MONEY, EXPECTATIONS, AND THE BUSINESS CYCLE*

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Introduction

Does money matter? Proponents and opponents of the importance of money generally agree that over the long run money matters a great deal for the development of nominal magnitudes, but not, at least not very much, for real magnitudes. The issue therefore is not whether money matters at all but rather whether fluctuations in the money supply are the most important cause of the business cycle. In particular would a policy of increasing the money supply at a constant rate, say four percent, as proposed by Friedman, result in significantly less fluctuations of output (about trend)? These issues were made clear by Friedman in his debate with Heller concerning monetary and fiscal policy.

The primary purpose of this paper is not to provide a definite answer to this very important policy question, though some light is shed upon the issue. Rather it is to develop an operational framework in which such questions may be answered. A dynamic general equilibrium framework, in its true sense, is utilized. Only preferences and technology are taken as given. In order to use the method, the first step is to parameterize these structures and the second, to use econometric techniques to estimate the parameters. Then, to evaluate a given policy, such as Friedman's four percent rule, one determines the dynamic competitive equilibrium given the structures of preferences and technology and the policy rule. The agents' equilibrium decision rules, which correspond to the behavioral equations of an econometric model, characterize the solution. Simulations, or some analytic technique, may then be used to determine the operating characteristics of the economy for the assumed policy.

It is perhaps worthwhile to contrast this with the conventional approach which Lucas [ ] has called "the theory of economic policy" and can be summarized as follows: the economy in a time period is described by a vector s_t of state variables, a vector π_t of policy variables, a vector d_t of agents decision or behaviorial variables, and a vector ε_t of random shocks. The motion of the economy is determined by a set of difference equations

$$s_{t+1} = G(s_t, d_t, \pi_t, \varepsilon_t)$$

and

$$d_t = F(s_t, \pi_t, \varepsilon_t),$$

the distribution of ε_t, and a prescribed set of future π_t. The equations summarized by F would be the behavioral equations of the econometric model being used to approximate the economy and would be estimated. To evaluate a policy, namely a specification of present and future values of the π_t, F and G are used to determine the implied motion of the economy.

The implicit assumption is that F will remain stable under arbitrary changes in the pattern of the policy sequences. However, only if agents' expectations of future prices are invariant to the true process generating these series will the behavioral equations F be stable, since different policy rules imply difference processes for the relevant price, demand, and income flow series.

With my analysis, policy <u>rules</u> which specify π_t as a function of state variables (and possibly lagged variables) can be evaluated.* Given

* This is the point made by Lucas in [ ]. Kydland and Prescott [ ] used this approach to evaluate investment tax credit policies, treating aggregate demand and labor supply as exogenous.

functions G describing the motion of the state variable conditional upon agents' decisions d_t and the policy rule, the competitive equilibrium is computed. It is characterized by a set of behavioral equations of the form

$$d_t = F_\pi(S_t).$$

The function F is indexed by π because there will be a _different_ set of relationships associated with each policy. In other words, there will be a _different_ econometric model for each policy rule.

Expectations are central to the monetarist argument (c.f. [ ] and [ ]). Ignoring them and using an IS-LM framework, monetary disturbances, namely shifts in the LM curve, would result in a negative correlation between interest rates and output, a result inconsistent with empirical observations. Monetarist recognize this and explain this observation by arguing that there are shifts in expectations.

Therefore, crucial to this analysis and, for that matter, any analysis of economic dynamics, is the way in which the behavior or agents' expectations of future events are described. Until recently, the standard resolution of this problem has been to postulate a simple _ad hoc_ rule of thumb which agents are assumed to use in extrapolating the past and present into the future. While operational, these mechanical treatments typically imply persistent, easily correctible nonoptimal behavior on the part of agents. In addition, they introduce large number of additional "free parameters" into econometric models, providing good fits but bad predictions.

Following the analyses of Muth [ ] and Lucas and Prescott [ ], I shall assume that the actual and anticipated prices have the <u>same</u> probability distribution, or that price expectations are rational. An equivalent assumption is that economic agents use all information available to forecast future events in an efficient or optimal manner.

