IMPACT OF ANTICIPATED AND UNANTICIPATED

MONETARY AND FISCAL CHANGES ON

OUTPUT: AN EMPIRICAL STUDY

by

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CHAPTER I

INTRODUCTION

Statement of the Problem

The proposition that fiscal policy is relatively important and monetary policy is impotent has been supported by many Keynesians (Blinder and Solow, 1974, pp. 8-11). They claim that the private sector is unstable and the disturbances affecting the economy arise from the real sector; thus governmental intervention is necessary to offset the fluctuations in economic activity. They therefore advocate discretionary fiscal policy (Modigliani, 1977, p. 2). In contrast to the Keynesian view, monetarists argue that the disturbances affecting the economy are monetary in foundation and fiscal policy is largely ineffective in influencing economic activity (Andersen, 1973, p. 3). Since the consequences of varying the rate of growth of the money supply cannot be predicted with great accuracy, it is extremely difficult for the authorities to use discretionary policy to fine-tune the economy. Thus, monetarists prefer a fixed rate of money supply growth rule (Mayer, 1975, p. 192). These are the terms on which the macroeconomic debate has been waged between the Keynesian and monetarist camps.

Recently, the main battle among the economists has shifted away from the Keynesian--monetarist debate; the rational expectations hypothesis has become the center of debate in economic theory. It has led to serious questions on the validity of the Keynesian and monetarist doctrines; it has also emphasized limitations on the scope and effectiveness of stabilization policy. It has provided an alternative to evaluate the effects of different policy actions. According to Lucas (1981, pp. 123-126), the behavior of economic agents is incorporated into the structure of an econometric model. Their decisions are based on their expectations of the rules by which the authorities conduct policy. Suppose the authorities change their policies, agents may also be expected to change their decisions rationally, thereby altering the structure of the economy as well.[1]

The importance of this theoretical innovation has stimulated much work testing the main implications of the rational expectations hypothesis. In its extreme form, one of the most striking implications is that only unanticipated changes in the money supply affect the real variables of the economy; this is sometimes called "the policy ineffectiveness proposition" because anticipated policy actions have no systematic effect on the economy.

The pioneering empirical work of Barro (1977) on the subject of the policy ineffectiveness proposition has offered support for the rational expectations hypothesis. Barro decomposes observed money growth into anticipated and unanticipated components. He finds that only unanticipated monetary changes have a significant effect on

[1]Sims (1982, pp. 110-121) disagrees with the Lucas critique. He argues that the authorities change their policy actions slowly; as a result, the structure of the economy does not change radically and rapidly.

unemployment and real output. His work has stimulated a number of other economists to undertake empirical investigations into the relative effects of anticipated versus unanticipated money growth on unemployment and real output. However, the available empirical evidence about the policy ineffectiveness proposition is mixed. There is a lack of consensus between those who argue for the importance of systematic monetary or fiscal policy and those who are against such a point of view. The following conceptual issues have been raised, but not satisfactorily resolved:

a. Do anticipated monetary and fiscal changes affect real economic activity?

b. Do unanticipated monetary and fiscal policy actions have a larger impact on real economic variables than the anticipated monetary and fiscal changes?

c. Are Barro's results robust when the interdependence between monetary and fiscal policy variables is taken into account?

Organization of the Study

This study inquires into the controversial issues mentioned above. To that end, the study is organized as follows. Chapter II discusses the meaning of rational expectations. It reviews the argument of the policy ineffectiveness proposition. It also explains why both extrapolative and adaptive expectations are irrational. Chapter III examines previous empirical studies on the policy ineffectiveness proposition. Chapter IV develops a rational expectations model. The theory behind the structure of the model is illustrated at that point, and the policy ineffectiveness proposition is derived. It also includes a discussion of the data sources. Chapter V provides empirical results and economic interpretation of the results. It also presents the estimation methods and concluding comments. The final chapter is a summary and conclusions of the study.

CHAPTER II

STABILIZATION POLICY UNDER THE RATIONAL EXPECTATIONS HYPOTHESIS

Expectations or animal spirits are a key factor of consumption, saving and investment, and other economic activities (Keynes, 1936, pp. 46-51). For example, the manner in which the authorities conduct their policies--how they increase expenditure, cut taxation, issue more money and finance their deficits--may affect the public's expectations, which in turn may affect the future economy.

Since expectations may play an important role in the public's and the authorities' decisions, it is useful at this point to examine the role of expectations in greater depth. Extrapolative and adaptive expectations are employed by many economists. Generally, agents, who have these kinds of expectations, expect the future value of any economic variable in the model to be determined by a distributed lag of past values of the variable. First, the extrapolative expectations can be illustrated in following manner (Heady and Kaldor, 1954).

$$EX_t = b_o X_t + b_1(X_t - X_{t-1}) \quad b_1 > 0 \qquad (2.1)$$

where EX_t = the expected value of X_t,

X_t = current observed value,

b_1 = the trend of expectation.

The adaptive expectations hypothesis was first employed by Cagan (1956, pp. 27-35). His study dealt with the demand for money during a period of hyperinflation. The technique was further popularized by Chow (1966). The equation is

$$EX_t - EX_{t-1} = \beta(X_t - EX_{t-1}) \qquad 0 < \beta \leq 1 \tag{2.2}$$

Equation (2.2) can be rewritten as

$$EX_t = \beta X_t + (1-\beta)\ EX_{t-1} \tag{2.3}$$

Equation (2.3) states that agents' adjustments are based on an error-learning process. Agents incorporate expectations into their behavior as they learn from the experience of recent events.

The extrapolative and adaptive expectations models make sense only if the relationships among the past and future variables are constant. Lucas's critique (Lucas, 1981, pp. 123-126) of econometric models implies that the structural parameters are not constant but depend on policy rules. When agents form expectations extrapolatively or adaptively, one can therefore project a policy variable in such a way that agents can be systematically fooled. Accordingly, the human learning process of adaptive or extrapolative expectations is irrational (Sargent and Wallace, 1973, p. 349).

The Characteristics of Rational Expectations

In recent years, a number of economists have advocated another approach to economic modelling. They suggested the rational expectations hypothesis. According to this new approach, a model is built in which expectations were not represented arbitrarily, but were formed rationally. The roots of the rational expectations school were already forming in the 1960s. Muth (1961) introduced the literal concept of rational expectations. His work stimulated Lucas (1972, 1973), Barro (1976), Sargent and Wallace (1975, 1976) and others to trace some of the implications of the rational expectations hypothesis.

Muth's analysis (Muth, 1961) related to a variant of cobweb theory. He tried to illustrate the price-fixing behavior on a certain market in the agriculture sector. He defined the concept of rational expectations in the following manner:

> In order to explain these phenomena, I should like to suggest that expectations, since they are informed predictions of future events, are esentially the same as the predictions of the relevant economic theory. At the risk of confusing this purely descriptive hypothesis with a pronouncement as to what firms ought to do, we call such expectations 'rational'. (Muth, 1961, p. 316).

Rational expectationists therefore assert that economic agents make economic decisions taking into account all the available information without cost to ensure that past mistakes would not be repeated. That is, agents use current and past data and the knowledge of behavior to estimate the relationship among economic variables. Agents also update their estimation on the basis of new information. Lack of complete information or uncertainty may cause the agents to make a biased prediction, which in turn may cause real shocks in the economy (McCallum, 1980a, p. 43; Maddock and Carter, 1982, pp. 44-46).

Monetary Policy Implications of the Rational Expectations Hypothesis

With regard to the effectiveness of monetary policy, Sargent and Wallace (1976) present a model in which a deterministic money supply rule has no effect on real economic variables. That is the fundamental implication of the rational expectations hypothesis, which is also a basic tenet of classical monetary theory.

Consider the Lucas supply function:

$$\ln Y_t = \ln Y_{t-1} + \theta(\ln P_t - E_{t-1} \ln P_t) + \varepsilon_t \qquad \theta > 0 \qquad (2.4)$$

where Y = real aggregate output,

P_t = the price level in time t,

$E_{t-1}P_t$ = the price level that is expected to prevail in t, based on t-1 available data,

ε = the random shock.

Equation (2.4) illustrates the implications of the rational expectations hypothesis--the policy ineffectiveness proposition. This proposition states that if agents and the authorities have access to the same information and if agents have identical preferences, then the authorities can influence real economic variables only if they can change or influence the actual price level $\ln P_t$ and at the same time not change the expected price level $E_{t-1} \ln P_t$ by the same proportion. In other words, an anticipated change of monetary growth causes proportional responses in both the actual price level and the anticipated price level, and thus leaves other real variables unchanged (Sargent and Wallace, 1976; McCallum, 1980b).

Essentially an anticipated monetary policy is unable to generate employment and production effects either in the short run or in the long run. The authorities can achieve real effects only by unanticipated monetary policy actions.

This argument goes further. Woglom (1979) shows that if the authorities follow a combination policy involving a combination interest rate and money supply rule, the inclusion of the contemporaneous interest rate generates instantaneous money supply changes in response to economic shocks which change the rate of interest. Thus monetary policy parameters may influence real output. Fackler (1982) also explains the interaction between monetary policy and the tax system. He assumes that labor supply decisions are based on after-tax real wages. For a given output, agents may be pushed into higher marginal tax brackets by inflation. Therefore, expansionary monetary policy increases the price level and then real tax liabilities alter the after-tax real wage, causing the behavior of labor to change. Consequently, expansionary monetary policy creates short-run employment and production effects.

Fiscal Policy Implications of the Rational Expectations Hypothesis

Surprisingly, little attention has been paid to fiscal policy. Sargent (1973, p. 463) considers a model with an aggregate supply schedule, an aggregate demand schedule, and a portfolio balance schedule. He points out that the real output is independent of government expenditure policy.

In a general equilibrium model with the Sargent-Wallace supply function, McCallum and Whitaker (1979) find that the systematic part of any feedback rule for monetary or fiscal policy has no effect on the real economic variables. However, built-in stabilizers, features of the tax structure that make tax liabilities respond automatically to current economic conditions, provide automatic but not immediate adjustments to reduce random disturbances and therefore have an effect on real economic variables.

Peel (1981) considers the role of both built-in stabilizers and systematic monetary and fiscal stabilization policy in the Sargent-Wallace supply function and takes into account future expectations in the IS curve. He concludes that built-in stabilizers and systematic monetary and fiscal policy all have substantial impacts on real variables.

Within a general equilibrium model, Canzoneri (1978) examines the random disturbances or unanticipated components of monetary and fiscal policy. He explains that the unanticipated components depend upon the Fed's regulations of the banking system, which determine money growth and on the political process, which determines fiscal policy. Unless all reserve requirements are set at 100 percent, it is impossible for the Fed to control total reserves completely. Commercial banks can still hold excess reserves, which may cause the existing randomness in the money supply behavior. On the other hand, fiscal policy differs from one time to another depending on the history of previous fiscal policy actions and on past and current legislative debates. It is quite impossible to predict agents' spending response to fiscal changes in a particular year without bias. Consequently, discretionary monetary and fiscal policy may be at work.

The Policy Ineffectiveness Proposition and Its Validity

According to the literature, there are several potential channels through which even fully anticipated changes in monetary or fiscal policy actions can affect real economic variables. These are, respectively, the cost of information, price-level stickiness, Fischer-Phelps-Taylor effect, nonindexed tax system, and the Mundell-Tobin effect.

These channels provide room for discretionary policy.

Cost Information

It is important to realize that the rational expectations hypothesis involves expectations formed in a rational manner based on collecting information without cost. Actually, agents may not have as much information as the rational expectations hypothesis indicates. Information is costly to collect. Agents may choose not to collect sufficient information concerning aggregate disturbances when it is costly to do so (Feige and Pearce, 1976, p. 500; Cukierman, 1979, p. 214). If information were really free, agents would have identical rational expectations. When information is costly, differences in the cost of acquiring data cause differences in expectations (Darby, 1976). Consequently, agents make choices on the basis of incomplete information. They are unable to distinguish between real and monetary phenomena which influence nominal wage signals. This leads to an inflation-unemployment trade-off (Weiss, 1980).

Even if information is readily available, economic activity may be affected by agents who are unable to utilize it efficiently. Thus, a model with rational expectations is unable to make an optimal forecast of the value of the economic variable concerned (Friedman, 1979, p. 39). Barro (1976), for example, considers an economy in which there are many separate markets for the same good among which information does not move immediately. He also provides a useful explanation of the implications of an information differential between the authorities and the agents. The authorities may have more superior information on price expectations than the agents. Since expectations are formed based on restricted information, individuals cannot predict the actions of the authorities without bias. Hence, even systematic changes in policies can influence the stability of output. Howitt (1981), who takes into account costs of collecting and using information and uncertainty of the structure of the economy, points out that it may be costly for agents to use macroeconomic information even if that information is provided free of charge by the authorities.

Taylor's (1975) analysis focuses entirely on the agents learning about the authorities' policy actions. He emphasizes the notions that agents would not have perfect information about policy actions and that the authorities would have more information than the agents. It is possible for the authorities to conduct policy actions so as to systematically fool the agents. Thus, deceptive policy actions can have systematic output effects in transition periods during which new information is combined with old information. Agents modify their expectations about the form of policy and gradually learn the rules of policy actions. The same conclusion is also shown by Friedman (1979). He points out the similarity of rational expectations to error learning during the learning process.

Lucas (1975) develops a model in which agents face an information problem. They do not realize whether a change in the price of their labor is a real change or simply a reflection of inflation, so they do not know how to respond. They respond as if the price changes were real and not a reflection of inflation. In this case, unanticipated changes in the price level can generate a real effect.

