In the former cases, $s_{1,2,5,6}$, the ratio of debt to output was lower in the calibrated case in the long term (64 quarters). The ratio was higher in the calibrated case when the other states, $s_{3,4,7,8}$, were the initial ones. So, this means that judgments about the effects of Approval volatility on this aspect of the economy are dependent on initial conditions.

Presidents Who "Love Dangerously" The calibration 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" (cf. fn. 21). 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 the calibrated value of .55. The resulting decision rule is reported in columns 5 and 6 of Table 4. The indications are that for a target of 70% Approval governments adopt much higher tax rates than for a target of 55% but that their interest rate choices are comparable in the two situations. In terms of our model, the higher tax rates discourage households from working, yield more leisure time, and this leisure augments Approval levels to ones nearer the higher target value (cf. fns. 21, 24). According to the solution, minor adjustments are needed in the interest rates for the different states to enable government to finance its spending (cf. fn. 27). Figure 4 reports the results of a typical simulation of this model. Government again is quite successful in achieving it objective; Approval stays in a range only about 2.5% below the target. The trend in Consumption again is increasing. But, interestingly, the trend in debt is decreasing. Even more interesting, the debt level is negative implying that the government runs a surplus in this case. The projected debt to output ratios for case with APP* =.70 (Table 6) indicate the same.

The results of the 1000 simulations of this second counterfactual model are reported in the bottom half of Table 5. They indicate that the pursuit of the higher Approval target has no substantial effect on the volatility of output and of government expenditure. Deviations in HP trend log output and in HP trend log government expenditure have essentially the same standard deviations in the calibrated and counterfactual cases. The degrees of persistence in these deviations are roughly the same as well. The only difference in the results is in the ratio of government expenditure to output. The average value of this ratio is slightly higher for the simulations of the high Approval target model. But, again, this higher average ratio of government spending to output is associated with budget surpluses, not shortfalls.

In sum, there is no evidence that "Loving Dangerously" is socially harmful.

Conclusion

As an interdisciplinary bridge, 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, or 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 the 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 and Brady's (1993) and others' call for a better marriage of formal theory and political methodology.[32]

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

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[32] The nature of this methodological contribution is explained more fully in the longer version of this paper, Freeman (1995).

model.[33] Also, 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 essentially is an approval technology rather than a fully rationalized approval function. There also is 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. In addition, monetary policy should be introduced in order that government has more flexibility in how it chooses to manage the economy and the polity (cf. Chari *et al.*, 1991: 531ff).

The polity in the model could be enriched as well. At present, there obviously is no provision for the separation of powers among different political institutions or for elections. To the extent that economic policy making 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 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 3 shows that, without any provision for the elections of the 1980s, when a theoretically consistent

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[33] 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 *et al.*, 1991: esp. fn. 2.

decomposition method is employed, the behavior of our political-economy matches that of the U.S. 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 in Approval in different election years (cf. Figure A-1 in the Appendix). The fact is that the conclusions of the more recent work in this genre is that the impacts of elections are temporary and of very modest magnitudes. Provisions for electoral forces eventually ought to be made. 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 (fn. 23) and, over the short and medium terms, through surveys of approval and related popular evaluations of government, not through what are infrequent elections.[34] Finally, the claim that unitary agent set-ups can be useful notwithstanding (Lalman, *et al.*, 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.

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

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[34] 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 (1975), 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. I am indebted to Michael Alvorez for the point about the possible connection between low frequencies trends in Approval and in macroeconomic variables like growth.

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 also is 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 two ways and to determine if our findings about the salutary 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.[35]

In the spirit of the AJPS workshop, the present effort has laid the groundwork for these extensions. It has shown that a theoretically balanced, temporally disaggregated, genuinely stochastic, and methodologically coherent political-economic model can be built. In this way, it has constructed a new and improved bridge between the two disciplines.

[35] 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.

APPENDIX

The HP Filter

The HP filter divides a time series into a smooth, unobserved nonlinear part, g_t, and a remaining part, say, $c_t = y_t - g_t$.[1] Let us describe how this is done. The "smoothness" of a time function is captured by its second differences:

$$(1-B)^2 g_t = (g_t - g_{t-1})-(g_{t-1} - g_{t-2})$$
$$= (g_t - 2g_{t-1} - g_{t-2})$$

The square of these second differences is a measure of "unsmoothness;" intuitively, it is the degree to which the function jumps up and down from point to point to model the y_t series. For a smooth approximation, we want $(1-B)^2 g_t$ to be small relative to Σc_t^2.

Imagine then, fitting g_t such that $(1-B)^2 g_t$ is smaller than some arbitrary constant μ. To do this we set up the joint sum:

$$\Sigma c_t^2 + \lambda\Sigma((1 - B)^2 g_t)^2$$

or,

$$\Sigma(y_t - g_t)^2 + \lambda\ \Sigma(g_t - 2g_{t-1} - g_{t-2})^2 \qquad \textbf{(A0)}$$

where λ is a weighting parameter, which embodies the tradeoff between minimizing errors, Σc_t^2, and maximizing smoothness, $\Sigma((1 - B)^2 g_t)^2$. The Hodrick-Prescott filter is the minimum of this joint sum. It is fully determined by the time series, y_t and the choice of λ. The filter is estimated by a linear regression solution for the T values of g_t which

[1] The HP g_t term appears nonlinear. But Kyland and Prescott contend that it is a linear transformation. They explain, "The reason for linearity is that the first two moments of the transformed data are functions of the first two moments, and not the higher moments, of the original data." (1990: 9)

minimize the joint sum in (3). So constructed, $\hat{c}_t = y_t - \hat{g}_t$,, are "business cycle phenomena" of the Lucasian variety (Lucas 1980, 1987). That is, they are the high frequency fluctuations about the trend in output--roughly less than 32 quarters--with which modern business cycle theorists are most concerned.[2]

The limiting properties of the filter should be clear. Letting λ be zero produces a (senseless) perfect approximation of g_t to y_t. As the smoothness constraint becomes more and more severe, on the other hand, as λ approaches ∞, g_t becomes a straight line, the only function for which $\Sigma((1-B)^2 g_t)^2 = 0$. Thus linear deterministic detrending is a limiting case of the Hodrick-Prescott filter.