I Rational Expectations and General Equilibrium

The equilibrium construct which we use is that of a competitive equilibrium. A commodity point is not a finite dimensional vector, but rather an element of a set of infinite sequences of function $\{x_t(\epsilon_1,\ldots,\epsilon_{t-1})\}$*. The x_t function specifies a vector of factors and commodities in period t, conditional on past realizations of random elements $\epsilon_1,\ldots,\epsilon_{t-1}$. The valuation function or pricing system is also a sequence of functions $\{P_t(\epsilon_1,\ldots,\epsilon_{t-1})\}$. These price functions along with the assumed probability law for the random elements define the expectations of economic agents. A competitive equilibrium is characterized by a price system $\{P_t^o\}$ and commodity points for each household and firm. As with all competitive equilibria, each household maximizes its utility subject to its budget constraint, each firm maximizes valuation subject to a technology constraint, and supply equals demands. The valuation of a commodity for purposes of determining firms' valuations and households' budget constraints has the form

$$\sum_{t=1}^{\infty} E\ \{x_t(\epsilon_1,\ldots,\epsilon_{t-1})\ P_t(\epsilon_1,\ldots,\epsilon_{t-1})\}$$

where P_t is a column vector and x_t a row vector of the same dimension and E is the expectations operator.

Competitive Equilibrium and Social Optimum

It is well known that under very general conditions, competitive equilibria are Pareto optima. In this analysis, as in [ ], this fact

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*This discussion is designed to give the reader an intuitive understanding of the approach. Anyone interested in mathematical rigor is referred to Lucas and Prescott [ ], Prescott and Lucas [ ], and Bewley [ ].

will be exploited in characterizing the competitive solution. I assume that there is an economy wide consumer, i.e. that the economy is Hicksian (c.f. Arrow and Hahn [ ]). This assumption implies that the effect of wealth redistributions upon product demands and factor supplies net out. For many purposes this is an overly strong assumption. But, for business cycle analyses the effect of wealth redistributions (which do not affect total wealth) probably have a second order effect. Consequently, the Hicksian assumption is probably not a serious misspecification.

Remembering that any Pareto optimum is a competitive equilibrium with some initial wealth distribution, the Hicksian assumption implies that the total quantity demanded of any product is the same for all competitive equilbria Since it is only total demands and supplies which are being considered, characterizing any Pareto optimum is equivalent to characterizing all competitive solutions. This transforms the problem of calculating a competitive equilibrium into one of maximizing the utility of the economy wide consumer.

Rational Expectations

Agents' decisions, or more precisely, contingency action plans, depend upon the expected distribution of prices. The true price distribution in turn depends upon the decisions of agents. In equilibrium the expected and actual distribution are the same, i.e. the expectations are rational.*

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* This is not the definition of rational expectations but rather an example. Rational expectations merely implies that agents use the information available to them in an efficient matter in forecasting future events. Lucas[ ] has considered a case where agents have different information sets. Kydland [ ] uses the concept to analyze imperfectly competitive markets where the solution concept is that of a Nash equilibrium.

State Variable Representation

The state variable representation was used in the introductory discussion. By suitably defining the vector of states s_t, I assume that the motion of the economy, conditional on the policy and agents' decisions, is determined by

$$(1.1) \qquad s_{t+1} = G(s_t, d_t, \pi_t, \epsilon_t)$$

and the distribution of the independent ϵ_t. The s_t would include the beginning of period stocks and any variables needed to forecast future exogenous factors. The social objective function is assumed to have form

$$(1.2) \qquad E \{\sum_{t=1}^{\infty} \beta^t u(d_t, \pi_t, s_t\}$$

where E is the expectations operator. Under the assumptions that policy is some function of the state variables,

$$(1.3) \qquad \pi_t = \pi(s_t),$$

it is well known that under these conditions the social objective function will be maximized, given (1.1) and (1.3), by some Markovian (i.e. time invariant) decision rule of the form *

$$(1.4) \qquad d_t = d_\pi(s_t).$$

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* This, of course, assumes an optimal policy exists.