Price-Level Stickiness

When agents build up their information expectations rationally, the anticipated monetary growth rate immediately and completely causes a proportional increase in nominal wage and price levels, and at each moment of time relative prices among goods remain unchanged. There are no costs associated with changing prices. These assumptions are obviously unrealistic. In the actual economy, there are significant direct and indirect costs associated with changing prices, such as the costs of printing new price lists, the cost of making decisions about price changes, and the cost of renegotiating price agreements (Mussa, 1981). Therefore, the price level is neither perfectly fixed nor perfectly flexible. The price level may be too sticky and adjust too sluggishly (Gordon, 1976).

It is important to realize that price level stickiness does not contradict the idea that expectations are formed rationally. Presumably, it is costly for firms to hire and fire workers. When demand is changing, in order to meet the new demand conditions, firms gradually adjust their inputs and outputs. When the expected price level increases due to increasing aggregate demand, the demand curve for workers does not shift in response to the higher price level immediately, but instead gradually shifts. Thus, there exists a dispersion in the price changes. The stickiness of the price level suggests a Keynesian mechanism in which changes in the money stock lower the interest rate and increase investment spending, shifting up aggregate demand, which in turn affects real output.

Baily (1978) assumes price stickiness rather than flexibility. He also assumes that agents have changed the way in which expectations are formed rationally from observing economic development. He claims that these changes reflect evolving perceptions of the role of discretionary fiscal policy in maintaining economic stability. Alogoskoufis and Pissarides (1983, pp. 618-621) argue that in a model with price stickiness, supply does not equal demand. Whether or not policy ineffectiveness is valid depends on the source of the observed lags; if the sources come from the supply or demand equation, then the policy ineffectiveness proposition is valid. If the sources come from a partial adjustment in price, then the policy is effective.

The implication that price adjusts sluggishly rather than immediately and therefore prevents agents from promptly responding to aggregate disturbances tends to deny the policy ineffectiveness proposition. In a series of papers, McCallum (1978, 1980b) has argued that price level stickiness is not a central issue. In a rational expectations model with price level stickiness, the policy ineffectiveness proposition still holds.

Fischer-Phelps-Taylor Effect

Another channel stems from the fact that contracts in the labor market are long and overlapping. It is not the case that wages rise and fall from day to day and hour to hour. Each worker does not negotiate a contract in the same day; instead, workers enter into contracts that last over a period of time.

In short, worker contracts in existence in any particular year were negotiated at different dates in the past, and so the expectations that are incorporated in these contracts are based on information that is available at different dates in the past. This implies that the authorities can change their policy actions more frequently than workers can alter their contracts (Fischer, 1977; Phelps and Taylor, 1977; Taylor, 1980).

The implications of long term contracting have been explored by Fischer (1977). He demonstrated the effectiveness of systematic policy actions in a model which had a labor market fix nominal wages for two periods in advance, rational expectations, and the Lucas aggregate supply function. He found that during the contracting period, the authorities can react to the new inflow of information about recent disturbances of the economic process through their policy actions, thus providing a stabilizing role for discretionary policy actions including policy actions fully anticipated by the agents. But if long term contracts are indexed, anticipated policy actions may lose their effectiveness.

Phelps and Taylor (1977) assume that both wage and price levels are fixed one period in advance and reach essentially the same conclusions as Fischer, who asserts that the nominal wage contracts in a rational expectations model have some room for discretionary monetary or fiscal policy during the contracting period.

The argument mentioned above in terms of the Lucas aggregate supply function can be summarized as

$$\ell n Y_t = \ell n Y_{t-1} + \sum_{i=o}^{\eta} \theta_i (\ell n P_t - E_{t-i} \ell n P_t) + \varepsilon_t \tag{2.5}$$

Assuming a Lucas supply function with two period labor contract, this becomes

$$\ell n Y_t = \ell n Y_{t-1} + \theta_1(\ell n P_t - E_{t-1}\ell n P_t)$$
$$+ (1-\theta_1)(\ell n P_t - E_{t-2}\ell n P_t) + \varepsilon_t \tag{2.6}$$

Obviously, the expected price level during the second period is not in accordance with the information at t-1. The difference between $\ell n P_t$ and $E_{t-2}\ell n P_t$ therefore provides real effect for systematic monetary or fiscal policy.

Nonindexed Tax System

Consider the real effects of anticipated monetary policy actions arising from the nature of a nonindexed tax system. The rational expectations hypothesis proposes that the expected rate of inflation is equal to the sum of the expected rate of money growth and the expected value of disturbance term. Since the latter is assumed to be equal to zero, the expected rate of inflation is equal to the expected rate of money growth. Anticipated changes in the money supply cause changes in the expected rate of inflation. Consequently, taxes are pushed into higher tax brackets, which in turn reduce real output. As a result, the policy ineffectiveness proposition is no longer valid.

Now consider the impact of a change in the expected rate of inflation on nominal and real interest rates when taxes are paid on interest income, depreciation deduction, and interest deduction.

According to the United States Tax Code, capital gains are taxed when realized. Suppose capital gains are taxed, then the effective tax rate rises with the increasing rate of anticipated price level, thus reducing the return on capital. Depreciation for tax purposes is valued at historical cost rather than replacement cost. Suppose the price of machines is rising; the value of the depreciation allowances for the same machine will be higher if the investment is proposed. Hence, investment in depreciable assets will become less attractive under increasing anticipated price level. Nominal interest payments rather than real interest payment are tax deductible. Since debtors can deduct nominal interest payments, debt-financed investment becomes more attractive if anticipated price level increases (Feldstein and Summers, 1978; Feldstein, Green, and Sheshinski, 1978).

The Fisherian conclusion is that the nominal rate of interest will be equal to the real rate of interest plus the anticipated rate of changes in the price level. The nominal rate of interest rises by the anticipated rate of changes in the price level and leaves the saving supply function and the investment demand unchanged. The nature of nonindexed tax system discussed above may deny the Fisherian conclusion, even when monetary policy actions are fully anticipated. Anticipated monetary policy actions tend to cause an increase in the anticipated rate of inflation, which in turn reduces investment and subsequent output. Consequently, anticipated monetary changes do have a real effect.

Mundell-Tobin Effect

According to Mundell (1963) and Tobin (1965), monetary policy has real effects by changing the distribution of returns to money holding.

Mundell (1963) argues that an increase in the anticipated inflation rate reduces real balance holdings and therefore wealth, which causes a reduction in the real interest rate and an increase in real saving and investment. Tobin (1965) also points out that an increase in the anticipated rate of price level reduces the expected real rate of return from holding money as an asset, induces a portfolio shift toward capital, and thus increases the capital stock and real output in subsequent period.

Sargent and Wallace (1975) include capital accumulation in their model. Since the demand for capital depends only on the expected real rate of return on nominal bonds, and since the aggregate demand is unaffected by the anticipated rate of the price level, money is neutral and the Fisherian proposition still holds in this model. However, Fischer (1979) assumes that the demand function for capital goods depends not only on the expected real rate of return on capital goods but also positively on the anticipated inflation rate. Since anticipated changes in the money supply affect the anticipated rate of inflation, the nonneutrality of anticipated monetary changes arises from the Tobin effect. Thus anticipated countercyclical policy actions are feasible.

CHAPTER III

REVIEW OF PREVIOUS EMPIRICAL STUDIES

A large number of empirical studies have been carried out to test the policy ineffectiveness proposition. For example, Barro (1977, 1978, 1979, 1981), Pigott (1978), Stein (1981, 1982, pp. 114-162), Small (1979), Sheffrin (1979), Froyen (1979), Grossman (1979), Barro and Hercowitz (1980), Barro and Rush (1980, pp. 23-54), Wogin (1980), Leiderman (1980), Attfield, Demery, and Duck (1981a, 1981b), Bellante, Morrell, and Zardkoohi (1982), Mishkin (1982), Fitzgerald (1982), Garner (1982), Gordon (1982), Makin (1982), Darby (1983, pp. 273-288), Urich (1982), Canarella and Garston (1983), Driscoll, Ford, Mullineux, and Sen (1983). However, the results of these are mixed, and there exists presently no consensus over the hypothesis that only unanticipated monetary or fiscal changes have real effects.

Only Unanticipated Monetary Changes Affect Real Economic Variables

Barro (1977, 1978, 1979), Stein (1981), Sheffrin (1979), Grossman (1979), Barro and Hercowitz (1980), Barro and Rush (1980, pp. 23-54), Wogin (1980), Leiderman (1980), Attfield et al. (1981a, 1981b), Bellante et al. (1982), Urich (1982), Canarella and Garston (1983) have concluded that anticipated money supply changes have no systematic influence on real economic variables, but that only unanticipated monetary changes affect real variables. Generally, a two-stage procedure is employed to test the policy ineffectiveness proposition. First, a forecasting equation for money growth is estimated by ordinary least squares over the sample period. The fitted values of the equation are then taken as the anticipated components of monetary or fiscal changes; the residuals are taken as the unanticipated components.

Barro and others utilize annual and quarterly data gathered from the United States, and the Barro-type empirical investigations are based on the following equations:

Money growth equation

$$DM_t = \alpha_o + \alpha_1 DM_{t-1} + \alpha_2 DM_{t-2} + \alpha_3 \ FEDV_t + \alpha_4 U_{t-1} + W_{1t} \tag{3.1}$$

where DM = the rate of growth of annual average old M1,

FEDV = Log (FED) - (Log(FED))*,

$Log(FED)^*_t = \beta(Log(FED))_t + (1-\beta) \ (Log(FED))^*_{t-1} \qquad 1 < \beta < 0,$

where FED is real federal government expenditure. FEDV is the deviation of federal government expenditure relative to its normal value.

U = the annual average unemployment rate.

The parameters α_1 through α_4 are assumed to be positive; α_o and W_{1t} are the constant term and the disturbance term, respectively.

Barro's money growth equation is designed to capture the following aspects of the money supply process. First, the federal government expenditure variable, FEDV, reflects the revenue motivation for money creation when federal government expenditure is abnormally high or low. Second, the lagged value of the unemployment variable is designed to take into account a countercyclical relation of the monetary authority. Finally, the lagged money growth variables are autoregressive to describe lagged adjustment or serial dependence not captured by the other independent variables (Barro, 1977, p. 104). Barro and Rush's money growth equation is a quarterly generalization of Barro's annual money growth equation. Thus, the quarterly growth of money equation is defined as a function of six lagged values of money growth, three lagged values of the seasonally adjusted total unemployment, and a measure of current federal government expenditure (Barro and Rush, 1980, p. 33).

Unemployment equation

$$U_t = b_o + b_1 (DM_t - \hat{DM}_t) + b_2(DM_{t-1} - \hat{DM}_{t-1}) + b_3 (DM_{t-2} - \hat{DM}_{t-2}) + b_4 MIL_t + b_5 MINW_t + W_{2t} \quad (3.2)$$

where MIL = a measurement of military conscription,

MINW = a minimum wage,

$\hat{DM}$ = the anticipated value of DM.

The parameters b_1 through b_4 are expected to be negative, b_5 is expected positive; b_o and W_{2t} are the constant term and the error term, respectively (Barro, 1977, p. 107).

Output equation

$$\ell n Y_t = C_o + C_1 (DM_t - \hat{DM}_t) + C_2 (DM_{t-1} - \hat{DM}_{t-1}) + C_3(DM_{t-2} - \hat{DM}_{t-2}) + C_4 (DM_{t-3} - \hat{DM}_{t-3}) + C_5 MIL_t + C_6 t + W_{3t} \quad (3.3)$$

where Y = real GNP,

t = time trend.

The parameters C_1 through C_6 are expected to be positive; C_o and W_{3t} are the constant term and the error term, respectively (Barro, 1978, p. 553).

Price equation

$$\ell\eta P_t = f_o + \ell\eta M_t - f_1 \ell\eta Y_t + f_1 \gamma\ G/Y_t + F_2 i_t - f_3 t - W_{4t} \tag{3.4}$$

where G = real federal purchases of goods and services,

$f_1>0$, $f_2>0$, $b_3 \gtreqless 0$, $0\leq\gamma\leq 1$ (Barro, 1978, p. 559).

To test the policy ineffectiveness proposition, Barro uses a two-stage procedure, which involves the separation of total money supply (DM) into its anticipated and unanticipated components. He includes DM and unanticipated money component in his model simultaneously, then removes each in turn to estimate if a significant worsening of the fit results. For unemployment, output, and price equation, the F-statistic results indicate that the null hypothesis, that only unanticipated monetary changes affect real economic variables, cannot be rejected by the data at the 5 and 1 percent significance levels.

Grossman (1979), using quarterly data 1947-1975 for the United States, considered aggregate demand as a linear function of real balances, international relative price level, and fiscal policy. In his model, monetary, fiscal, and exchange rate policies are taken as exogenous policy parameters. Over the sample period, he finds that unanticipated nominal income growth has a significant impact on unemployment.

Wogin (1980) uses Canadian annual data for the period from 1927 to 1972. A dummy variable is included for the war years 1940-1945. The money growth equation is specified as follows:

$$DM_t = e_o + e_1 D + e_2 DM_{t-1} + e_3 F_{t-1} + e_4 X_{t-1} + e_5 gnp_{t-1} + e_6 U_{t-1} + W_{5t} \tag{3.5}$$

where F = real government expenditure,

X = the export,

D = a dummy variable,

gnp = real GNP.

The parameters e_1, e_2, e_3, and e_6 are to be positive, e_4 and e_5 are to be negative; e_o and W_{5t} are the constant term and the error term, respectively (Wogin, 1980, p. 61).