As regards the parameter λ, Hodrick and Prescott interpret it as the ratio of the standard deviation in the cyclical component of output relative to the standard deviation in the second differences in the growth component of output. On the basis of examining the business cycle dating it produces, the volatility and autocorrelation properties of c_t, the response of an autoregressive model of c_t to shocks in c_t, and simple intuition Hodrick and Prescott set this value to 1600. In terms of statistical theory, λ can be interpreted as a Bayesian hyperparameter. And HP filtering can be viewed as a signal extraction method where g_t is the noise of integration order n and c_t is a stationary signal. In this context it

[2] Once more, the argument is that the c_t term -- the part left after g_t is subtracted from y_t -- comes closest to what most macroeconomists mean by business cycles (Brandner and Neusser, 1990; see also Prescott, 1986; Kyland and Prescott, 1990). This c_t term contains the high level frequencies which embody business cycles while the g_t term picks up all the lower frequencies associated with long-term trends in the economy.

can be shown that the HP filter is optimal in the mean square error sense for a certain class of ARIMA models.[3]

Solution to the Politically Motivated Allocation Problem.[4] The problem in (9) is the dual. The primal -- the equivalent version in terms of optimal decision rules for consumption and labor rather than for tax and interest rates -- is considerably easier to solve. Hence in what follows we focus on the primal. Once determined, the optimal decision rules for c and ℓ can be used to derive the optimal decision rules for τ and R. This is demonstrated below. In addition, we focus first on the case of no growth, that is,

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[3] The HP filter is know in statistics as the Whittaker-Henderson A filter. It has its origins in actuarial science, more specifically, in methods for analyzing mortality rates. There also is an analogue in ballistics research (Kyland and Prescott, 1990:10). As regards the conception of λ, Hodrick and Prescott (1980:5) explain it this way. Let σ_1^2 and σ_2^2 denote the variances in the cyclical component and in the second differences of the growth component respectively. Assume that these two components are iid with their means equal to zero. Then the relevant programming problem is

$$\underset{g_t}{Min} \{\sigma_1^{-2}\sum_{t=1}^{T} c_t^2 + \sigma_2^{-2}\sum_{t=1}^{T} (\Delta^2 g_t)^2\}$$

The solution to this problem is equivalent to that of finding the $\{g_t\}^T_{t=1}$ which minimize the sum in (A0) in the text if $\sqrt{\lambda} = \frac{\sigma_1}{\sigma_2}$. Hodrick and Prescott write "our prior view is that a five percent cyclical component is moderately large as is a one-eighth of one percent change in the growth rate each quarter. This leads us to select $\sqrt{\lambda}=5/(1/8)=40$, $\lambda=1600$ as a value for the smoothing parameter." As noted in the text, the reasonableness of this parameter was assessed through an examination of the dating it gives for US business cycles in comparison to the dating produced by the NBER and other sources, the volatility it produces in c_t, and the persistence it creates in c_t. Technical developments of the HP filter as a signal extraction problem can be found in works like Brandner and Neuser (1990).

[4] The solution was derived by Marcelo Veracierto on the basis of the theorems in Chari et al. (1991). Veracierto also wrote the computer program for this purpose (see below).

on the case where ρ=0 so $(1+\rho)^t$ is unity and the household and government have the same discount rate. Then we show how growth can be reintroduced to obtain the desired solution for the dual, and, in turn, for the primal. A condition on the relationship between the discount rates of the representative household and of government is derived in this context.

We begin by expressing the programming problem in a way that allows us to derive a useful first order condition. Define the function W as

$$W(c(s^t), \ell(s^t), z(s^t), e(s^t), \lambda) =$$

$$[\alpha_0 + \alpha_1 c(s^t) + \alpha_2 \ell(s^t) + e(s^t) - APP^*]^2$$

$$+ \lambda \, [U_c(s^t)c(s^t) + U_\ell(s^t)l(s^t)]$$

where λ is a LaGrangian variable used to incorporate the constraints in the solution. Then using W the problem in (9) can be rewritten:

$$\min \sum_t \sum_{s^t} \beta^t u(s^t)\, W[c(s^t), \ell(s^t), e(s^t), \lambda] - \lambda\, U_c(s_0) R(s_0) b_{-1} \qquad \text{(A1)}$$

subject to the (no growth) constraint:

$$c(s^t) + g(s^t) = z(s^t)\; f\,[\ell(s^t)]. \qquad \text{(A1.1)}$$

We want to obtain the optimal decision rule for c and ℓ. Therefore, we set the partial derivatives of W with respect to these two variables equal to zero. This yields, after some manipulation, equations of the form

$$\beta^t u(s^t) W_c(s^t) = \varnothing(s^t) \qquad \text{(A2.1)}$$

$$-\beta^t u(s^t) W_\ell(s^t) = \varnothing(s^t) z(s^t) f'[\ell(s^t)] \qquad \text{(A2.2)}$$

where $\O(s^t)$ represents the LaGrangian for the fiscal constraint in (A1), W_c and W_ℓ are the partials of W with respect to c and ℓ, and f′ is the derivative of the production function with respect to ℓ. Next substitute for $\O(s^t)$ in (A2.2) with the left-hand-side of (A2.1) and divide through both sides of the resulting expression by $\beta^t u(s^t)$ and then by $W_c(s^t)$. This produces the following first order condition for t > 0:

$$\frac{-W_\ell(s^t)}{W_c(s^t)}=z(s^t)f'[\ell(s^t)]. \tag{A2.3}$$

It can be shown that for t=0, we have

$$W_c(s^t)-\lambda U_{cc}(s_0)R(s_0)b_{-1}=\frac{W_\ell(s_0)}{z(s_0)f'(\ell_0)}. \tag{A2.4}$$