This along with (1.1) and (1.3) specify the stochastic process governing the motion of the economy in equilibrium. The subscript π was used in the optimal decision rule in order to emphasize that different policies π imply different decision rules for agents.

Linear Quadratic Approximation

A standard technique of stochastic control theory is to determine the approximately optimal or target path $\{s_t^*, d_t^*, \pi_t^*\}$, and then to use first order Taylor series expansions of the G functions about the target path. Likewise a second order Taylor series expansion about the target values is used to approximate the social objective function. The approximate problem can then be solved using dynamic programming techniques.* It can be computed for large systems involving hundreds of state and decision variables.

The target path in this business cycle application will be the full employment path, which can be determined using optimal growth theory. Subsequently, for notational convenience, I assume that all variables are measured as deviations from their full employment path values.

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* I [ ] believe I was the first economist to use the dynamic programming formulation. For a good exposition see Kushner [ ] though he only develops the optimal decision rule within the class of linear decision rules. Using techniques of Strauch [ ], it can be shown that the linear feedback decision rule is optimal within the broader class of sequence of measurable contingency functions of the form $\{d_t(\varepsilon_1,\ldots,\varepsilon_{t-1})\}$. Because the loss functions are not bounded, the standard arguments of Blackwell [ ] and Denardo [ ] are not directly applicable

Operating Characteristics of the Economy

An implicit assumption of this analysis is that the operating characteristics of the linear quadratic economy are a good approximation of the true economy. Provided the functions G and u are sufficiently smooth and variances of disturbance sufficiently small, this will be the case.* The rational expectations equilibrium rule $d_{\pi}(s_t)$, along with (1.1) and (1.3), constitute a set of linear stochastic difference equations describing the motion of the economy. We need techniques to characterize, in a simple and easily understandable way, the operating characteristics of such a system. I have only begun to explore some alternatives, and in this paper will report only the variances of real output and the correlations with other state, decision, and policy variables.**

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* I have never seen a small sigma theory for control theory, but I am virtually certain such a theory could be developed.

** There is a problem in analyzing the relative and absolute prices which are obtained by considering the marginal conditions. They are not linear functions of the state variable; therefore, the theory of linear systems cannot be applied.

II The Structures of Preferences, Technology, and Policy

Conventional structures of preferences and technology are, at least within the rational expectation general equilibrium framework, inconsistent with observed movements of certain series over the business cycle. For example, conventional neoclassical theory predicts that productivity will be higher in recessions, when in fact it moves procyclically. In trying to resolve this inconsistency, I shall assume that firms allocate labor services between productive and investment activities, with the latter widely defined to incluce preventive maintenance, training, and improvement of technology. There is considerable evidence that in slack periods (c.f. [ ]) firms do allocate more resources to training. This is when workers acquire the skills needed to perform the next higher job on the job ladder in the internal labor market. There is also evidence, that during busy periods some engineers are assigned to supervisory functions, in order to increase current output rather than to advance production technology. If such activities were correctly measured and included in the national income accounts, it is indeed possible that output per worker would move counter rather than procylically.

Technology

It will be assumed that the stock of technology T_t, where technology is used in a very general way to include all the investment activities discussed above, is related to labor resources n_{1t}, allocated to improving the production process, as follows:

$$T_{t+1} = (1-\tau)\ T_t + n_{1t} + \epsilon_{1t} \tag{2.1}$$

where ϵ_{1t} are independent shocks. In a world with growth, T_t would be the deviation of productivity growth from trend.