The unemployment equation is defined as a function of a lagged value of unemployment rate, current and lagged value of anticipated and unanticipated changes in the logarithms of the money supply and the changes in the logarithms of government expenditure $\dot{F}$ and exports $\dot{X}$ (Wogin, 1980, p. 64), that is

$$U_t = \gamma_o + \gamma_1 U_{t-1} + \gamma_2 D\hat{M}_t + \gamma_3 D\hat{M}_{t-1} + \gamma_4 (DM_t - D\hat{M}_t)$$
$$\gamma_5 (DM_{t-1} - D\hat{M}_{t-1}) + \gamma_6 \mathring{F}_t + \gamma_7 \dot{X}_t + W_{6t} \tag{3.6}$$

The parameters γ_1 and γ_3 are to be positive, γ_2, γ_4, γ_5, γ_6, and γ_7 are to be negative; γ_o is the constant term, and W_{6t} is the disturbance term.

Recent investigation by Leiderman (1980), using annual data for the United States for the period 1946 to 1973, has paid attention to the logical independence of the rational expectations and structural neutrality hypotheses. He utilized Full Information Maximum Likehood (FIML) to test Barro's money growth and unemployment equations. His findings indicate that the policy inefffectiveness proposition is not rejected by the data at the 5 and 1 percent significance levels. Bellante et al. (1982) and Attfield et al. (1981a, 1981b) also employ a Barro-type formulation to examine the effects of unanticipated money growth on unemployment, output and price level for the United Kingdom.

Unlike the United States, the United Kingdom is a largely open economy. They therefore take into account two important variables which may influence the money supply reaction function. One is the real value of the current public sector borrowing requirement, and the other is a lagged value of the balance of payments surplus. Time and a measure of the variability of the inflation are also taken into account in the output equation. Their results are identical to Barro's.

Stein (1982, pp. 114-162) build a general dynamic model and included a Fischer effect in his model. He adopted Barro's measure of unanticipated monetary growth to test the policy ineffectiveness proposition, and his findings rejected this proposition.

Urich (1982) establishes a model with an LM schedule. Within his framework, the monetary authority is assumed to maintain a target growth rate and uses partial adjustment to adjust the past deviation from money growth. A weekly unanticipated money supply announcement leads the agents to expect that the Fed will alter the money growth. Therefore, agents revise their expectations of short term interest rate which in turn affect real output.

Attfield and Duck (1983) apply the method used by Attfield et al. (1981b) and collect data from a cross section of eighteen countries to test the policy ineffectiveness propostion. They conclude that this proposition is not rejected by the data.

Anticipated Monetary Cahnges Affect Real Economic Variables

It should be clear that a crucial problem in examining the policy ineffectiveness proposition lies in developing an appropriate decomposition of observed money growth into its anticipated and unanticipated components. Pigott (1978), Small (1979), Froyen (1979), Mishkin (1982), Garner (1982), Gordon (1982), Makin (1982), Darby (1983, pp. 273-288), Driscoll, Ford, Mullineux, and Sen (1983) have criticized Barro's original decomposition on various grounds.

Small (1979, p. 999) argued that only anticipated government expenditure permits prior investment in tax-gathering capital; it causes more investment and less money creation. The following equation of his explains government expenditure behavior:

$$FED_t = \alpha_o + \alpha_1 FED_{t-1} + \alpha_2 FED_{t-2} + \alpha_3 GNP_{t-1} + W_{7t} \qquad (3.7)$$

where FED = the nominal federal government expenditure,

GNP = the nominal GNP.

The parameters α_1, α_2, and α_3 are expected to be positive; α_o and W_{7t} are the constant and the disturbance term, respectively.

The residual from equation (3.7) is a measurement of unanticipated changes, which is called FEDUN; the money supply equation is then specified as

$$DM_t = v_o + v_1 DM_{t-1} + v_2 DM_{t-2} + v_3 MILX1_{t-1} + v_4 MILX2_{t-1} + v_5 FEDUN_t + v_6 U_{t-1} + W_{8t} \qquad (3.8)$$

where MILX1 = the cost of World War II,

MILX2 = the cost of Korean and Vietnam War.

The parameters v_1 through v_6 are expected to be positive; v_o and W_{8t} are the constant term and the error term, respectively.

Hence Small's money supply reaction function contains the distinction between anticipated and unanticipated fiscal policy action changes and the effect of the war on the money growth as well. Consequently, he challenges the aspects of Barro's results and rejects the policy ineffectiveness proposition.

Pigott (1978) employs Barro's version to test the policy ineffectiveness proposition for Japan. His findings indicate that the anticipated increases in money supply stimulate real economic activity, especially industrial production. Anticipated decreases in money supply depress the real economic activity.

Froyen (1979, p. 75) assumed that the Fed pursued short run stabilization. Thus the money reaction function includes the unemployment rate, inflation rate, foreign payment balance, income, outstanding government debt held by the public, and full employment surplus. These are all lagged values. His results support the view that such anticipated policy actions do have real effects. Adopting Small's revision of government expenditure, and using a real term rather than nominal term, Garner (1982) finds that the results for the United Kingdom tend to support the effectiveness of systematic monetary policy actions.

Mishkin (1982) expands Barro's analysis by distinguishing the hypothesis that only unanticipated changes in the monetary policy affect real variables from the hypothesis that the relevant anticipations are rational expectations, and he tries to test these hypotheses both jointly and separately. Using another kind of theoretical statistical procedure to forecast money growth, he begins with a very different money supply reaction function. He utilizes a multivariate Granger test in order to choose the variables that best predict money growth and then regresses money growth on its own four lagged variables, the 90-day Treasury bill rate, and the high employment surplus. Barro's variables of the current level of real government expenditures and unemployment are omitted from the money supply equation. He finds that anticipated monetary policy actions do affect real output and unemployment, but unanticipated movements in the money supply do not have a larger impact on output than the anticipated monetary changes. His result is quite different and provides an ambiguous verdict on the rational expectations hypothesis.

Gordon (1982) provides an alternative hypothesis, which is that the price level adjusts gradually in the short run and fully in the long run. He includes both an alternative hypothesis and the policy ineffectiveness proposition in a single estimating equation. His results accept the alterntive hypothesis, but reject the policy ineffectiveness hypothesis. Makin (1982) has pointed out that a measurement of inflation uncertainty should be taken into account. He assumes inflation uncertainty has a negative effect on output. The measurement of anticipated money growth is from an ARIMA model. His findings also reject the policy ineffectiveness proposition.

Darby (1983, pp. 273-288) uses data from the United States, the United Kingdom, Canada, France, Germany, Italy, Japan, and the Netherlands. Real government spending and real exports are taken into account in the money reaction function. The data, except for the United States, seem to reject the policy ineffectiveness proposition. Driscoll et al. (1983) respecify a money growth equation. The only difference between the Driscoll model and the Barro model is that the former includes U_{t-2} and $MINW_t$. In order to test the joint hypothesis of rational expectations and structure neutrality, they employ a joint Full Information Maximum Likehood estimation. The data reject the rational expectations hypothesis.

Unanticipated Fiscal Changes Affect Real Economic Variables

In most empirical works fiscal policy variables are included in a money supply reaction function as independent variables. Fiscal policy variables affect money growth, particularly government expenditure. Furthermore, the empirical works do not make a clear-cut distinction between anticipated and unanticipated fiscal changes.

In a rational expectations model, Hall (1978) investigates the effectiveness of unanticipated income tax changes. He assumes that the response of an income tax cut is to increase consumption, and the interest elasticity of the demand for money is a key factor in determining the impact of an income tax cut. Suppose the demand for money is interest elastic. Then real output increases more than the consumption due to an increase in investment. On the other hand, suppose the demand for money is interest inelastic. Then the increase in consumption is exactly offset by the decrease in investment, and an unanticipated tax cut has no impact on real output. However, empirical evidence indicates that an unanticipated tax decrease has an expansionary impact on output.

Sheffrin (1979) develops a rational expectations model in which the price level is fixed rather than flexible. An autoregressive moving average procedure is employed in order to generate unanticipated money growth and fiscal changes. Because firms can not distinguish between temporary and permanent inventory fluctuations, unanticipated monetary and fiscal policy action do have real effects by affecting inventories. In another paper, Hall (1980, pp. 7-33) indicates that public services are an input for private production process. An increase in unanticipated government expenditures stimulates intertemporal substitution of labor and production; consequently, the supply of labor increases and total unemployment declines; hence unanticipated government expenditures can substantially alter the level of real output.

Barro (1981) focuses on the distinction between temporary and permanent changes in federal government expenditure. The former captures the unanticipated components, and the latter reflects the anticipated changes, which have been emphasized in earlier Barro's works. The empirical results suggest that temporary defense purchases have a significant expansionary effect on output.

Fitzgerald (1982) examines the fiscal policy variables, the budget balance, and the level of government net borrowing. He employs a multivariate time series approach to decompose the fiscal changes into anticipated and unanticpated components. The regression results from the United States confirm the implication of rational expectations hypothesis. Canarella and Garston (1983) utilize FIML method, and consider lagged unanticipated changes in the stock of debt in Barro's output and unemployment equations. Their results are the same as Barro's.

Problems of Specification

Questions to Barro's theory of the money supply process have also been raised. Most empirical works only estimate reduced forms rather than structural equations, but explain the econometric results as stemming from a Lucas-Sargent-Wallace type of structural model in which only unanticipated components have real effects (Blinder, 1980, p. 50).

Barro's tests contain total money (DM) and unanticipated monetary changes, and anticipated monetary changes having real effect are not included. Therefore, his tests are biased in favor of the policy ineffectiveness proposition (Sheekey, 1984).

The measurements of government expenditure by adaptive expectations seem inconsistent with the rational expectations hypothesis. The adaptive expectations seem reasonable and useful in explaining data as in Cagan's (1956, pp. 25-117) pioneering work on hyperinflation. However, even in Cagan's model adaptive expectations are systematically wrong in predicting inflation (Sargent and Wallace, 1973, p. 349).

In Barro's framework, there exists no clear relation of monetary or fiscal policy actions to interest rates and the price level (Buiter, 1983, p. 208). With respect to the interrelationship between monetary and fiscal policies, the money supply is influenced by government expenditure rather than by taxation. Because deficits may cause interest rate increases, they in turn may cause inflation by rapid money growth. Therefore, monetary policy is strongly affected either by government expenditure or budget deficits (Hamburger and Zwick, 1981). The specification error problem arises if the explanatory variables do affect money supply but are incorrectly excluded, and vice versa.

Monetary policy therefore should involve a broader and more complex set of considerations. The previous interaction of the money supply process seems overly simple. It is necessary to provide a more realistic and more complex money supply process.

CHAPTER IV

A RATIONAL EXPECTATIONS MODEL OF POLICY EFFECTIVENESS

This chapter contains four sections. The first discusses the specification of government expenditure and taxation. The second focuses on the money supply process in which a set of money supply equations is derived. The third section develops a set of rational expectations models, with each corresponding to different money supply rules, and the last describes data sources.

Specification of Fiscal Policy Variable

In order to establish the model, it is necessary to specify the government policy variables--government expenditure, taxation, and money supply. First to be considered are the fiscal policy variables. Assume that the real government expenditure is the function of the lagged value of real government expenditure and a lagged value of real output; the former is autoregressive, and the latter represents the historical upward trend of government expenditure.

$$\frac{G}{P_t} = G\left(\frac{G}{P_{t-1}}, Y_{t-1}\right) \tag{4.1}$$

which in logarithmic form is

$$\ell\eta\left(\frac{G}{P_t}\right) = g_o + g_1 \ell\eta\left(\frac{G}{P_{t-1}}\right) + g_2 \ell\eta Y_{t-1} + \varepsilon_{1t} \tag{4.2}$$

Equation (4.2) can be written in terms of nominal expenditure

$$\ell\eta G_t = g_o + g_1(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + g_2\ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{1t} \tag{4.3}$$

where P = the price level,

G = nominal government expenditure;

ε_{1t} = the error term with zero mean which is serially uncorrelated.

The coefficients g_1 and g_2 are positive, and g_o is the constant term.

The personal income tax and corporation income tax are two major revenue sources for the federal government. According to the United States Tax Code, corporations are allowed to carry back income over several years in order to adjust loss in bad years. Therefore, real tax revenue is assumed functionally related to the current and most recently observed value of real income.

$$\frac{T}{P_t} = T(Y_t, Y_{t-1}) \tag{4.4}$$

where T = nominal tax revenue.

In terms of logarithms, this functional relation is written as

$$\ell\eta T_t = t_o + t_1\ell\eta Y_t + t_2\ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{2t} \tag{4.5}$$

The coefficients t_1 and t_2 are positive; t_o and ε_{2t} are the constant and the error terms, respectively.

Specification of Monetary Policy Variable

Money Supply Rule A

There is no general agreement about how to formulate the policymaker's objective function. One way to formulate the money supply policy rule is to derive it from the budget restraint literature. According to Friedman and Schwartz (1963, p. 791), Cagan (1965, p. 12), and Brunner and Meltzer (1964, p. 252), the money supply can be expressed as

$$M_t = m_t H_t \tag{4.6}$$

where M = the money supply,

m = the money multiplier,

H = the high-powered money.

The government budget restraint is the fundamental identity that states the interdependence of different macroeconomic policies.[1] This identity can be written as follows:

$$G_t = T_t + \Delta B_t + \Delta H_t \tag{4.7}$$

where ΔB = change in the government outstanding debt,

ΔH = change in the high-powered money.