Recall that the state of the political-economy, s^t, is defined in terms of random variables for productivity, government spending, and approval shocks. We denoted these realizations as $z(s^t)$, $g(s^t)$, and $e(s^t)$, respectively. Hence the optimal decision rules for consumption and labor now can be expressed as:

$$c(s^t,\lambda) = c(z(s^t), g(s^t), e(s^t), \lambda) \tag{A3.1}$$

$$\ell(s^t,\lambda) = \ell(z(s^t), g(s^t), e(s^t), \lambda) \tag{A3.2}$$

These functions tell us, for a given λ, the best levels of consumption and labor given the realization of a state $s^t \equiv (z(s^t), gs^t), e(s^t))$. Now, for a given λ, we have two equations and two unknowns. The next step therefore is to obtain a first-order expression in terms of either c or ℓ. This can be done by adding the positive value of the quotient on the left hand side of (A2.3) to both sides of that equation and using (A1.1) to substitute for $c(s^t)$. The result is a new function G:

$$G(\ell,z,g,e,\lambda) = zf'[\ell] + \frac{W_\ell(zf[\ell]-g,\ell,z,e,\lambda)}{W_c(zf(\ell)-g,\ell,z,e,\lambda)} \tag{A4}$$

where, for convenience, the s^t have been suppressed momentarily. The desired result for ℓ then can be found by setting this function equal to zero

$$0 = G(\ell,z,g,e,\lambda); \tag{A5}$$

The optimal decision rule in (A3.2) is implicitly defined by this condition.

The heart of this problem is to find a λ* which makes the relevant condition for household optimization, (9.2), true:

$$\begin{aligned}\sum_{t=0}^{\infty} \beta^t \sum_s u_t(s)\ [&U_c(c(s,\lambda^*),\ell(s,\lambda^*))\cdot c(s,\lambda^*) + \\ &U_\ell(c(s,\lambda^*),\ell(s,\lambda^*))\cdot \ell(s,\lambda^*)] \\ &= U_c(c(s_o,\lambda^*),\ell(s_o,\lambda^*))R(s_o)b_{-1}.\end{aligned} \tag{A6}$$

With this λ* we can use G in (A5) to approximate the optimal decision rule for ℓ. Then, with the optimal decision rule for ℓ, we can use (A2.3) and the definition for W to derive the optimal decision rule for c.

To find λ* we need to characterize, $u_t(s)$, the probability function over the political-economic states. This is done as follows. Following Chari et al. (1991), we assume that the random variables for productivity, government spending, and approval shocks each can take on two distinct values. Hence, overall, there are 2x2x2=8 possible political-economic states: $(s_1 \ldots s_8)$.[5] Assume that the vector of these states follows a finite state Markov process. And denote the transition matrix for this process by Π. Define u_o as a vector all but one of the elements of which are zero; the single nonzero element has a value of unity representing the corresponding initial state, s_o.[6] Then $u_t(s)$ can be generated recursively as

$$U_t = \Pi^t u_o \qquad t=1,2,\ldots.$$

Using this specification, it is possible to evaluate (15) for alternative values of λ and, usually, to find the λ^* that makes that expression true.[7]

A computer program was written to implement the procedure outlined above. The program takes the inputted values for the parameters in the model in (1)-(8), the possible range of λ^* values, and the values of the transition matrix Π and it returns the optimal decision rules for c and ℓ. The optimal decision rules are expressed in the form of two

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[5] Denote the two values of each random variable by 1 and 2. Then we have s_1:$(z_1,g_1,e_1,)$, s_2:(z_1,g_2,e_1), s_3:(z_1,g_1,e_2), s_4:(z_1,g_2,e_2), s_5:$(z_2,g_1,e_1,)$, s_6:(z_2,g_2,e_1), s_7:(z_2,g_1,e_2), s_8:(z_2,g_2,e_2).

[6] So, for instance, if the vector has a single non-zero value of unity in the eighth cell, the initial state is s_8: (z_2,g_2,e_2).

[7] Several points should be made about the solution procedure. First, note that unlike Chari et al. (1991), a direct solution for the optimal decision rules is obtained here. Chari et al. produce an indirect solution to their version of the problem. They do this by setting $b_1 = 0$ on the right side of (15). Second, because of the nature of our problem -- it does not have a recursive structure (cf. Hansen and Prescott, 1992; cf. also Freeman, 1993) -- there is no guarantee that an optimal λ^* can be found. Finally, if capital were included in the production function, an ever expanding number of states would have to be allowed for, states which represent alternative histories of capital allocation.

vectors. The two vectors indicate the best response in terms of consumption and labor to the realization of each of the eight states.[8]

This solution can be used to find the solution to the dual of the problem. Define

$$L=\sum_t \sum_{s^t} \beta^t u(s^t)\, U[c(s^t),\ell(s^t)] + \sum_t \sum_{s^t} \lambda(s^t)\{[1-\tau(s^t)]w(s^t)\ell(s^t) + R(s^t)b(s^{t-1}) + V(s^t) - c(s^t) - b(s^t)\}. \tag{A7}$$

At equilibrium, the partials of L with respect to $c(s^t)$ and $l(s^t)$ must be equal to zero. That is, we must have

$$\frac{\partial}{\partial c(s^t)}:\quad \beta^t u(s^t)\, U_c[c(s^t),\ell(s^t)] - \lambda(s^t) = 0 \tag{A8.1}$$

$$\frac{\partial}{\partial \ell(s^t)}:\quad \beta^t u(s^t) U_l[c(s^t),\ell(s^t)] + \lambda(s^t)[1-\tau(s^t)]w(s^t) = 0. \tag{A8.2}$$

(A8.1) implies that

$$\lambda(s^t) = \beta^t u(s^t) U_c[c(s^t),\ell(s^t)]. \tag{A8.3}$$

Making this substitution in (A8.2) and collecting terms we arrive at

[8] For instance, the fourth elements of the vectors for the optimal c and ℓ indicate the best consumption and labor responses to the realization of $s_4:(z_1,g_2,e_2)$.