The economy's production function, relating net output y_t (not including changes in stock of technology) to inputs is in the relevant range approximated by

$$(2.2) \qquad y_t = \varphi_1 k_t + \varphi_2 n_{2t} + \varphi_3 T_t + \varphi_4 k_t n_{2t} + \varphi_5 k_t T_t + \varphi_6 n_{2t} T_t - \varphi_7 k_t^2 - \varphi_8 n_{2t}^2 - \varphi_9 T_t^2$$

Where k_t is real physical capital, n_{2t} is labor services allocated to production, and the φ_i are positive constants. To complete the specification of technology, the physical capital stock is assumed to depreciate exponentially at the rate δ. Therefore

$$(2.3) \qquad k_{t+1} = (1-\delta) k_t + x_t .$$

where x_t is gross investment

<u>Preferences</u>

In this economy there is a representative consumer who maximizes expected discounted utility taking (distribution of) future prices as given. There is some evidence that the disutility of work is greater the more one has worked in the past, as indicated by the fact that workers are willing to temporarily, but not permanently, increase work hours. In order to capture the essence of this phenomenon, let N_t be the cumulative stock of work experience and assume that it decays exponentially at some rate η.

Then

$$N_{t+1} = (1-\eta)\ N_t + n_t \tag{2.4}$$

where $n_t = n_{1t} + n_{2t}$ is total labor supplied.

The approximation of the utility function is

$$U = \sum_{t=1}^{\infty} \beta^t \{c_t + \mu_1 m_{t+1} - \mu_2 n_t - \mu_3 N_t n_t\} \tag{2.5}$$

where c_t is real consumption, m_{t+1} real cash balances during period t and at the beginning of period t + 1, β the social discount factor, and the μ_i are positive parameters.

Clearly there is a need for a good theoretical justification for introducing real cash balances into the utility function. Cash balances do not provide utility directly, but rather make it possible for an individual to realize greater utility from a given level of consumption expenditures. Ideally, the demand for money should be derived from technological considerations. However, such a theory would probably justify this assumption.

<u>Policy</u>

Let g_t be real government purchases, m_t real money supply, carried over from the previous period, b_t real government bills issued at time t-1 and due at time t, and f_t random noise in the money supply. Real government purchases of goods and services g_t are assumed to follow

$$g_{t+1} = \gamma_1 q_t - \gamma_2 b_t - \gamma_2 m_t + \epsilon_{2t} \tag{2.6}$$

where ϵ_{2t} has mean zero and constant variance, and the γ_i are all positive.

At this stage tax policy has not been included so g_t is the real deficit and (2.6) characterizes fiscal policy. The deficit is financed either by creating money (high powered money), or issuing debt. Let λ be the fraction of the deficit financed by selling bonds to the FED. Then

(2.7) $$m_{t+1} = \frac{m_t}{\beta+\mu_1} + \frac{1}{\beta+\mu_1} \lambda g_t + \frac{1}{\beta+\mu_1} f_t.$$

As a deficit must be financed either by selling bills to the FED or the public

(2.8) $$b_{t+1} = \frac{1}{\beta} b_t + \frac{1}{\beta} (1-\lambda) g_t - \frac{1}{\beta} f_t.$$

The factors $\beta+\mu_1$ and $1/\beta$ are implied by marginal conditions for the utility function (2.5). The f_t variable is noise introduced by the monetary authorities and is assumed independent; that is

(2.9) $$f_{t+1} = \epsilon_{3t}$$

where all the ϵ_{it} and uncorrelated. Only policies for which the linear difference equation system (2.6) - (2.9) are stable, can be evaluated.

III Parameter Estimation

It is perhaps pretentious to refer to the parameter selection as estimation. I did examine certain correlations and economic ratios and ran a few regressions before coming up with what I hope are "ball park" values. For purposes of this analysis, semi-annual American economic data for the 1950-70 period was used. I considered using both quarterly and annual observations, but it seemed that three months was too short and twelve months too long for the basic time unit, given that the analysis assumes one period elapses before investment expenditures become productive.