The basis of this relationship is how to finance budget deficits. If government expenditure exceeds the revenue from taxation the difference must be financed in one way or another, namely, by increasing taxes, by increasing government debt, or by issuing high-powered money. The implication for the rational expectations hypothesis is as follows. Suppose the government budget is in deficit. Agents' expectations are then that in the future, either increased taxes, reduced government expenditures or increased money stock, i.e., taxes on real balances can be expected.

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[1]The issue of budget restraint has been discussed by Christ (1968, 1979) and Steindl (1971, 1974, 1977).

The idenity (4.7) can be rearranged as

$$G_t = T_t + B_t - B_{t-1} + H_t - H_{t-1} \tag{4.8}$$

Hence

$$H_t = G_t - T_t - B_t + B_{t-1} + H_{t-1} \tag{4.9}$$

Substituting (4.9) into (4.6) yields

$$M_t = m_t(G_t - T_t - B_t + B_{t-1} + H_{t-1}) \tag{4.6$'$}$$

The budget restraint literature suggests that money supply movements can be expressed as a function of certain variables to which the Fed may respond, that is

$$M_t = H(G_t, T_t, B_t, B_{t-1}, H_{t-1}) \tag{4.10}$$

the log-linear money supply equation (4.10) is

$$\ell\eta M_t = h_o + h_1 \ell\eta G_t + h_2 \ell\eta T_t + h_3 \ell\eta B_t + h_4 \ell\eta B_{t-1} + h_5 \ell\eta H_{t-1} + \varepsilon_{3t} \tag{4.11}$$

The coefficients h_1, h_3, h_4, and h_5 are expected to be positive,[2] and h_2 is expected to be negative; h_0 is the constant term, ε_{3t} is the random disturbance with zero mean.

Money Supply Rule B

The behavior of the money stock may also be considered with reference to the Fed's policy goals. The following variables, presented in a money supply reaction function in the tradition of Barro, are relevant.[3]

$$M_t = F(M_{t-1}, M_{t-2}, P_t, P_{t-1}, U_t, U_{t-1}) \tag{4.12}$$

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[2]Government issuing more bonds means that the government is experiencing a deficit (Barro, 1984, p. 374), which may cause an increase in the money supply through Fed's open market operations.

[3]If the influence of current target variables is excluded in reaction function, then the result may underestimate the effect of contemporaneous feedback (Blinder, 1980, pp. 51-52).

The price and unemployment variables reflect the Fed's policy goals which are to pursue high employment and price level stability (Blinder, 1980, pp. 49-54).

The log-linear form of the money supply reaction function is

$$\ell\eta M_t = f_o + f_1\ell\eta M_{t-1} + f_2\ell\eta M_{t-2} + f_3\ell\eta P_t + f_4\ell\eta P_{t-1} + f_5\ell\eta U_t + f_6\ell\eta U_{t-1} + \varepsilon_{6t} \qquad (4.13)$$

The signs of f_1, f_2, f_5, and f_6 are expected to be positive, the signs of f_3 and f_4 are expected to be negative; f_o is the constant, and ε_{6t} is the error term.

Consider the unemployment variable. Assume that the unemployment rate is a function of real government expenditure and nominal tax revenue.

$$U_t = U(\frac{G}{P_t}, T_t) \qquad (4.14)$$

The real government expenditure and nominal tax revenue capture the countercyclical relation of the fiscal authority.[4] Since labor supply decisions are related to after-tax real wages, then decreased taxes raise the after-tax real wages and increase the labor supply through the income effect (Hausman, 1981, pp. 27-29).

One can specify the functional relation (4.14) in logarithms as

$$\ell\eta U_t = s_o + s_1(\ell\eta G_t - \ell\eta P_t) + s_2\ell\eta T_t + \varepsilon_{7t} \qquad (4.15)$$

The coefficient s_1 is expected to be negative, and s_2 is expected to be positive; s_o is the constant, and ε_{7t} is the error term.

Substituting equation (4.15) into (4.13) an alternative monetary

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[4]Barro (1977, p. 104) developed this technique. Furthermore, he exposited the effects of taxes on incentives, and of government expenditures on private production and consumption decisions (Barro, 1984, pp. 346-359).

policy rule is as follows:

$$\ell n M_t = f_7 + f_1 \ell n M_{t-1} + f_2 \ell n M_{t-2} + f_9 \ell n P_t + f_4 \ell n P_{t-1} + f_8 \ell n G_t + f_{10} \ell n T_t + f_6 \ell n U_{t-1} + \varepsilon_{8t} \qquad (4.16)$$

where

$f_7 = f_o + s_o,$

$f_8 = f_5 s_1,$

$f_9 = f_3 - f_5 s_1,$

$f_{10} = f_5 s_2,$

$\varepsilon_{8t} = f_5 \varepsilon_{7t} + \varepsilon_{6t}.$

The coefficients f_1, f_2, f_6, and f_{10} are positive, f_4, f_9, and f_8 are negative; f_7 is the constant, and ε_{8t} is the error term.

Policy Effectiveness

In order to derive the policy ineffectiveness proposition, a version of McCallum (1980b) is used by including the fiscal policy variables G and T into the IS curve.[5]

$$\text{IS:} \ell n Y_t = b_o + b_1 (\ell n i_t - E_{t-1}(\ell n P_{t+1} - \ell n P_t)) + b_2 \ell n G_t - b_3 \ell n T_t + \mu_{1t} \qquad (4.17)$$

$$\text{LM:} \ell n M_t = c_o + c_1 \ell n Y_t + c_2 \ell n i_t + \ell n P_t + \mu_{2t} \qquad (4.18)$$

$$\text{AS:} \ell n Y_t = a_o + a_1 (\ell n P_t - E_{t-1} \ell n P_t) + a_2 \ell n Y_{t-1} + \mu_{3t} \qquad (4.19)$$

The following are standard assumptions regarding the parameters of the IS relation: $b_1 < 0$, $0 < b_2 < 1$, $0 < b_3 < 1$;

[5] McCallum and Whitaker (1979, p. 180) argue that since the current tax system is far from indexed, it is better to use nominal term.

the parameters of the LM relation: $C_2 < 0 < C_1$;

the parameters of the AS relation: $a_1 > 0$, $0 \leq a_2 < 1$.

where $E_{t-1}X_{t+j}$ = mathematical expectations of X_{t+j} $(j = 0,1,\cdots)$ given equations and information on all variables as of t-1,

i = the nominal interest rate,

μ_{1t}, μ_{2t}, μ_{3t} = the random disturbance term, which have zero means and constant variances.

Rearrange equation (4.18) to get

$$\ell\eta i_t = \frac{1}{C_2} (\ell\eta M_t - C_o - C_1 \ell\eta Y_t - \ell\eta P_t - \mu_{2t}) \quad (4.20)$$

Substituting equation (4.20) into (4.17) eliminates i; thus equation (4.21) becomes

$$\ell\eta Y_t = \frac{1}{b_1 c_1 + c_2} (c_2 b_o - b_1 c_o + b_1 \ell\eta M_t - b_1 \ell\eta P_t - b_1 c_2 E_{t-1} (\ell\eta P_{t+1} - \ell\eta P_t) + b_2 c_2 \ell\eta G_t - b_3 c_2 \ell\eta T_t + c_2 \mu_{1t} - b_1 \mu_{2t}) \quad (4.21)$$

Two sub-models, with each corresponding to different money supply rules, can be developed from this framework.

Model A-with Money Supply Rule A

This model uses money supply rule A, which was discussed above.

$$\ell\eta G_t = g_o + g_1 (\ell\eta G_{t-1} - \ell\eta P_{t-1}) + g_2 \ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{1t} \quad (4.3)$$

$$\ell\eta T_t = t_o + t_1 \ell\eta Y_t + t_2 \ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{2t} \quad (4.5)$$

$$\ell\eta M_t = h_o + h_1 \ell\eta G_t + h_2 \ell\eta T_t + h_3 \ell\eta B_t + h_4 \ell\eta B_{t-1} + h_5 \ell\eta H_{t-1} + \varepsilon_{3t} \quad (4.11)$$

Substituting money supply rule A (4.11) and then equations (4.3), (4.5) into (4.21) gives

$$\ell\eta Y_t = \beta_o + \beta_1 (\ell\eta G_{t-1} - \ell\eta P_{t-1}) + \beta_2 \ell\eta Y_{t-1} + \beta_3 \ell\eta P_t + \beta_4 E_{t-1} (\ell\eta P_{t+1} - \ell\eta P_t) + \beta_5 \ell\eta B_t + \beta_6 \ell\eta B_{t-1} + \beta_7 \ell\eta H_{t-1} + \varepsilon_{9t} \quad (4.22)$$

where $\beta = \frac{1}{\Delta}(C_2b_o - b_1c_o + b_1h_o + (b_1h_1 + b_2c_2)g_o + (b_1h_2 - b_3c_2)t_o)$,

$$\Delta = b_1c_1 + c_2 - t_1(b_1h_2 - b_3c_2),$$

$$\beta_1 = \frac{1}{\Delta}(g_1(b_1h_1 + b_2c_2)),$$

$$\beta_2 = \frac{1}{\Delta}((b_1h_1 + b_2c_2)g_2 + t_2(b_1h_2 - b_3c_2)),$$

$$\beta_3 = \frac{1}{\Delta}(b_1h_1 + b_2c_2 + b_1h_2 - b_3c_2 - b_1),$$

$$\beta_4 = \frac{1}{\Delta}(-b_1c_2),$$

$$\beta_5 = \frac{1}{\Delta}(b_1h_3),$$

$$\beta_6 = \frac{1}{\Delta}(b_1h_4),$$

$$\beta_7 = \frac{1}{\Lambda}(b_1h_5),$$

$$\varepsilon_{9t} = \frac{1}{\Delta}(c_2\mu_{1t} - b_1\mu_{2t} + b_1\varepsilon_{3t} + (b_1h_1 + b_2c_2)\varepsilon_{1t} + (b_1h_2 - b_3c_2)\varepsilon_{2t}).$$

Substituting equation (4.22) into (4.19) yields

$$\ell\eta P_t = \frac{1}{a_1 - \beta_3}(\beta_o - a_o + \beta_1(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + (\beta_2 - a_2)\ell\eta Y_{t-1} + \beta_4 E_{t-1}(\ell\eta P_{t+1} - \ell\eta P_t) + \beta_5\ell\eta B_t + \beta_6\ell\eta B_{t-1} + \beta_7\ell\eta H_{t-1} + a_1E_{t-1}\ell\eta P_t + \varepsilon_{9t} - \mu_{3t}) \tag{4.23}$$

Take the expectation, E_{t-1}, of equation (4.23)

$$E_{t-1}\ell\eta P_t = \frac{1}{a_1 - \beta_3}(\beta_o - a_o + \beta_1(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + (\beta_2 - a_2)\ell\eta Y_{t-1} + \beta_4E_{t-1}(\ell\eta P_{t+1} - \ell\eta P_t) + \beta_5\ell\eta B_t + \beta_6\ell\eta B_{t-1} + \beta_7\ell\eta H_{t-1} + a_1E_{t-1}\ell\eta P_t) \tag{4.24}$$

Subtracting from equation (4.23) gives

$$\ell\eta P_t - E_{t-1}\ell\eta P_t = \frac{1}{a_1 - \beta_3}(\varepsilon_{9t} - \mu_{3t}) \tag{4.25}$$

The effects of policy and shocks are given by the partial derivatives of equation (4.25).

$$\frac{\partial(\ell\eta P_t - E_{t-1}\ \ell\eta P_t)}{\partial h_1} = \frac{b_1 A\varepsilon_{1t} + bD}{A^2} \neq 0 \tag{4.26}$$

$$\frac{\partial(\ell\eta P_t - E_{t-1}\ell\eta P_t)}{\partial h_2} = \frac{(b_1\varepsilon_{2t} + t_1 b_1 \mu_{3t})A + a_1 t_1 b_1 D}{A^2} \neq 0 \tag{4.27}$$

$$\frac{\partial(\ell\eta P_t - E_{t-1}\ell\eta P_t)}{\partial t_1} = \frac{(b_1h_2 - b_3c_2)\mu_{3t}A}{A^2} + \frac{a_1(t_1h_2 - b_3c_2)D}{A^2} \neq 0 \tag{4.28}$$

where $A = a_1\ \Delta - (b_1h_1 + b_2c_2 - b_3c_2 - b_1)$,

$D = c_2\mu_{1t} - b_1\mu_{2t} + b_1\varepsilon_{3t} + (b_1h_1 + b_2c_2)\varepsilon_{1t}$
$+ (b_1h_2 - b_3c_2)\varepsilon_{2t} - \mu_{3t}\Delta$,

h_1, h_2 = the parameters of money supply equation (4.11),

t_1 = the parameter of tax revenue equation (4.5).

Putting equation (4.25) into (4.19), the reduced-form equation for output is

$$\ell\eta Y_t = a_o + \frac{a_1\varepsilon_{9t}}{a_1 - \beta_3} - \frac{\beta_3}{a_1 - \beta_3}\ \mu_{3t} + a_2\ell\eta Y_{t-1} \tag{4.29}$$

The expectation error, $\ell\eta P_t - E_{t-1}\ell\eta P_t$, does depend on the policy parameters h_1 h_2, and t_1. Consequently, β_3 and ε_{9t} which are functions of h_1, h_2, and t_1 has a systematic effect on real output. The need for further empirical investigation of the policy ineffectiveness proposition is suggested by the results obtained from the model A. Thus, the interest is whether the behavior of real output is dependent on the authorities' choices or random disturbance terms.