The program contains a tolerance parameter for determining when the λ^* has been found. If also contains integration parameters for making the determination in (14).

$$\frac{-U_\ell[c(s^t),\ell(s^t)]}{U_c[c(s^t),\ell(s^t)]} = [1-\tau(s^t)]w(s^t). \quad \text{(A8.4)}$$

Once the optimal decision rules for c and ℓ have been determined, the left hand side of (A8.4) can be evaluated for each s^t. The second term on the right hand side of (A8.4), $w(s^t)$, also can be calculated for each s^t; the identity in the third part of the definition of political-economic equilibrium, $w(s^t|\pi') = z(s^t)\, f'[\ell(s^t|\pi')]$, can be used for this purpose. Once these determinations have been made, the value of the optimal tax rate for s^t, $\tau(s^t)$, immediately follows. The optimal interest rate on public debt, for s^t, $R(s^t)$ is calculated similarly. The value of variables like approval can be determined for each s^t with equations like (7).

The last task is to transform this no growth solution into that which applies to our growth model. Recall that for the latter, the Politically Motivated Allocation problem is:

I. $$\text{Min}_{c(\cdot),\,\ell(\cdot)} \Sigma_t \Sigma_{s^t} \bar{\beta}^t u(s^t)[A(s^t) - A^*]^2$$

s.t.

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

$$\Sigma_t \Sigma_{s^t} \beta^t u(s^t)[U_c(s^t)c(s^t) + U_\ell(s^t)\ell(s^t)] = U_c(s_0)R(s_0)b_{-1}$$

$$A(s^t) = \alpha_0 + \alpha_1\ell(s^t) + e(s^t)$$

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

Using the utility functions specified in the paper, the problem can be rewritten as

II. $$\text{Min}_{c(\cdot),\ell(\cdot)} \sum_t \sum_{s^t} \bar{\beta}^t u(s_t)[A(s^t) - A^*]^2$$

s.t.

$$c(s^t) + (1+\rho)^t g(s^t) = z(s^t)(1+\rho)^t \ell(s^t)^\theta$$

$$\sum_t \sum_{s^t} \beta^t u(s_t)[(c(s^t)^{(1-\gamma)}(1-\ell(s^t))^\gamma)^{\Psi-1}(1-\gamma)c(s^t)^{(1-\gamma)}(1-\ell(s^t))^\gamma + (c(s^t)^{(1-\gamma)}(1-\ell(s^t))^\gamma)^{\Psi-1}\gamma c(s^t)^{(1-\gamma)}(1-\ell(s^t))^{\gamma-1}\ell(s^t)] = (c(s_0)^{(1-\gamma)}(1-\ell(s_0))^\gamma)^{\Psi-1}(1-\gamma)c(s_0)^{-\gamma}(1-\ell(s_0))^\gamma R(s_0)b_{-1}$$

$$A(s^t) = \alpha_0 + \alpha_1 \ell(s^t) + e(s^t)$$
$$c(\cdot),\ell(\cdot) \geq 0,\ \ell(\cdot) \leq 1$$

Now define the variable $c^*(s^t)$ by $c^*(s^t) = c(s^t)/(1+\rho)^t$. Then observe one may write the minimization problem in terms of c^* as follows.

III. $$\text{Min}_{c^*(\cdot),\ell(\cdot)} \sum_t \sum_{s^t} \bar{\beta}^t u(s_t)[A(s^t) - A^*]^2$$

s.t.

$$c^*(s^t) + g(s^t) = z(s^t)\ell(s^t)^\theta$$

$$\sum_t \sum_{s^t} (\beta^*)^t u(s_t)[(c^*(s^t)^{(1-\gamma)}(1-\ell(s^t))^\gamma)^{\Psi-1}(1-\gamma)c^*(s^t)^{(1-\gamma)}(1-\ell(s^t))^\gamma + (c^*(s^t)^{(1-\gamma)}(1-\ell(s^t))^\gamma)^{\Psi-1}\gamma c^*(s^t)^{(1-\gamma)}(1-\ell(s^t))^{\gamma-1}\ell(s^t)] = (c^*(s_0)^{(1-\gamma)}(1-\ell(s_0))^\gamma)^{\Psi-1}(1-\gamma)c^*(s_0)^{-\gamma}(1-\ell(s_0))^\gamma R(s_0)b_{-1}$$

$$A(s^t) = \alpha_0 + \alpha_1 \ell(s^t) + e(s^t)$$

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

where $\beta^* = \beta(1+\rho)^{(1-\gamma)\Psi}$. But if $\bar{\beta} = \beta^* = \beta(1+\rho)^{(1-\gamma)\Psi}$ then this problem is in the form of the problem in (9). Therefore the solution derived above can be employed. In particular, if the function $(c^*(\cdot),\ell(\cdot))$ solves problem III, then $(c^*(1+\rho)^t, \ell)$ solves I. In sum, as long as the government's and household's discount rates are related by

$$\bar{\beta} = \beta(1+\rho)^{(1-\gamma)\Psi},$$

it is possible to transform the solution for the no-growth world into one like ours (for a world with growth). Note that in terms of our calibration we employ $\bar{\beta} = 0.990(1.006)^{-0.34} = 0.988$. So this condition implies a very slight difference in the way the household weights the future relative to the government.