Parameters of Policy

Three policies will be evaluated for each preference-technology structured considered. The first is the constant real money supply policy (constant except for FED noise f_t),

$$m_{t+1} = f_t. \tag{3.1}$$

For this policy all deficits (positive or negative) are financed by the issuance of debt. I wanted to evaluate a constant nominal money supply policy but the structure described in the previous section assumes real quantitites. At a latter stage, when I better understand the behavior of the competitive equilibria, I plan to evaluate a real money supply policy for which the nominal money supply is approximately constant, namely a policy for which fluctuations in the real money supply are approximately offset by equal magnitude but opposite sign fluctuations in the price level.

For the second policy, the entire deficit is financed by the expansion or contraction in the money supply. This is the constant debt policy,*

$$b_t = \frac{\beta + \mu_1}{\beta} f_t. \tag{3.2}$$

Within the American institutional framework, m_t corresponds roughly to government securities held by Federal Reserve Banks. Thus, I am abstracting from other FED policy actions, such as changes in reserve requirements, and am ignoring other components of high powered money. The estimated historical policy function was

$$m_{t+1} = .7m_t + .2g_t. \tag{3.3}$$

All variables are measured in billions of 1968 dollars.** The last policy equation estimated is the fiscal relationship:

$$g_{t+1} = .5g_t - .3m_t - .3b_t. \tag{3.4}$$

There was not good empirical support for the coefficient of $m_t + b_t$ but, unless there is some feedback, the policy structure would be unstable and

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* Certain second order terms have been dropped in order to keep the structure linear.

** In certain cases I passed the series through Nerlov's filter $(1-.75L)^2$, where L is the lag operator, in order to abstract from trends. Sims used this method in [ ]. Possibly the varying parameter techniques of [ ] will be useful given that the basic problem is to measure the deviation from trend when the trend is changing overtime. These issues must be faced when undertaking a serious estimation of the structures.

policy evaluation impossible.

Parameters of Technology

For purposes of determining the parameters φ_i of the quadratic approximation of the production function, a Cobb-Douglas relationship with constant returns was assumed. The Cobb-Douglas function has the convenient property that it can be estimated, assuming cost minimization, with a single period of observations of output, factor inputs, and factor shares. For this purpose I assume $k^* = T^* = y^* = 500$ billion dollars , $n^* = 100$ billion manhours, and factor shares of 10 percent for both capital and technology and 80 percent for labor. After using these numbers to determine the parameters of the Cobb-Douglas production function, a second order Taylor series expansion about the starred values of the variables was used to determine the φ_i of the quadratic approximation.

Implicit in these calculations was the assumption that both capital and technology depreciate expoentially at a 10 percent annual or 5 percent semi-annual rate. Thus,

$$T_{t+1} = .95\, T_t + n_{1t} + \epsilon_{1t} \tag{3.5}$$

and

$$k_{t+1} = .95\, k_t + x_t . \tag{3.6}$$

The disturbance ϵ_{1t}, in the equation describing the motion of technology, is autonomous, and in a world with growth would have a positive mean. As this analysis is concerned with deviation from trend, its mean is taken to be zero.

Preferences

In order to obtain reasonable estimates of the parameters of the quadratic approximation of the utility function, a log linear function was assumed for utility in each period. That is

$$U = \sum_{t=1}^{\infty} \beta^t c_t m_t^{\theta_1} (B-n_t)^{\theta_2} \tag{3.7}$$

where B is a bound for the labor supply. I then determine the values for β, θ_1, θ_2, and B which yielded a deterministic stationary solution with $m^* = 50$, $c^* = 450$, and $n^* = 100$ given the real wage $w^* = 4$ and real interest rate $r^* = .05$. Given the assumed production function, if there were no disturbances, $g_t = 0$ for all t, and variables were and stayed at their starred value, the economy would be in equilibrium.