Model B-with Money Supply Rule B

This model employs money supply rule B, which is summarized as

(4.16).

$$\ell\eta G_t = g_o + g_1(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + g_2\ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{1t} \tag{4.3}$$

$$\ell\eta T_t = t_o + t_1\ell\eta Y_t + t_2\ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{2t} \tag{4.5}$$

$$\ell\eta M_t = f_7 + f_1\ell\eta M_{t-1} + f_2\ell\eta M_{t-2} + f_9\ell\eta P_{t-1} + f_8\ell\eta G_t + f_{10}\ell\eta T_t + f_6\ell\eta U_{t-1} + \varepsilon_{8t} \tag{4.16}$$

Consider the alternative money supply rule given by (4.16). Substituting money supply rule B (4.16) and equations (4.3), (4.5) into (4.21) yields

$$\ell\eta Y_t = \beta_o' + \beta_1'(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + \beta_2'\ell\eta Y_{t-1} + \beta_3'\ell\eta P_t + \beta_4'E_{t-1}(\ell\eta P_{t+1} - \ell\eta P_t) + \beta_5'\ell\eta M_{t-1} + \beta_6'\ell\eta M_{t-2} + \beta_7'\ell\eta U_{t-1} + \beta_8'\ell\eta P_{t-1} + \acute{\varepsilon}_{9t} \tag{4.30}$$

where $\beta_o' = \frac{1}{\Delta'}(c_2b_o - b_1c_o + b_1f_7 + g_o(b_1f_8 + b_2c_2) + t_o(b_1f_{10} - b_3c_2))$,

$\Delta' = (b_1c_1 + c_2 - t_1(b_1f_{10} - b_3c_2))$,

$\beta_1' = \frac{1}{\Delta'}(g_1(b_1f_8 + b_2c_2))$,

$\beta_2' = \frac{1}{\Delta'}(g_2(b_1f_8 + b_2c_2) + t_2(b_1f_{10} - b_3c_2))$,

$\beta_3' = \frac{1}{\Delta'}(b_1f_9 - b_1 + b_1f_8 + b_2c_2 + b_1f_{10} - b_3c_2)$,

$\beta_4' = \frac{1}{\Delta'}(-b_1c_2)$,

$\beta_5' = \frac{1}{\Delta'}(b_1f_1)$,

$\beta_6' = \frac{1}{\Delta'}(b_1f_2)$,

$\beta_7' = \frac{1}{\Delta'}(b_1f_6)$,

$\beta_8' = \frac{1}{\Delta'}(b_1f_4)$,

$\acute{\varepsilon}_{9t} = \frac{1}{\Delta'}(b_1\varepsilon_{8t} + c_2\mu_{1t} - b_1\mu_{2t} + (b_1f_8 + b_2c_2)\varepsilon_{1t} + (b_1f_{10} - b_3c_2)\varepsilon_{2t})$.

Substitute Equation (4.30) into (4.19). This gives

$$\ell\eta P_t = \frac{1}{a_1 - \beta_3'} \quad (\beta_o' - a_o + \beta_1'(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + (\beta_2' - a_2)$$
$$\ell\eta Y_{t-1} + \beta_4' \; E_{t-1} \; (\ell\eta P_{t+1} - \ell\eta P_t) + \beta_5'\ell\eta M_{t-1} +$$
$$\beta_6'\ell\eta M_{t-2} + \beta_7' \; \ell\eta U_{t-1} + \beta_8'\ell\eta P_{t-1} + a_1 \; E_{t-1}$$
$$\ell\eta P_t + \varepsilon_{9t}' - \mu_{3t}) \tag{4.31}$$

Again, employing the expectation operator on (4.31), equation (4.32) is

$$E_{t-1} \; \ell\eta P_t = \frac{1}{a_1 - \beta_3'} \; (\beta_o' - a_o + \beta_1'(\ell\eta G_{t-1} - \ell\eta P_{t-1}) +$$
$$(\beta_2' - a_2)\ell\eta Y_{t-1} + \beta_4' \; E_{t-1} \; (\ell\eta P_{t+1} - \ell\eta P_t) +$$
$$\beta_5'\ell\eta M_{t-1} + \beta_6'\ell\eta M_{t-2} + \beta_7'\ell\eta U_{t-1} + \beta_8'\ell\eta P_{t-1} +$$
$$a_1 E_{t-1}\ell\eta P_t) \tag{4.32}$$

which when subtracted from equation (4.31) gives

$$\ell\eta P_t - E_{t-1}\ell\eta P_t = \frac{1}{a_1 - \beta_3'} \; (\varepsilon_{9t}' - \mu_{3t}) \tag{4.33}$$

Taking the partial derivatives from equation (4.33), the effects of policy actions are

$$\frac{\partial(\ell\eta P_t - E_{t-1} \; \ell\eta P_t)}{\partial f_8} = \frac{b_1\varepsilon_{1t} \; A' + b_1 D'}{A'^2} \neq 0 \tag{4.34}$$

$$\frac{\partial(\ell\eta P_t - E_{t-1}\ell\eta P_t)}{\partial f_9} = \frac{b_1 D'}{A'^2} \neq 0 \tag{4.35}$$

$$\frac{\partial(\ell\eta P_t - E_{t-1}\ell\eta P_t)}{\partial f_{10}} = \frac{(b_1\varepsilon_{2t} + t_1 b_1 \mu_{3t})A'}{A'^2}$$
$$\frac{- (-t_1 b_1 a_1 - b_1)D'}{A'^2} \neq 0 \tag{4.36}$$

$$\frac{\partial(\ell\eta P_t - E_{t-1}\ell\eta P_t)}{\partial t_1} = \frac{(b_1 f_{10} - b_3 c_2)\mu_{3t} A'}{A'^2} + \frac{a_1(b_1 f_{10} - b_3 c_2)D'}{A'^2} \neq 0 \tag{4.37}$$

where

$A' = a_1'\Delta' - (b_1 f_9 - b_1 + b_1 f_8 + b_2 c_2 + b_1 f_{10} - b_3 c_2)$,

$D' = b_1 \varepsilon_{8t} + c_2 \mu_{1t} - b_1 \mu_{2t} + (b_1 f_8 + b_2 c_2)\varepsilon_{1t} + (b_1 f_{10} - b_3 c_2)\, \varepsilon_{2t} - \mu_{3t}\Delta'$,

f_8, f_9, f_{10} = the parameters of money supply equation (4.16).
Bringing equation (4.33) into (4.19), the result of reduced-form output level is

$$\ell\eta Y_t = a_o + \frac{a_1 \varepsilon_{9t}'}{a_1 - \beta_3'} - \frac{\beta_3'}{a_1 - \beta_3'} + a_2 \ell\eta Y_{t-1} \tag{4.38}$$

Again, the expectation error, $\ell\eta P_t - E_{t-1}\ell\eta P_t$, does depend on the parameters β_3' and ε_{9t}' as they are the functions of the policy parameters f_8, f_9, f_{10}, and t_1. Consequently, equation (4.38) shows that the behavior of real output can be affected by the systematic part of monetary and taxation policy actions. The need for further empirical investigation of the policy ineffectiveness proposition is suggested by the results obtained from the model B. Thus, the interest is whether the behavior of real output is dependent on the systematic part of monetary and fiscal policy actions or random disturbance terms.

The output reduced-form equations (4.29) and (4.38) may be influenced not only by the policy parameters of taxation and money supply but also by the random disturbance terms. The policy ineffectiveness proposition does not necessarily hold, and its existence thus is an empirical matter. Since the systematic part of monetary and taxation policy actions could influence the behavior of real output, a more general output equation is given in (4.39).

$$\ell n Y_t = 1_o + 1_1 \ell n Y_{t-1} + A(L)AT + B(L)AM + C(L)UG + D(L)\ UT + + E(L)UM + \varepsilon_{4t} \tag{4.39}$$

where

AT = anticipated taxation,

AM = anticipated money supply,

UG = unanticipated government expenditure,

UT = unanticipated taxation,

UM = unanticipated money supply,

A(L), B(L), C(L), D(L), E(L) are lag polynominals; ε_{4t} is the random disturbance.

Source of Data

Both annual and quarterly data are used to test the policy ineffectiveness proposition for the United States from 1954 to 1983. The time period under study is significant because it is a postwar period which excludes the Korean War period and includes the period of redefinition of monetary aggregates.

Money supply (M) is defined as old M1 (1954-1958), new M1 (1959-1983), seasonally adjusted. The rate of nominal interest (i) is the commercial paper (3-month) rate. The stock of high-powered money (H) is currency held by the nonbank public and commercial bank reserves. These are taken from _Banking and Monetary Statistics 1941-1970_, _Annual Statistical Digest 1970-1979_, _1980_, _1981_, and from various issues of the _Federal Reserve Bulletin_ (Board of Governors).

Price level (P) is the GNP implicit price deflator 1972=100. Real output (Y) is real GNP in 1972 dollars. Federal government nominal expenditure (G) includes government purchases and transfer payments, and T is federal government nominal receipts. These are obtained from various issues of the *Survey of Current Business* (U.S. Department of Commerce).

The unemployment rate (U) is taken from *Labor Force Statistics Derived from the Current Population Survey: A Data Book*, and from various issues of the *Monthly Labor Review* (U.S. Department of Labor).

The federal government outstanding debt (B) is taken from various issues of the *Treasury Bulletin* (U.S. Department of the Treasury).

CHAPTER V

EMPIRICAL RESULTS AND POLICY IMPLICATIONS

This chapter is divided into five sections. The first summarizes the equations to be estimated. The second discusses the technique for estimating unanticipated policy variables. The third section presents and discusses the empirical results, while the fourth develops some of the policy implications of the empirical results. Finally, some summary comments are presented.

Statement of Equations To Be Estimated

Following Barro (1978), the price level is derived from a demand for money function, that is

$$\ell\eta M_t - \ell\eta P_t = \alpha_0 + \alpha_1 \ell\eta Y_t + \alpha_2 \ell\eta i_t + \mu_{4t} \tag{5.1}$$

which can be rearranged as

$$\ell\eta P_t = \ell\eta M_t - \alpha_0 - \alpha_1 \ell\eta Y_t - \alpha_2 \ell\eta i_t - \mu_{4t} \tag{5.2}$$

The parameter α_1 is positive, α_2 is negative; α_0 and μ_{4t} are the constant term and the error term, respectively.

Equation (5.2) states that an increase in the money supply which is fully anticipated is accompanied by an equiproportionate increase in the price level, and there is no accompanying change in the nominal interest rate. The interest rate here is taken as econometrically exogenous with regard to monetary and fiscal policy variables (Sargent, 1976, p. 208; Barro, 1978, pp. 560-564; Barro and Rush, 1980, p. 27; Attfield et. al., 1981a, 1981b).

From the models developed, there are two which are estimated. The first is model A--equations (4.3), (4.5), (4.11), (5.2), and (4.39). The second is model B consisting of equations (4.3), (4.5), (4.16), (5.2), and (4.39). The two differ only in that the first uses (4.11) and the other (4.16); these are two different money supply mechanisms.

These equations are summarized as follows:

$$\ell\eta G_t = g_0 + g_1(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + g_2\ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{1t} \tag{4.3}$$

$$\ell\eta T_t = t_0 + t_1\ell\eta Y_t + t_2\ell\eta Y_{t-1} + \ell\eta P_t + \varepsilon_{2t} \tag{4.5}$$

$$\ell\eta M_t = h_0 + h_1\ell\eta G_t + h_2\ell\eta T_t + h_3\ell\eta B_t + h_4\ell\eta B_{t-1} + h_5\ell\eta H_{t-1} + \varepsilon_{3t} \tag{4.11}$$

$$\ell\eta M_t = f_7 + f_1\ell\eta M_{t-1} + f_2\ell\eta M_{t-2} + f_9\ell\eta P_t + f_4\ell\eta P_{t-1} + f_8\ell\eta G_t + f_{10}\ell\eta T_t + f_6\ell\eta U_{t-1} + \varepsilon_{8t} \tag{4.16}$$

$$\ell\eta P_t = \ell\eta M_t - \alpha_0 - \alpha_1\ell\eta Y_t - \alpha_2\ell\eta i_t - \mu_{4t} \tag{5.2}$$

$$\ell\eta Y_t = l_0 + l_1\ell\eta Y_{t-1} + A(L)AT + B(L)AM + C(L)UG + D(L)UT + E(L)UM + \varepsilon_{4t} \tag{4.39}$$

Technique for Estimating
Unanticipated Variables

Three-stage least squares (3SLS) is applied to estimate the anticipated and unanticipated components of the policy variables. The simultaneous equations to be estimated are (4.3), (4.5), (4.11), and (5.2) in model A, and (4.3), (4.5), (4.16), and (5.2) in model B. The endogenous variables are G, T, M, and P. The fitted values of the endogenous variables from the estimated model are taken as the anticipated monetary and fiscal components, the residuals are taken as the unanticipated monetary and fiscal components. For testing the policy ineffectiveness proposition, the output equation (4.39) is then estimated by ordinary least squares (OLS). This procedure yields consistent estimates of the model's parameters (Mishkin, 1982, p. 41).

An ARIMA procedure is employed to test the serial correlation of output equation (4.39). If serial correlation exists, then relevant variables have been excluded or the functional form of output equation (4.39) is incorrect. Either suggests that the agents do not use all relevant information to form their expectations about the behavior of real output.

Empirical Results

Model A

The model given by equations (4.3), (4.5), (4.11), and (5.2) is linear; three-stage least squares (3SLS) is performed on model A. This method takes into account all a priori restrictions inherent in the specification. The output equation (4.39) is estimated by ordinary least squares (OLS) for testing the policy ineffectiveness proposition. The empirical results for annual data are reported in Table I. All parameter estimates have the appropriate theoretical sign, with the exception of T_t in equation (I.3) and AM_t in equation (I.5).[1] Since the relationship is linear in the logs of the variables, the coefficients

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[1]The coefficients of T_t and AM_t are not significantly different from zero at the 1 percent significance level.