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Conception of Government

	Unitary Actor	Representative Democracy		Direct Democracy
		Two Parties	N Parties/Actors	
Deterministic Economy and Polity	Nordhaus (1975) Chappel & Keech (1983)	Alesina (1987, 1988)	Krusell, Quadrini, and Rios-Rull (1992)	Krusell, Quadrini and Rios-Rull (1994, 1995)
Stochastic Economy and/or Polity	Rogoff & Sibert (1988)	Alesina, Londregan, and Rosenthal (1993) Drissen and van Winden (1993) van der Ploeg (1987)		

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

TABLE 3

The Calibrated Model and the Data

	Deviations from Trend				Trend	
	Log Output		Log Gov. Exp.		Log Approval	
	Actual	Model*	Actual	Model*	Actual	Model*
SD	0.016	0.019	0.0143	0.0142		
Empirical SD	-	(0.004)	-	(0.003)		
Serial Correlation	0.83	0.38	0.579	0.589	0.98	0.97
Empirical SD	-	(0.18)	-	(0.135)		0.005

Gov Exp to Output Ratio	
Actual	0.228
Model	0.230
SD	0.003

Based on 1000 56 quarter simulations

Calibrated Parameter Values

ρ	0.006
β	0.990
$\bar{\beta}$	0.988
γ	0.660
θ	0.640
Ψ	-1.000
$\alpha0$	1.600
$\alpha2$	-4.500
APP*	0.550
b(-1)*r(0)	0.000
Technology Shock	
low	0.970
high	1.030
Trns Prob	0.950
Gov Spending Shock	
low	0.090
high	0.094
Trns Prob	0.910
Approval Shock	
low	-0.020
high	0.020

TABLE 3

TABLE 4

Government Income Tax and Interest Rate Policy Rules

STATE			POLICY					
			Calibrated Model		APP*=0.70		Large App Shocks	
Productivity	Approval	Gov Spending	Income Tax	Interest Rate	Income Tax	Interest Rate	Income Tax	Interest Rate
Low	Low	Low	0.29	0.15	0.43	0.17	0.32	0.31
Low	Low	High	0.30	0.16	0.44	0.18	0.33	0.32
Low	High	Low	0.25	-0.08	0.40	-0.10	0.22	-0.21
Low	High	High	0.26	-0.08	0.40	-0.10	0.23	-0.22
High	Low	Low	0.28	0.12	0.42	0.16	0.31	0.29
High	Low	High	0.29	0.13	0.43	0.17	0.32	0.30
High	High	Low	0.24	-0.08	0.38	-0.11	0.20	-0.22
High	High	High	0.24	-0.08	0.39	-0.11	0.21	-0.22

TABLE 5

Simulations with Counterfactual Parameter Values

Model with Large Approval Shocks

	Deviations from Trend				Trend	
	Log Output		Log Gov. Exp.		Log Approval	
	Actual	Model*	Actual	Model*	Actual	Model*
SD	0.016	0.032	0.0143	0.0143		
Empirical SD	-	(0.003)	-	(0.003)		
Serial Correlation	0.83	0.16	0.579	0.586	0.98	0.98
Empirical SD	-	(0.14)	-	(0.135)		0.004

Gov Exp to Output Ratio	
Actual	0.228
Model	0.230
SD	0.004

Model with APP*=0.70

	Deviations from Trend				Trend	
	Log Output		Log Gov. Exp.		Log Approval	
	Actual	Model*	Actual	Model*	Actual	Model*
SD	0.016	0.019	0.0143	0.0144		
Empirical SD	-	(0.0040)	-	(0.0032)		
Serial Correlation	0.83	0.36	0.579	0.581	0.98	0.98
Empirical SD	-	(0.17)	-	(0.138)		0.004

Gov Exp to Output Ratio	
Actual	0.228
Model	0.253
SD	0.005

**Based on 1000 56 quarter simulations*

TABLE 6

DEBT ACCUMULATION IN THE CALIBRATED AND COUNTERFACTUAL MODELS

INITIAL STATE			MEAN DEBT TO OUTPUT RATIO*											
			Calibrated Model				APP* = 0.70				Large App Shocks			
			Quarter				Quarter				Quarter			
Productivity	Approval	Gov Spending	4	16	32	64	4	16	32	64	4	16	32	64
Low	Low	Low	0.23	1.03	2.19	3.52	-0.04	-0.15	-0.34	-0.52	0.22	1.00	2.10	3.13
		SD	*0.00*	*0.26*	*0.88*	*1.98*	*0.00*	*0.10*	*0.29*	*0.48*	*0.00*	*0.62*	*2.07*	*4.50*
Low	Low	High	0.25	1.06	2.23	3.52	-0.03	-0.12	-0.26	-0.49	0.24	1.05	2.08	3.12
		SD	*0.00*	*0.26*	*0.98*	*1.98*	*0.00*	*0.09*	*0.22*	*0.40*	*0.00*	*0.68*	*3.05*	*4.96*
Low	High	Low	0.26	1.05	2.25	3.57	-0.02	-0.13	-0.30	-0.51	0.28	1.07	2.19	3.78
		SD	*0.00*	*0.26*	*1.02*	*1.98*	*0.00*	*0.11*	*0.25*	*0.58*	*0.00*	*0.68*	*2.52*	*6.06*
Low	High	High	0.27	1.09	2.36	3.77	-0.01	-0.10	-0.25	-0.45	0.29	1.08	2.33	4.19
		SD	*0.00*	*0.28*	*1.17*	*2.17*	*0.00*	*0.09*	*0.20*	*0.47*	*0.00*	*0.69*	*2.62*	*11.79*
High	Low	Low	0.21	0.97	2.10	3.38	-0.07	-0.22	-0.40	-0.60	0.20	0.95	2.17	3.14
		SD	*0.00*	*0.24*	*0.79*	*1.82*	*0.00*	*0.02*	*0.10*	*0.27*	*0.00*	*0.57*	*2.37*	*4.22*
High	Low	High	0.23	1.00	2.15	3.42	-0.06	-0.19	-0.37	-0.58	0.22	1.00	2.37	3.36
		SD	*0.00*	*0.24*	*0.82*	*1.92*	*0.00*	*0.02*	*0.07*	*0.30*	*0.00*	*0.66*	*4.87*	*6.34*
High	High	Low	0.24	0.99	2.11	3.47	-0.05	-0.20	-0.38	-0.58	0.27	1.05	2.08	4.03
		SD	*0.00*	*0.24*	*0.90*	*1.91*	*0.00*	*0.01*	*0.08*	*0.27*	*0.00*	*0.66*	*2.16*	*10.74*
High	High	High	0.25	1.02	2.26	3.60	-0.04	-0.17	-0.36	-0.59	0.27	1.05	2.33	3.90
		SD	*0.00*	*0.26*	*0.97*	*1.95*	*0.00*	*0.01*	*0.10*	*0.43*	*0.00*	*0.68*	*2.88*	*7.47*