There are three sources of noise in this model, arising from monetary, fiscal, and autonomous technology changes sources respectively. The equilibrium decision rules for economic agents, $d_\pi(s_t)$, will be independent of their variances. The decision rules were determined for each of the three policies and the implied covariance matrixes of the stationary distribution computed for alternative variance structures. The three sets of variance considered were obtained by setting the disturbance of one of the disturbances equal to one and the other two equal to zero. Letting $\Sigma_{i\pi}$ be the covariance matrix obtained for policy π if all the variance ε_{it} were one, the

(3.8) $$\Sigma_{\pi} = \sum_{i=1}^{3} \sigma_i^2 \Sigma_{i\pi}$$

where $\sigma_i^2 = \mathrm{Var}\ (\epsilon_{it})$. This relationship can be used to determine how sensative the results are to the assumption concerning the relative sizes of the disturbances.

IV A Policy Evaluation

My goals are (1) to develop a theory of the business cycle which is a competitive equilibrium and entails rational expectations and (2) to develop operational procedures to evaluate alternative stabilization policy rules. Within that framework, a theory is a specification of the policy-preference-technology structure. A successful theory is one for which the rational expectation equilibrium is stochasticaly similar to the economy. For example series which have moved pro or counter cyclically must do likewise for the equilibrium.

Before developing such a theory, methods are needed to compute the competitive equilibrium for a given structure. I think I have been successful in developing such procedures and have computed the rational expectations equilibrium decision rules for one particular simple policy-preference-technology structure. I am not concerned with the fact that the equilibrium was inconsistent with historical observations because I do not consider the assumed structure for preference an adequate approximation of reality. I considered it a success to have demonstrated the procedure is operational.

Even though the example is not adequate, I think it worth presenting because it makes the method of analysis clearer. It is as follows:

Technology

Suppose

(1) $$y_t = (A + T_t)\, k_{1t}^{\alpha(1)}\, k_{2t}^{\alpha(2)}\, n_t^{\alpha(3)}$$

where y_t is real output

$\alpha(1) = \alpha(2) = .15$

$\alpha(3) = .70$

k_{1t} is real capital of variety 1

k_{2t} is real capital of variety 2

n_t is labor services

T_t is technological shift parameter.

In addition

(2) $$k_{1,t+1} = .90\, k_{1t} + x_{1t}$$

(3) $$k_{2,t+1} = .91\, k_{2t} + x_{2,t-1}$$

(4) $$T_{t+1} = .5\, T_t + \epsilon_{1t}$$

$$y_t = c_t + x_{1t} + x_{2t} + g_t$$

Where x_{it} are real invesements, g_t real deficit, and c_t real consumption.

Preferance

$$U = E \sum_{t=1}^{\infty} \beta^t \left[c_t + \mu_1 m_t - \mu_2 n_t - \mu_3 n_t N_t\right]$$

where $\beta = 1/(1 + r)$ and $r = .05$

$\mu_1 = 1 - \beta$ $\mu_2 = 3.5$

$\mu_3 = .001$

(6) $$N_{t+1} = .5N_t + n_t$$

Policy

(7) $$g_{t+1} = .5\, g_t - .3\,(b_t + m_t) + \epsilon_{2t}$$

(8) $$m_{t+1} = m_t + \frac{1}{2}\, g_t + f_t$$

(9) $$b_{t+1} = \frac{1}{\beta}\, b_t + \frac{1}{2\beta}\, g_t - \frac{1}{\beta}\, f_t$$

(10) $$f_{t+1} = \epsilon_{3t}$$

A second order Taylor series expansion of (1) was computed about the point $k_{1t} = k_{2t} = y_t = 500$ billion dollars and $n_t = 100$ billion man hours. At these points, the real interest rate was .05 and the real wage \$3.50 per hour.

State Variables

$$\begin{bmatrix} k_{1t} \\ k_{2t} \\ N_t \\ T_t \\ g_t \\ t_t \\ m_t \\ f_t \\ x_{2,t-1} \end{bmatrix} = S_t$$

Decision Variables

$$d_t = \begin{bmatrix} x_{1t} \\ x_{2t} \\ n_t \end{bmatrix}$$

Equations have the form

$$s_{t+1} = A\, s_t + B\, d_t + \epsilon_t$$

where A and B are matricies obtained from equations (2)-(4) and (6)-(10). The objective function is obtained by solving (5) for c_t, using the quadratic approximation of (1) to eliminate y_t and substituting the resulting expression for c_t into the utility function.