TABLE I

MODEL A EQUATION ESTIMATES
ANNUAL: 1954 - 1983

Government Expenditure Equation

$$\ell\eta G_t = \underset{(-3.323)^{**}}{-2.936} + \underset{(5.490)^{**}}{0.647}(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + \underset{(3.502)^{**}}{0.469}\ell\eta Y_{t-1} + \underset{(19.819)^{**}}{0.996}\ell\eta P_t \qquad (I.1)$$

$\bar{R}^2 = 0.998$ SE = 0.031

Tax Revenue Equation

$$\ell\eta T_t = \underset{(-16.581)^{**}}{-6.821} + \underset{(1.856)^{*}}{0.717}\ell\eta Y_t + \underset{(0.786)}{0.321}\ell\eta Y_{t-1} + \underset{(13.590)^{**}}{1.067}\ell\eta P_t \qquad (I.2)$$

$\bar{R}^2 = 0.994$ SE = 0.126

Money Supply Equation

$$\ell\eta M_t = \underset{(15.058)^{**}}{1.378} + \underset{(3.441)^{**}}{0.187}\ell\eta G_t + \underset{(1.066)}{0.062}\ell\eta T_t + \underset{(1.031)}{0.125}\ell\eta B_t + \underset{(0.776)}{0.094}\ell\eta B_{t-1} + \underset{(6.080)^{**}}{0.317}\ell\eta H_{t-1} \qquad (I.3)$$

$\bar{R}^2 = 0.998$ SE = 0.017

TABLE I (Continued)

Price Level Equation

$$\ell\eta P_t = \underset{(3.137)^{**}}{0.852} + \underset{(25.737)^{**}}{1.112\ell\eta M_t} - \underset{(-5.043)^{**}}{0.333\ell\eta Y_t} + \underset{(1.667)}{0.028\ell\eta i_t} \qquad \text{(I.4)}$$

$\bar{R}^2 = 0.995 \qquad SE = 0.029$

Output Equation

$$\ell\eta Y_t = \underset{(-0.640)}{-0.132} + \underset{(19.255)^{**}}{1.056\ell\eta Y_{t-1}} - \underset{(-1.666)}{0.009\ell\eta AT_{t-1}} - \underset{(-0.964)}{0.033\ell\eta AM_t} + \qquad \text{(I.5)}$$

$$\underset{(3.418)^{**}}{0.311\ell\eta UG_{t-1}} - \underset{(-0.188)}{0.015\ell\eta UT_{t-1}} + \underset{(1.980)^{*}}{0.616\ell\eta UM_t}$$

$\bar{R}^2 = 0.995 \qquad SE = 0.020 \qquad D.W. = 1.879$

** indicates significance at 1 percent level
* indicates significance at 5 percent level
NOTE: t-statistics are in parentheses.

are elasticities. All equations fit the data quite well.

The coefficients in the government expenditure equation (I.1) imply the elasticities of nominal government expenditure with respect to lagged value of real government expenditure of 0.647, with respect to lagged value of real output of 0.469, and with respect to price level of 0.996. These elasticities are clearly significantly different from zero at the 1 percent level. A test of the null hypothesis that the P_t coefficient of 0.996 is equal to unity has a t-statistic of -0.08, which is less than the critical value of 2.779 at the 1 percent significance level. This result confirms with the null hypothesis of a unit elasticity. Therefore, nominal government expenditures would move proportionately with the price level.

The coefficients in the tax revenue equation (I.2) imply the elasticity of tax revenue with respect to current value of real output of 0.717, which is statistically different from zero at the 5 percent level. A test of the null hypothesis that the P_t coefficient of 1.067 is equal to unity yields a t-statistic of 0.666, which is less than the critical value of 2.779 at the 1 percent significance level. This result suggests that the null hypothesis of a unit elasticity cannot be rejected. Therefore, tax revenues would move proportionately with the price level.

The coefficients in the money supply equation (I.3) have the correct sign except the coefficient of T_t, which has the incorrect sign but is not significantly different from zero at the 1 percent level. The coefficients imply elasticities of money supply with respect to government expenditure of 0.187 and with respect to lagged value of high-powered money of 0.317. Both elasticities are clearly significantly different from zero at the 1 percent level.

The t-statistic on interest rate is not significantly different from zero at the 1 percent level in the price level equation (I.4). A test of the null hypothesis that the M_t coefficient of 1.112 is equal to unity has a t-statistic of 2.60, which is less than the critical value of 2.779 at the 1 percent significance level. One therefore cannot reject the null hypothesis of a unit elasticity. Thus, the unity coefficient on M_t indicates the price level would move proportionately with the money supply.

The test of serial correlation is the Box-Pierce test statistic, a chi-square test statistic (Pindyck and Rubinfeld, 1981, pp. 548-549).

The lags of the autocorrelation series for the annual data by an ARIMA procedure are reported in Table II. The calculated values of the Box-Pierce test for the residuals from equation (I.5) are 14.92 with 18 degrees of freedom and 21.09 with 24 degrees of freedom. These are less than the critical values of 35 and 43 at the 1 percent significance level, respectively. Therefore, one cannot reject the hypothesis of no autocorrelation.[2]

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[2]The calculated value of the D-W test for annual data is 1.879 for equation (I.5). This indicates no serial correlation at the 1 percent significance level.

Although, of course, the presence of a lagged dependent variable causes the D-W test statistic to be biased to two. One, therefore, must employ a Durbin h test to examine the presence of serial correlation. That is, obtain the residual variable from the regression process and then generate the lagged residual variable (Judge et al., 1982, pp. 456-457). Thus the transformation for equation (I.5) is

$$\hat{\varepsilon}_{4t} = \underset{(-2.223)}{-2.918} - \underset{(-0.763)}{0.180}\hat{\varepsilon}_{4t-1} + \underset{(2.074)}{0.293}\ell\eta Y_{t-1} - \underset{(-2.257)}{0.545}\ell\eta AT_{t-1} +$$

$$\underset{(2.251)}{0.689}\ell\eta AM_t - \underset{(-0.941)}{0.091}\ell\eta UG_{t-1} + \underset{(0.346)}{0.027}\ell\eta UT_{t-1} - \underset{(-0.011)}{0.003}\ell\eta UM_t \qquad \text{(I.5)}$$

$\bar{R}^2 = 0.034 \qquad SE = 0.018$

The estimate for ρ^*, the serial correlation coefficient, is -0.180 with a t-statistic -0.763, which is less than the critical value of 2.831 at the 1 percent level of significance. Hence the null hypothesis of no autocorrelation cannot be rejected at the 1 percent significance level.

TABLE II

MODEL A AUTOCORRELATION OF RESIDUALS
ANNUAL: 1954 - 1983

Autocorrelation of Residuals from Equation (I.5)

To Lag	Chi Square	DF	Autocorrelations					
6	5.79	6	0.059	-0.163	-0.293	-0.225	0.009	-0.003
12	8.57	12	0.130	0.075	-0.053	-0.146	-0.047	0.107
18	14.92	18	0.121	-0.062	0.069	0.067	0.101	-0.219
24	21.09	24	-0.110	-0.032	-0.035	0.133	-0.065	0.104

S.D. = 0.018

The quantitative results for the output equation (I.5) are reported in Table I. The coefficients have the correct sign, with the exception of AM_t. Its coefficient is statistically insignificant at the 1 percent level. Additional lagged variables are statistically insignificant when incorporated in equation (I.5). The Box-Pierce test indicates absence of serial correlation in the residuals. Therefore, agents use all relevant information to form their expectations about the behavior of real output. The authorities cannot conduct policy actions to fool the agents systematically. Furthermore, the coefficient of lagged value of the real output is significantly different from zero at the 1 percent level.

The t-statistic on the lagged value of unanticipated government expenditures has significant explanatory power at the 1 percent level, and the other coefficients are not significantly different from zero at that level though UM_t is significant at the 5 percent level. These results show that the anticipated monetary and fiscal policy actions have no systematic effect on real output; only the unanticipated fiscal and monetary components have significant effect on real output. Therefore, these results support the policy ineffectiveness proposition. The UG_{t-1} coefficient of 0.311 suggests that a one percent increase in unanticipated government expenditures increases the real output by 0.311 percent one year later. The UM_t coefficient of 0.616 suggests that a one percent increase in unanticipated money supply increases the real output by 0.616 percent.

With regard to the quarterly data, the estimated equations of model A by 3SLS and OLS are reported in Table III. The sign of parameters, except T_t and B_{t-1} in equation (III.3), are all as expected.[3] All equations fit the data quite well.

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[3]The coefficient of B_{t-1} is not significantly different from zero at the 1 percent level.

TABLE III

MODEL A EQUATION ESTIMATES
QUARTERLY: 1954:I - 1983:IV

Government Expenditure Equation

$$\ell\eta G_t = \underset{(-3.617)^{**}}{-1.038} + \underset{(22.625)^{**}}{0.874}(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + \underset{(3.784)^{**}}{0.161}\ell\eta Y_{t-1} + \underset{(63.355)^{**}}{1.006}\ell\eta P_t \qquad \text{(III.1)}$$

$\bar{R}^2 = 0.999$ SE = 0.020

Tax Revenue Equation

$$\ell\eta T_t = \underset{(56.036)^{**}}{-7.120} + \underset{(2.172)^{*}}{0.585}\ell\eta Y_t + \underset{(1.980)^{*}}{0.538}\ell\eta Y_{t-1} + \underset{(41.848)^{**}}{1.003}\ell\eta P_t \qquad \text{(III.2)}$$

$\bar{R}^2 = 0.997$ SE = 0.036

Money Supply Equation

$$\ell\eta M_t = \underset{(34.818)^{**}}{1.338} + \underset{(2.049)^{*}}{0.06}\ell\eta G_t + \underset{(5.161)^{**}}{0.159}\ell\eta T_t + \underset{(2.687)^{**}}{0.379}\ell\eta B_t - \underset{(-1.040)}{0.146}\ell\eta B_{t-1} + \underset{(14.067)^{**}}{0.339}\ell\eta H_{t-1} \qquad \text{(III.3)}$$

$\bar{R}^2 = 0.998$ SE = 0.015

TABLE III (Continued)

Price Level Equation

$$\ell\eta P_t = \underset{(6.457)^{**}}{0.950} + \underset{(51.111)^{**}}{1.129\ell\eta M_t} - \underset{(-10.255)^{**}}{0.362\ell\eta Y_t} + \underset{(4.043)^{**}}{0.036\ell\eta i_t} \qquad \text{(III.4)}$$

$\bar{R}^2 = 0.994$ SE $= 0.030$

Output Equation

$$\ell\eta Y_t = \underset{(0.056)}{0.005} + \underset{(56.211)^{**}}{1.002\ell\eta Y_{t-1}} - \underset{(-0.557)}{0.004\ell\eta AT_t} + \underset{(1.063)}{0.002\ell\eta AM_{t-1}} + \qquad \text{(III.5)}$$

$$\underset{(2.202)^{*}}{0.063\ell\eta UG_{t-1}} - \underset{(-2.841)^{**}}{0.075\ell\eta UT_{t-1}} + \underset{(0.754)}{0.057\ell\eta UM_t}$$

$\bar{R}^2 = 0.999$ SE $= 0.011$ D.W. $= 1.570$

** indicates significance at 1 percent level
 * indicates significance at 5 percent level
NOTE: t-statistics are in parentheses.

The coefficients in the government expenditure equation (III.1) suggest the elasticities of nominal government expenditure with respect to lagged value of real government expenditure of 0.874, with respect to lagged value of real output of 0.161, and with respect to price level of 1.006. These elasticities are clearly significantly different from zero at the 1 percent level. A test of the null hypothesis that the P_t coefficient of 1.006 is equal to unity has a t-statistic of 0.377, which is less than the ciritical value of 2.576 at the 1 percent significance level. This result confirms with the null hypothesis of a unit elasticity. Therefore, nominal government expenditures would move proportionately with the price level.

The coefficients in the tax revenue equation (III.2) imply the elasticities of tax revenue with respect to current value of real output of 0.585 and with respect to lagged value of real output of 0.538. Both elasticities are significantly different from zero at the 5 percent level. A test of the null hypothesis that the P_t coefficient of 1.003 is equal to unity yields a t-statistic of 0.125, which is less than the ciritical value of 2.576 at the 1 percent level. This result suggests that the null hypothesis of a unit elasticity cannot be rejected. Thus, tax revenues would move proportionately with the price level.

The coefficients in the money supply equation (III.3) have the correct sign except the coefficients of T_t and B_{t-1}, and the coefficient of B_{t-1} is not significantly different from zero at the 1 percent level. The coefficients imply the elasticity of money supply with respect to government expenditure of 0.06 which is significantly different from zero at the 5 percent level. The elasticity of money supply with respect to current value of bonds is 0.379, and the elasticity of money supply with respect to lagged value of high-powered money is 0.339. These elasticities are all significantly different from zero at the 1 percent level.

The coefficients in the price level equation (III.4) suggest the elasticities of price level with respect to real output of -0.362 and with respect to interest rate of 0.036. Both elasticities are significantly different from zero at the 1 percent level. A test of the null hypothesis that the M_t coefficient of 1.129 is equal to unity has a t-statistic of 5.84, which is greater than the critical value of 2.576 at the 1 percent level. One therefore cannot accept the hypothesis of a unit coefficient. This result indicates that the price level would not move proportionately with the money supply.

The lags of the autocorrelation series for the quarterly data by an ARIMA procedure are reported in Table IV.