** Mean is based on 500 64-quarter model simulations at each initial state. The initial debt level is set to zero in each simulation.*

FIGURE 1

Results of a Single Simulation with Calibrated Parameter Values

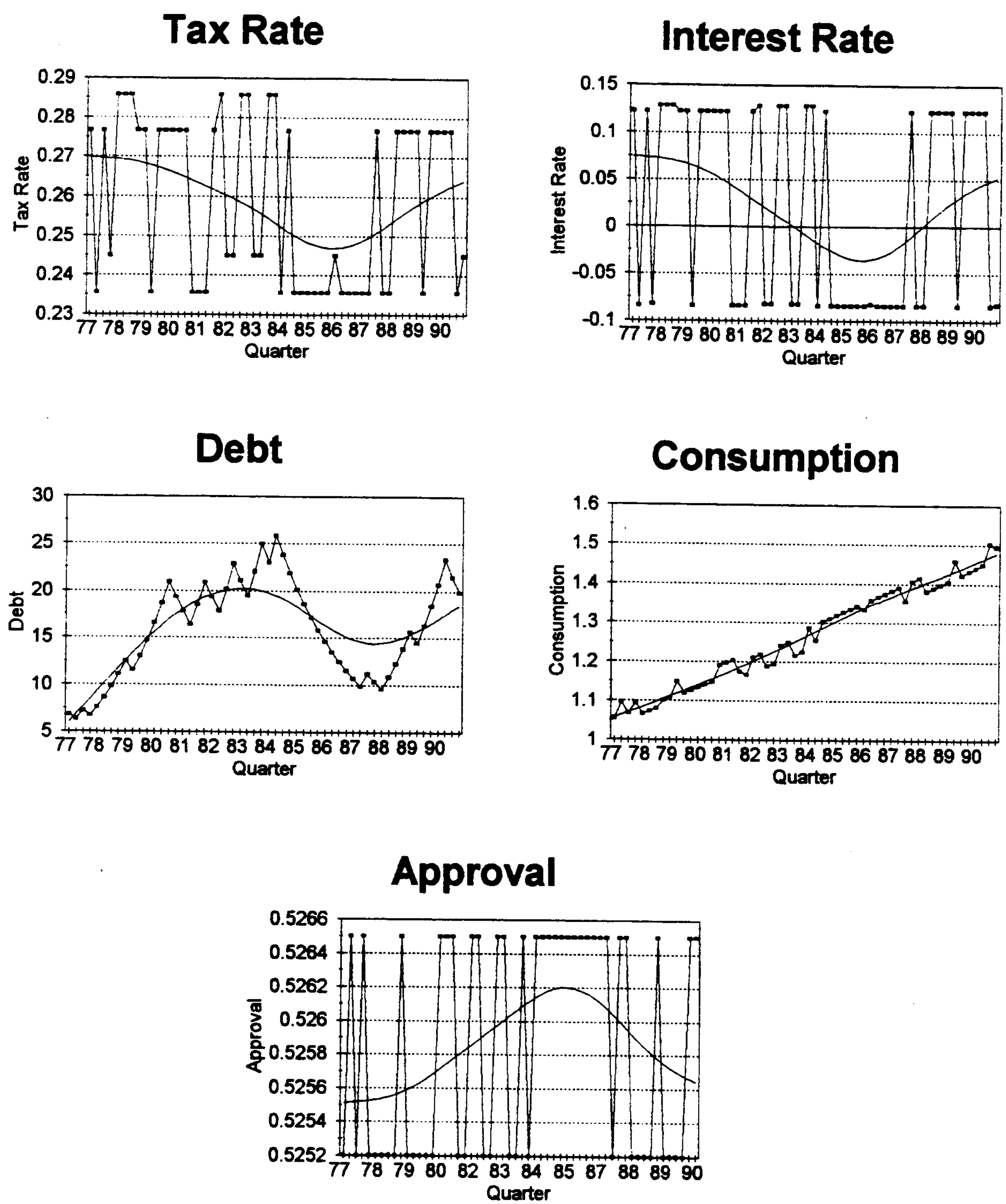


FIGURE 2

Results of a Single Simulation with Large Approval Shocks and Otherwise Calibrated Parameter Values