Results

(1) Money did not matter.

(2) Decreases in g_t were met by equal reductions in c_t (i.e. multiplier of minus one)

A More Reasonable Utility Structure

The assumption that money and consumption are prefect substitutes is unreasonable. I plan to explore utility functions of the form

$$\sum_{t=1}^{\infty} \beta^t \, c_t^{\beta_1} \, m_t^{\beta_2} \, (\beta_4 - n_t)^{\beta_3}$$

where $\beta_1 + \beta_2 + \beta_3 = 1$. I had hoped to report results for this structure today but did not get it done. It involved a large number of hand calculations to get the parameters of the quadratic approximations straight.

V Discussion

The models considered may appear to be relatively simple when compared with the MIT-FRB-Penn and Wharton models. This is not the case. Both these, and virtually all, the large scale models are based on the simple IS-LM mechanism.* It is through disaggregation that the number of variables and equations becomes large. My structure can and will be disaggregated. In particular I plan to treat consumer durables and nondurables separately, and to disaggregate investment into plant, equipment, and inventory expenditures. For the various components of investment expenditures, different lead times will be assumed. I, however, expect that given the objective of evaluating stabilization policy, it will be neither necessary nor desirable to disaggregate to as great an extent as is now done with the big models. For other purposes, such as making accurate short term forecasts, this rational expectations equilibrium analysis is probably dominated by both the large scale forecasting models and the simple ARMA forecasting schemes (c.f. Nelson [ ]).**

Stability of Equilibria

There is no fundamental theory concerning the behavior of economic decision makers out of equilibrium, and I doubt whether there ever will be one. None-the-less, when comparing equilibria, which I am doing, such comparisons are not meaningful unless there are forces in the economy that tend to drive the economy towards equilibrium, when it is not already

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* The IS-LM mechanism is augmented by a labor supply, Phillips curve, markup equation, and a production function, in order to determine (with limited success) price and wage dynamics. For a good explanation of the basic structure of the Macro models, see McCarthy [ ].

** The adaptive regression technique [ ] uses features of both these approaches and may work better for short term forecasting.

there. Conventional techniques for analyzing the stability of static systems are not appropriate for dynamic process, as they require the introduction of the time dimension. When the economy is not in equilibrium, agents' expectations are not rational and they will be making persistent, costly, and easily correctable forecasterrors. Surely, over time they will revise their forecasting schemes. If as a result of a sequence of such revisions, agents' decision rules converge to the equilibrium ones, then clearly there are forces tending to drive the economy towards equilibrium when it is not already there. I am currently trying to establish this result formally.

Lucas [ ] and Crawford [ ] have used direct methods in calculating the rational expectations equilibria for highly abstract economies. The advantage of such approaches is that one need not assume a Hicksian economy and more importantly, policy can be formulated in nominal rather than real terms. It also permits analyses of economic behavior when agents have varying information sets.* There is a need for developments which permit the direct calculation of the competitive equilibrium for structures of reasonable complexity.

* This is an essential element of Lucas's [ ] explanation of the Phillip's curve relationship.

VI Summary and Conclusions

The primary focus of this paper was the development of an analytic structure to correctly evaluate alternative stabilization policies. The approach is fundamentally different from the conventional evaluation procedure, which is to estimate parameters specifying a set of behavioral equations and then to evaluate alternative policies under the assumption that these equations will not change. With the rational expectations equilibrium approach, one estimates the parameters of technology and preferences and then computes the equilibrium behavioral equations associated with the policy being evaluated. In calculating the competitive equilibrium, I assume economic agents form expectations rationally and behave optimally given these expectations. Thus the expectations imputed to economic agents are the same as the predictions of the model.

In summary, this is but a first step towards the development of a theory of the business cycle and an operational framework for correctly evaluating stabilization policy. Much research remains to be done.