The Box-Pierce statistics for the residuals from equation (III.5) are 21.93 with 18 degrees of freedom and 27.40 with 24 degrees of freedom. These are less than the critical values of 35 and 43 at the 1 percent level of significance, respectively. Therefore, one cannot accept the hypothesis of serial correlation.[4]

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[4]According to the Durbin procedure, the transformation for output equation (III.5) is

$$\begin{aligned}\hat{\varepsilon}_{4t} = {} & \underset{(1.326)}{-0.786} + \underset{(2.273)}{0.216}\hat{\varepsilon}_{4t-1} - \underset{(-1.330)}{0.102}\ell\eta Y_{t-1} + \underset{(1.316)}{0.115}\ell\eta AT_t - \underset{(-1.297)}{0.127}\ell\eta AM_{t-1} + \\ & \underset{(0.010)}{0.002}\ell\eta UG_{t-1} - \underset{(-0.568)}{0.015}\ell\eta UT_{t-1} + \underset{(0.305)}{0.023}\ell\eta UM_t \qquad \text{(III.5)}'\end{aligned}$$

$\bar{R}^2 = 0.021 \qquad SE = 0.010$

The estimate for ρ^* is 0.216 with a t-statistic 2.273 which is less than the critical value of 2.576 at the 1 percent level of significance. Thus, there exists no serial correlation in output equation.

TABLE IV

MODEL A AUTOCORRELATION OF RESIDUALS
QUARTERLY: 1954:I - 1983:IV

Autocorrelation of Residuals from Equation (III.5)

To Lag	Chi Square	DF	Autocorrelations					
6	8.73	6	0.215	0.062	0.005	-0.018	-0.116	-0.083
12	17.61	12	0.119	-0.146	-0.076	0.062	0.020	-0.148
18	21.93	18	-0.118	0.008	-0.024	-0.082	0.095	-0.027
24	27.40	24	-0.055	0.019	0.010	-0.110	-0.145	0.014

S.D. = 0.010

The quantitative results for the output equation (III.5) are reported in Table III. The coefficients have the correct sign. Additional lagged variables are statistically insignificant when incorporated in equation (III.5). The Box-Pierce test indicates absence of serial correlation in the residuals. Therefore, agents use all available information to form their expectations about the behavior of real output. The authorities cannot conduct policy actions to fool the agents systematically. Furthermore, the coefficient of lagged value of the real output is significantly different from zero at the 1 percent level.

The t-statistics on the lagged values of unanticipated government expenditures and tax revenues are significantly different from zero at the 5 and 1 percent level, respectively, and the other coefficients are not significantly different from zero at that level. These results indicate that the anticipated monetary and fiscal policy actions have no systematic effect on real output; only the unanticipated fiscal components do have significant effect on real output. Thus, the policy ineffectiveness proposition still holds. The estimates coefficients in equation (III.5) also demonstrate the importance of the UG_{t-1} and UT_{t-1}. The UG_{t-1} coefficient of 0.063 suggests that a one percent increase in unanticipated government expenditures will increase the real output by 0.063 percent one quarter later. The UT_{t-1} coefficient of -0.075 indicates that a one percent increase in unanticipated tax revenues will lead to a 0.075 percent decrease in real output one quarter later.

Model B

Again, the model B given by equations (4.3), (4.5), (4.16), and (5.2) is linear; three-stage least squares (3SLS) is performed on model B. This procedure takes into account all a priori restrictions inherent in the specification. The output equation (4.39) is estimated by ordinary least squares (OLS) for testing the policy ineffectiveness proposition. The empirical results for annual data are reported at Table V. It is found that, except M_{t-2}, P_{t-1}, G_t, T_t, and U_{t-1} in equation (V.3), the signs of parameters are all as expected.[5] Since the relationship is linear in the logs of the variables, the coefficients are elasticities. All equations fit the data quite well.

The coefficients in government expenditure equation (V.1) suggest the elasticities of nominal government expenditure with respect to lagged value of real government expenditure of 0.731, with respect to lagged value of real output of 0.311, and with respect to price level of 1.024. These elasticities are clearly significantly different from zero at the 1 percent level. A test of the null hypothesis that the P_t coefficient of 1.024 is equal to unity has a t-statistic of 0.5, which is less than the critical value of 2.779 at the 1 percent significance level. This result confirms with the null hypothesis of a unit elasticity. Thus, nominal government expenditures would move proportionately with the price level.

A test of the null hypothesis that the P_t coefficient of 1.044 is equal to unity in the tax revenue equation (V.2) yields a t-statistic of 0.54, which is less than the critical value of 2.779 at the 1 percent significance level. This result suggests that the null hypothesis of a unit elasticity cannot be rejected. Thus, tax revenues would move proportionately with the price level.

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[5]Model B is based on the assumption that the Fed pursues price level stability and highly employment. According to equation (V.3) the Fed does not fight to reduce unemployment, but to stabilize the price level.

The coefficients of M_{t-2}, P_{t-1}, G_t, T_t, and U_{t-1} are not significantly different from zero at the 1 percent level.

TABLE V

MODEL B EQUATION ESTIMATES
ANNUAL: 1954 - 1983

Government Expenditure Equation

$$\ell\eta G_t = \underset{(-2.204)^*}{-2.025} + \underset{(6.126)^{**}}{0.731}(\ell\eta G_{t-1} - \ell\eta P_{t-1}) + \underset{(3.241)^{**}}{0.311}\ell\eta Y_{t-1} + \underset{(21.506)^{**}}{1.024}\ell\eta P_t \tag{V.1}$$

$\bar{R}^2 = 0.999$ SE $= 0.030$

Tax Revenue Equation

$$\ell\eta T_t = \underset{(-15.355)^{**}}{-6.902} + \underset{(1.091)}{0.455}\ell\eta Y_t + \underset{(1.368)}{0.611}\ell\eta Y_{t-1} + \underset{(12.691)^{**}}{1.044}\ell\eta P_t \tag{V.2}$$

$\bar{R}^2 = 0.996$ SE $= 0.053$

Money Supply Equation

$$\begin{aligned}\ell\eta M_t = {} & \underset{(-0.914)}{-0.435} + \underset{(3.362)^{**}}{1.857}\ell\eta M_{t-1} - \underset{(-0.742)}{0.467}\ell\eta M_{t-2} - \underset{(-1.812)^*}{1.211}\ell\eta P_t + \underset{(1.733)^*}{0.853}\ell\eta P_{t-1} \\ & + \underset{(1.048)}{0.143}\ell\eta G_t - \underset{(-0.847)}{0.134}\ell\eta T_t - \underset{(-0.038)}{0.008}\ell\eta U_{t-1}\end{aligned} \tag{V.3}$$

$\bar{R}^2 = 0.998$ SE $= 0.015$

Price Level Equation

$$\ell\eta P_t = \underset{(3.359)^{**}}{1.082} + \underset{(26.583)^{**}}{1.162}\ell\eta M_t - \underset{(-5.476)^{**}}{0.402}\ell\eta Y_t + \underset{(0.705)}{0.016}\ell\eta i_t \tag{V.4}$$

$\bar{R}^2 = 0.995$ SE $= 0.026$

TABLE V (Continued)

Output Equation

$$\ell\eta Y_t = \underset{(0.357)}{0.052} + \underset{(41.053)^{**}}{1.002\ell\eta Y_{t-1}} - \underset{(-1.537)}{0.012\ell\eta AT_t} + \underset{(0.895)}{0.005\ell\eta AM_{t-1}} + \underset{(2.012)^{*}}{0.307\ell\eta UG_{t-1}}$$

$$- \underset{(-0.460)}{0.043\ell\eta UT_{t-1}} + \underset{(0.661)}{0.243\ell\eta UM_t} \qquad (V.5)$$

$\bar{R}^2 = 0.994$ SE = 0.022 D.W. = 1.680

** indicates significance at 1 percent level
 * indicates significance at 5 percent level
NOTE: t-statistics are in parentheses.

The coefficients of M_{t-2}, P_{t-1}, G_t, T_t, and U_{t-1} in the money supply equation (V.3) have the incorrect sign and are not significantly different from zero at the 1 percent level. The elasticity of money supply with respect to current value of price level is -1.211, which is significantly different from zero at the 5 percent level. The t-statistic on the lagged value of money supply is significantly different from zero at the 1 percent level. The M_{t-1} coefficient of 1.857 suggests that a one percent increase in money supply will increase the money supply by 1.867 percent one year later. According to the estimated coefficients, the Fed fights inflation, but not unemployment.

The t-statistic on interest rate is not significantly different from zero in the price level equation (V.4). The elasticity of price level with respect to real output is 0.402, which is significantly different from zero at the 1 percent level. A test of the null hypothesis that the M_t coefficient of 1.162 is equal to unity has a t-statistic of 3.682, which is greater than the critical value of 2.779 at the 1 percent significance level. One therefore cannot accept the null hypothesis of a unit elasticity. This result indicates that price level would not move proportionately with the money supply.

The ARIMA procedure also priovides no evidence to support the hypothesis of serial correlation. The lags of autocorrelation series for annual data are reported in Table VI. The Box-Pierce statistics for the residuals from equation (V.5) are 15.84 with 18 degrees of freedom and 22.83 with 24 degrees of freedom. These are less than the critical values of 35 and 43 at the 1 percent significance level, respectively. Therefore, the

TABLE VI

MODEL B AUTOCORRELATION OF RESIDUALS
ANNUAL: 1954 - 1983

Autocorrelation of Residuals from Equation (V.5)

To Lag	Chi Square	DF	Autocorrelations					
6	6.26	6	0.160	-0.114	-0.329	-0.187	-0.000	0.025
12	12.52	12	0.153	-0.050	-0.157	-0.183	0.053	0.212
18	15.84	18	0.157	-0.078	-0.008	-0.067	0.054	-0.113
24	22.83	24	-0.085	-0.102	-0.070	0.088	-0.019	0.143

S.D. = 0.020

hypothesis of serial correlation cannot be accepted.[6]

The quantitative results for the output equation (V.5) are reported in Table V. The coefficients have the correct sign. Additional lagged variables are statistically insignificant when incorporated in equation (V.5). The Box-Pierce test indicates absence of serial correlation in the residuals; therefore, agents use all relevant information to form their expectations about the behavior of real output. Since agents instantaneously modify their expectations about the behavior of real output, the authorities cannot conduct policy actions to fool the agents systematically. Furthermore, the coefficient of lagged value of the real output is significantly different from zero at the 1 percent level.

The t-statistic on the lagged value of unanticipated government expenditures is significantly different from zero at the 5 percent level; the other coefficients are not significantly different from zero at the 1 percent level. These results show that the anticipated monetary and fiscal policy actions do not have any systematic effect on real output; only the unanticipated government expenditures do have significant effect on real output. Therefore, these results support the policy ineffectiveness pro-

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[6]According to the Durbin procedure, the transformation for equation (V.5) is

$$\hat{\varepsilon}_{4t} = \underset{(-0.211)}{-0.010} + \underset{(0.594)}{0.148}\hat{\varepsilon}_{4t-1} + \underset{(0.221)}{0.021}\ell\eta Y_{t-1} - \underset{(-0.241)}{0.009}\ell\eta AT_t - \underset{(-0.046)}{0.003}\ell\eta AM_{t-1} +$$

$$\underset{(0.184)}{0.030}\ell\eta UG_{t-1} + \underset{(0.105)}{0.010}\ell\eta UT_{t-1} + \underset{(0.033)}{0.013}\ell\eta UM_t \qquad (V.5)'$$

$\bar{R}^2 = -0.234 \qquad SE = 0.023$

The estimate for ρ^* is 0.148 with a t-statistic 0.594, which is less than critical value 2.831 at the 1 percent level of significance. Therefore, the null hypothesis of no autocorrelation cannot be rejected.

position. The UG_{t-1} coefficient of 0.307 suggests that a one percent increase in unanticipated government expenditures will increase the real output by 0.307 percent one year later.

Regarding the annual data, the results of model B share the same features as model A have. First, only the unanticipated monetary and fiscal components do have significant effect on real output. Second, the anticipated monetary and fiscal policy actions do not have any systematic effect on real output.

With regard to the quarterly data, the results are reported in Table VII. The signs of parameters are all as expected, with the exception of P_{t-1} in equation (VII.3) and UM_t in equation (VII.5).[7] Again, all equations fit the data quite well.

The coefficients in the government expenditure equation (VII.1) imply the elasticities of nominal government expenditure with respect to lagged value of real government expenditure of 0.893, with respect to lagged value of real output of 0.127, and with respect to price level of 1.011. These elasticities are clearly significantly different from zero at the 1 percent level. A test of the null hypothesis that the P_t coefficient of 1.011 is equal to unity has a t-statistic of 0.724, which is less than the critical value of 2.576 at the 1 percent significance level. This result confirms with the null hypothesis of a unit elasticity. Thus nominal government expenditures would move proportionately with the price level.

The coefficients in the tax revenue equation (VII.2) imply the elasticities of tax revenue with respect to lagged value of real output of 0.788 and with respect of price level of 0.997. Both elasticities are

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[7]The coefficients of P_{t-1} and UM_t in equation (VII.5) are not significantly different from zero at the 1 percent level.