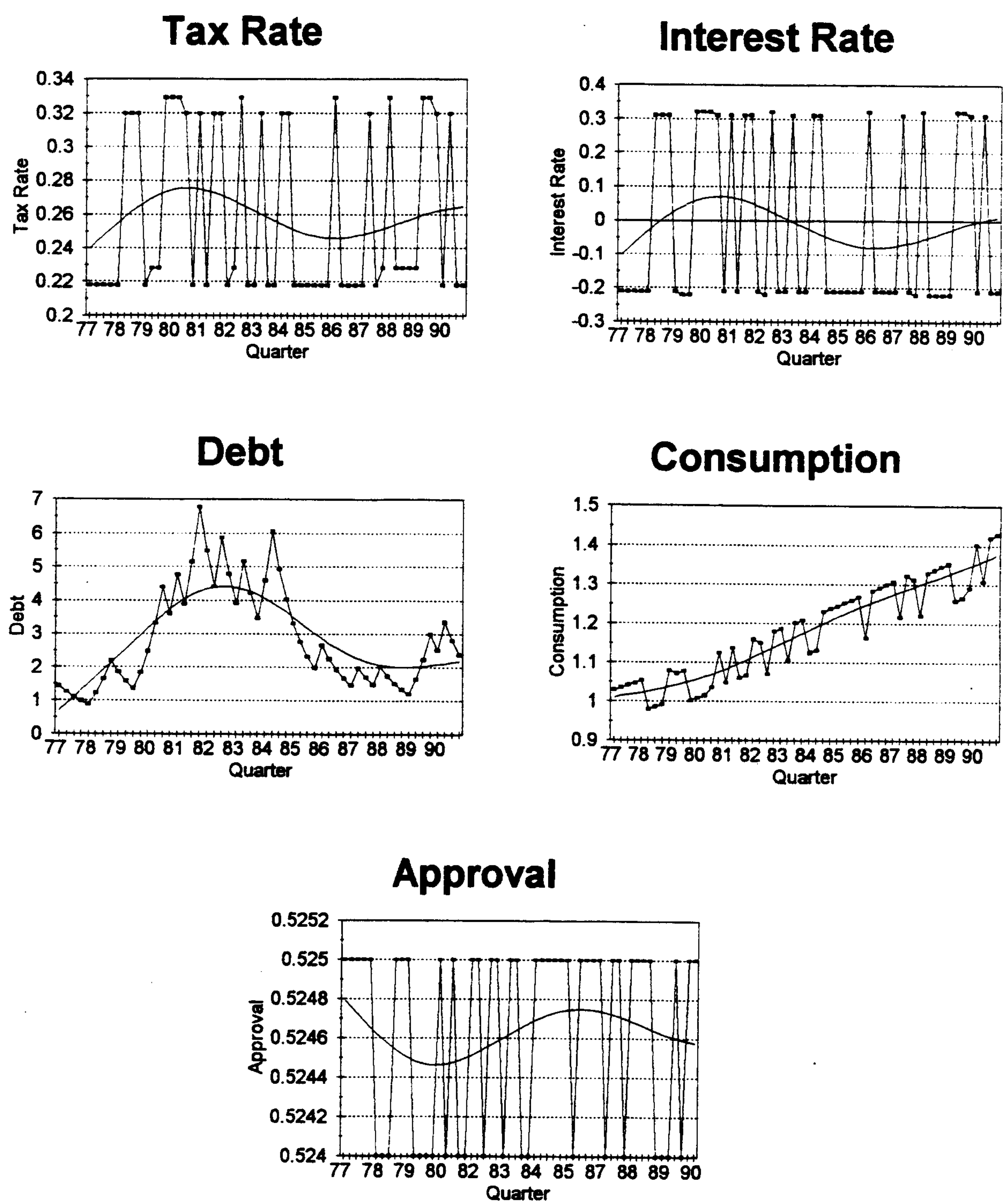


FIGURE 3

Results of a Single Simulation with APP*=0.70 and Otherwise Calibrated Parameter Values

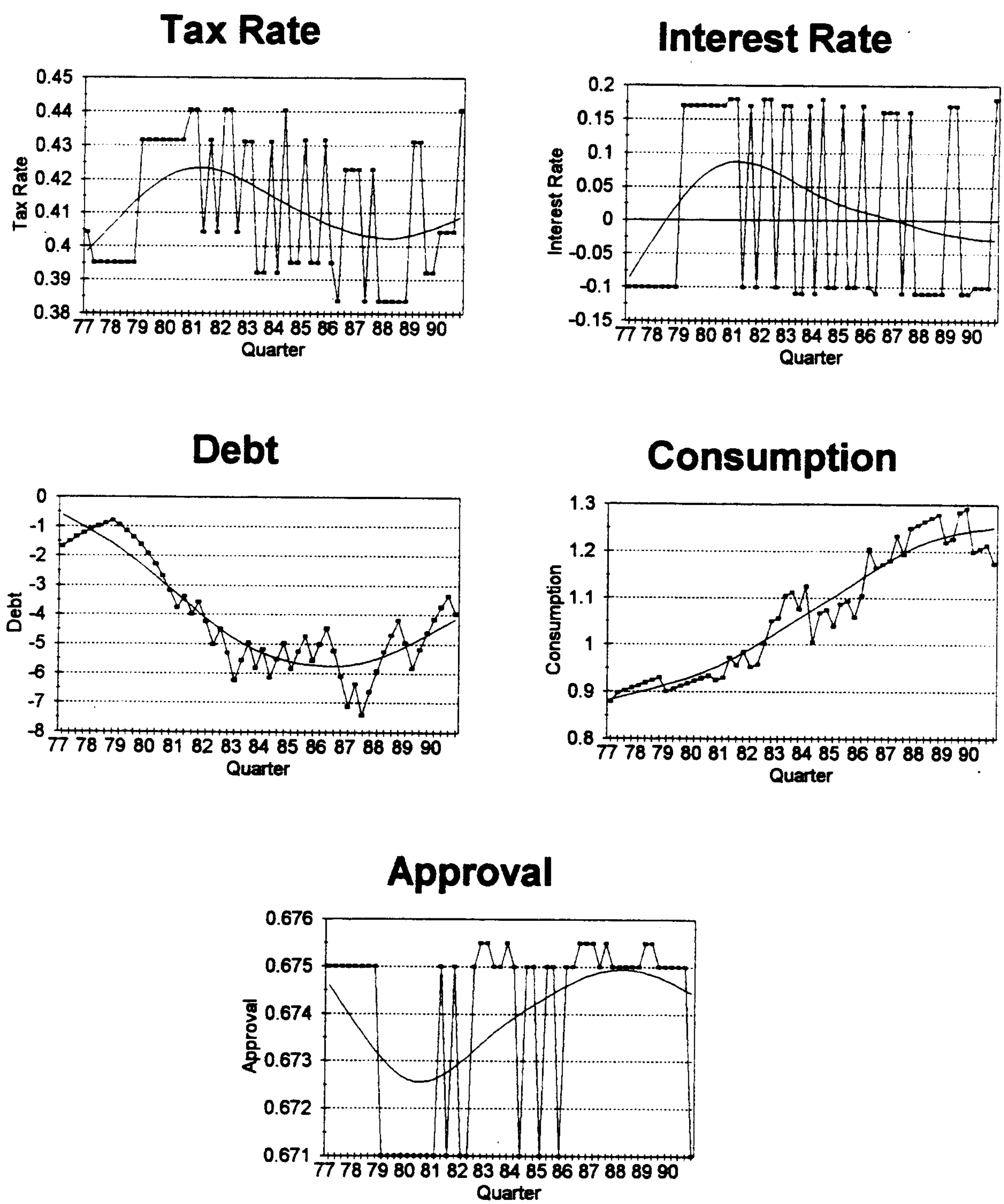
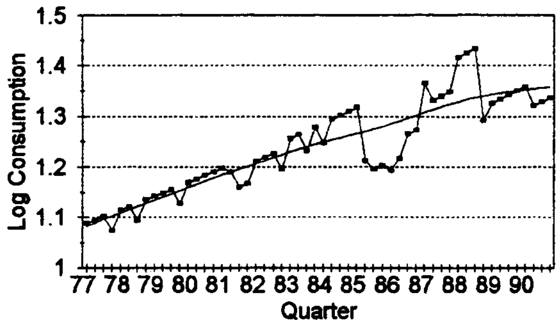


Table A.1

Consumption in the Model and in the Data

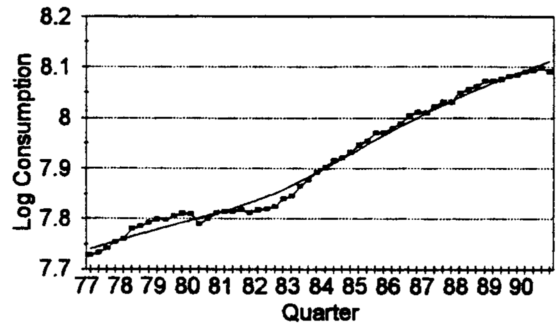
Simulated Consumption

Single Simulation of Calibrated Model



Actual Consumption

U.S. Data 1977:01 - 1990:04

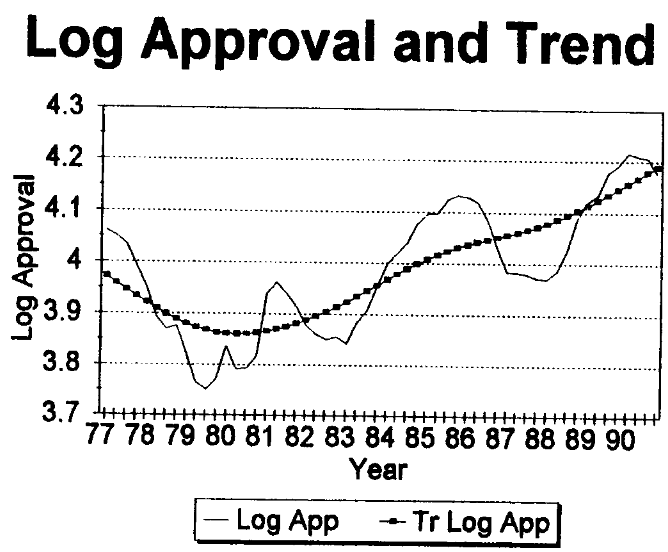


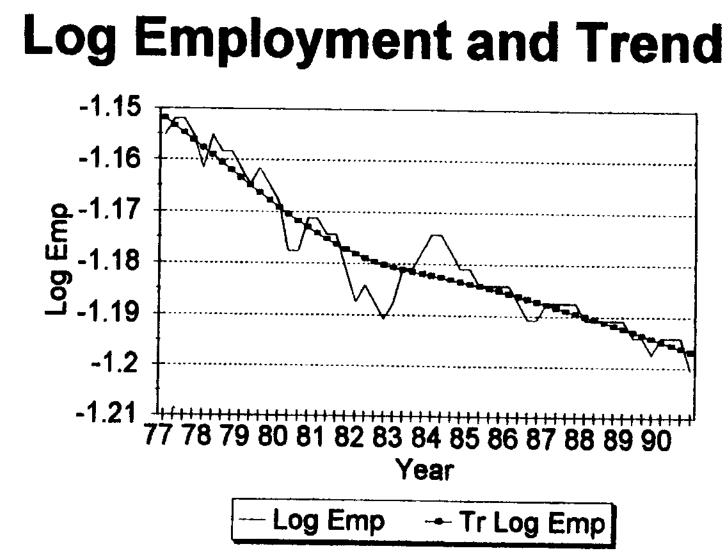
Descriptive Statistics*

	Detrended Consumption	
	Model	**U.S. Data**
Standard Deviatio	0.17	0.01
	(0.01)	-
Autocorrelation	0.38	0.82
	(0.03)	-

*Based on 1000 56 quarter simulations of the calibrated model. Standard deviations in parentheses.

Figure A.1





	Statistic	Log Approval	Log Labor
Trend	*Standard Deviation*	0.10	0.01
	Autocorrelation	0.99	0.95
Deviations from Trend	*Standard Deviation*	0.07	0.004
	Autocorrelation	0.88	0.63