TABLE VII

MODEL B EQUATION ESTIMATES
QUARTERLY: 1954:I - 1983:IV

Government Expenditure Equation

$$\ell n G_t = \underset{(-2.903)^{**}}{0.840} + \underset{(23.194)^{**}}{0.893}(\ell n G_{t-1} - \ell n P_{t-1}) + \underset{(2.952)^{**}}{0.127}\ell n Y_{t-1} + \underset{(66.650)^{**}}{1.011}\ell n P_t \qquad \text{(VII.1)}$$

$\bar{R}^2 = 0.999$ SE = 0.019

Tax Revenue Equation

$$\ell n T_t = \underset{(-55.166)^{**}}{7.118} + \underset{(1.158)}{0.339}\ell n Y_t + \underset{(2.674)^{**}}{0.788}\ell n Y_{t-1} + \underset{(41.703)^{**}}{0.997}\ell n P_t \qquad \text{(VII.2)}$$

$\bar{R}^2 = 0.998$ SE = 0.075

Money Supply Equation

$$\ell n M_t = \underset{(-1.911)^{*}}{0.205} + \underset{(5.857)^{**}}{0.993}\ell n M_{t-1} + \underset{(0.894)}{0.180}\ell n M_{t-2} - \underset{(-2.588)^{**}}{2.534}\ell n P_t + \underset{(2.524)^{**}}{2.357}\ell n P_{t-1} -$$

$$\underset{(-0.715)}{0.033}\ell n G_t + \underset{(1.027)}{0.056}\ell n T_t + \underset{(0.623)}{0.007}\ell n U_{t-1} \qquad \text{(VII.3)}$$

$\bar{R}^2 = 0.997$ SE = 0.011

Price Level Equation

$$\ell n P_t = \underset{(5.781)^{**}}{0.974} + \underset{(49.897)^{**}}{1.128}\ell n M_t - \underset{(-9.353)^{**}}{0.365}\ell n Y_t + \underset{(3.517)^{**}}{0.037}\ell n i_t \qquad \text{(VII.4)}$$

$\bar{R}^2 = 0.994$ SE = 0.030

TABLE VII (Continued)

Output Equation

$$\ell\eta Y_t = 0.039 + 0.994\ell\eta Y_{t-1} - 0.002\ell\eta AT_{t-1} + 0.004\ell\eta AM_t + 0.040\ell\eta UG_{t-1}$$
$$\quad (1.047) \quad (155.204)^{**} \quad (-0.569) \quad (1.293) \quad (0.783)$$

$$- 0.079\ell\eta UT_{t-1} - 0.004\ell\eta UM_t \qquad \text{(VII.5)}$$
$$(-2.801)^{**} \quad (-0.075)$$

$\bar{R}^2 = 0.999$ SE = 0.011 D.W. = 1.542

** indicates significance at 1 percent level
 * indicates significance at 5 percent level
NOTE: t-statistics are in parentheses.

significantly different from zero at the 1 percent level. A test of the null hypothesis that the P_t coefficient of 0.997 is equal to unity has a t-statistic of -0.125, which is less than the critical value of 2.576 at the 1 percent significance level. This result confirms with the null hypothesis of a unit elasticity. Thus, tax revenues would move proportionately with the price level.

The coefficients in the money supply equation (VII.3) have the correct sign except the coefficient of P_{t-1}. The coefficients imply the elasticities of money supply with respect to lagged value of money supply of 0.993 and with respect to current value of price level of -2.534. These elasticities are significantly different from zero at the 1 percent level. According to the estimated coefficients, the Fed fights inflation, but not unemployment.

The coefficients in the price level equation (VII.4) imply the elasticities of price level with respect to real output of -0.365 and with respect ot interest rate of 0.037. Both elasticities are significantly different from zero at the 1 percent level. A test of the null hypothesis that the M_t coefficient of 1.128 is equal to unity has a t-statistic of 5.66, which is greater than the critical value of 2.576 at the 1 percent level. One therefore cannot accept the hypothesis of a unit elasticity. Thus, price level would not move proportionately with the money supply.

The lags of autocorrelation series for quarterly data are reported in Table VIII. The Box-Pierce statistics for the residuals from equation (VII.5) are 21.22 with 18 degrees of freedom and 26.37 with 24 degrees of freedom, these are less than the critical values of 35 and 43 at the 1 percent significance level, respectively. Thus the hypothesis of serial

TABLE VIII

MODEL B AUTOCORRELATIONS OF RESIDUALS
QUARTERLY: 1954:I - 1983:IV

Autocorrelation of Residuals from Equation (VII.5)

To Lag	Chi Square	DF	Autocorrelations					
6	9.89	6	0.229	0.045	-0.024	-0.048	-0.123	-0.087
12	17.62	12	0.118	-0.131	-0.073	0.058	0.023	-0.136
18	21.22	18	-0.108	-0.027	0.002	-0.069	0.093	-0.015
24	26.37	24	-0.047	0.037	0.023	-0.104	-0.138	0.025

S.D. = 0.011

correlation can be rejected.[8]

The quantitative results for the output equation (VII.5) are reported in Table VII. The coefficients have the correct sign. Additional lagged variables are statistically insignificant when incorporated in equation (VII.5). The Box-Pierce test indicates absence of serial correlation in the residuals; therefore, agents use all relevant information to form their expectations about the behavior of real output. Since agents instantaneously modify their expectations about the behavior of real output, the authorities cannot conduct policy actions to fool the agents systematically. Furthermore, the coefficient of lagged value of the real output is significantly different from zero at the 1 percent level.

The t-statistic on the lagged value of unanticipated tax revenue is significantly different from zero at the 1 percent level, and the other coefficients are not significantly different from zero at that level. These results show that the anticiapted monetary and fiscal policy actions do not have any systematic effect on real output; only the unanticipated tax revenues to have significant effect on real output. Therefore these results confirm the policy ineffectiveness proposition. The UT_{t-1} coefficient of 0.079 suggests that a one percent increase in unanticipated tax

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[8]The transformation for equation (VII.5) is

$$\hat{\varepsilon}_{4t} = \underset{(0.079)}{0.004} + \underset{(2.488)}{0.240}\hat{\varepsilon}_{4t-1} - \underset{(-0.040)}{0.001}\ell\eta Y_{t-1} + \underset{(0.079)}{0.002}\ell\eta AT_{t-1} -$$

$$\underset{(-0.031)}{0.002}\ell\eta AM_t + \underset{(0.032)}{0.002}\ell\eta UG_{t-1} - \underset{(-0.513)}{0.014}\ell\eta UT_{t-1} - \underset{(-0.103)}{0.006}\ell\eta UM_t \qquad \text{(VII.5)}'$$

$\bar{R}^2 = 0.004 \qquad SE = 0.011$

Again, the estimate for ρ^* is 0.240 with a t-statistic 2.488, which is less than the critical value of 2.576 at the 1 percent significance level. Hence, this equation exists no serial correlation.

revenues will reduce the real output by 0.079 percent one quarter later.

Regarding the quarterly data, the results of model B and model A show a number of interesting features. First, the anticipated monetary and fiscal policy actions do not have any systematic effect on real output. Second, only the unanticipated fiscal components do have significant effect on real output.

Economic Interpretation

The above-mentioned evidence supports the policy ineffectiveness proposition. What do these quantative results imply about the United States monetary and fiscal policies over the sample period 1954-1983? Obviously, the results can be pulled together in a general conclusion. Namely, the anticipated monetary and fiscal policy actions do not have any systematic effect on real output; only the unanticipated fiscal and monetary components do have significant effect on real output. The results therefore carry certain implications for economic policy.

The most dramatic implication for macroeconomic policy, clearly, is that countercyclical monetary and fiscal policy actions are ineffective in reducing the United States business-cycle fluctuation. The results are identical to those rational expectations formulation that deny any systematic relationship among countercyclical monetary and fiscal policies and real output. Indeed, the findings for the United States are the same of those obtained by Barro's empirical works.

If these results are correct, countercyclical monetary and fiscal policy actions cannot be implemented to reduce the fluctuations of economy.

Concluding Comments

The empirical results present here are consistent with the hypothesis that the behavior of real output depends only on the random disturbance terms. The systematic parts of monetary and fiscal policy actions do not have any effect on real output. What are the reasons for the policy ineffectiveness proposition? The main reasons seem to be as follows:

a. The estimation of anticipated and unanticipated components is based on a full information simultaneous equations.

b. Two different money supply mechanisms take into account the interactions between monetary and fiscal policies. One is derived from the budget restraint literature, the other from the Fed's stabilization policy goals.

c. The models take into account the price level and interest rate. An increase in the money supply which is fully anticipated is accompanied by an equiproportionate increase in the price level.

d. According to the Box-Pierce test, the output equation exhibits no serial correlation in the residuals, implying that agents do use all relevant information to form their expectations about the behavior of real output. Since agents instantaneously modify their expectations about the behavior of real output, the authorities cannot conduct policy actions to fool the agents systematically.

The anticipated fiscal and monetary components were generated by an historical simulation process; thus, it is necessary to test the accuracy of simulation for both models.

In order to test the accuracy of simulation of model A and model B, the error statistics, mean absolute error (MAE), mean absolute percentage error (MAPE), root mean square error (RMSE), root mean square percent error (RMSPE), and Theil's inequality coefficient are employed (Pindyck and Rubinfeld, 1981, pp. 360-367).

The simulation error statistics of model A for annual data are reported at Table IX. The statistics of MAPE show a range of MAPE errors from 0.178 percent for money supply to 0.667 percent for government expenditure. The simulated statistics of government expenditure, tax revenue, money supply, and price level are off 0.667 percent, 0.636 percent, 0.178 percent, and 0.375 percent from the actual values, respectively. These statistics show excellent simulation results. Also, the statistics of Theil's U show a range of Theil's U from 0.001 for money supply to 0.005 for tax revenue. The simulation statistics of Theil's U for government expenditure, tax revenue, money supply, and price level are 0.004, 0.005, 0.001, and 0.002, respectively. These statistics are close to zero; thus, the simulation results are excellent.

The simulation error statistics of model A for quarterly data are reported at Table X. The statistics of MAPE show a range of MAPE errors from 0.190 percent for money supply to 0.629 percent for tax revenue. The simulated statistics of government expenditure, tax revenue, money supply, and price level are off 0.576 percent, 0.629 percent, 0.190 percent, and 0.465 percent from the actual values, respectively. These statistics show excellent simulation results. Also, the statistics of Theil's U show a range of Theil's U from 0.001 for money supply to 0.005 for tax revenue. The statistics of Theil's U for government expenditure, tax revenue, money supply, and price level are 0.004, 0.004, 0.001, and 0.003, respectively. These statistics are close to zero; thus, the simulation

TABLE IX

MODEL A SIMULATION ERROR STATISTICS
ANNUAL: 1954 - 1983

Endogenous Variable	MAE	MAPE	MRSE	MRSPE	Theil's U
G	0.034	0.667%	0.045	0.920	0.004
T	0.032	0.636%	0.048	0.991	0.005
M	0.010	0.178%	0.013	0.234	0.001
P	0.016	0.365%	0.021	0.478	0.002

TABLE X

MODEL A SIMULATION ERROR STATISTICS
QUARTERLY: 1954:I - 1983:IV

Endogenous Variable	MAE	MAPE	MRSE	MRSPE	Theil's U
G	0.029	0.576%	0.037	0.768	0.004
T	0.032	0.629%	0.042	0.840	0.004
M	0.010	0.190%	0.013	0.244	0.001
P	0.021	0.465%	0.025	0.579	0.003

results are excellent.

The simulation error statistics of model B for annual data are reported at Table XI. The statistics of MAPE show a range of MAPE errors from 0.206 percent for money supply to 0.656 percent for tax revenue. The simulated statistics of government expenditure, tax revenue, money supply, and price level are off 0.503 percent, 0.656 percent, 0.206 percent, and 0.212 percent from the actual values, respectively. These statistics show excellent simulation results. Also, the statistics of Theil's U show a range of Theil's U from 0.001 for money supply to 0.005 for tax revenue. The simulation statistics of Theil's U for government expenditure, tax revenue, money supply, and price level are 0.003, 0.005, 0.001, and 0.001, respectively. These statistics are close to zero; thus, the simulation results are excellent.

The simulation error statistics of model B for quarterly data are reported at Table XII. The statistics of MAPE show a range of MAPE errors from 0.147 percent for price level to 0.539 percent for tax revenue. The simulated statistics of government expenditure, tax revenue, money supply, and price level are off 0.344 percent, 0.539 percent, 0.307 percent, and 0.147 percent from the actural values, respectively. These statistics show excellent simulation results. Also, the statistics of Theil's U show a range of Theil's U from 0.001 for price level to 0.003 for tax revenue. The simulation statistics of Theil's U for government expenditure, tax revenue, money supply, and price level are 0.002, 0.003, 0.002, and 0.001, respectively. These statistics are close to zero; thus, the simulation results are excellent.

TABLE XI

MODEL B SIMULATION ERROR STATISTICS
ANNUAL: 1954 - 1983

Endogenous Variable	MAE	MAPE	MRSE	MRSPE	Theil's U
G	0.026	0.503%	0.033	0.667	0.003
T	0.034	0.656%	0.051	1.032	0.005
M	0.011	0.206%	0.014	0.259	0.001
P	0.010	0.212%	0.012	0.268	0.001

TABLE XII

MODEL B SIMULATION ERROR STATISTICS
QUARTERLY: 1954:I - 1983:IV

Endogenous Variable	MAE	MAPE	MRSE	MRSPE	Theil's U
G	0.018	0.344%	0.022	0.437	0.002
T	0.028	0.539%	0.037	0.707	0.003
M	0.016	0.307%	0.020	0.371	0.002
P	0.008	0.147%	0.008	0.181	0.001

CHAPTER VI

SUMMARY AND CONCLUSIONS

The present study focuses particularly on the issue of the policy ineffectiveness proposition. Since the literature on the issue of policy ineffectiveness is still controversial, it is of considerable interest to investigate this issue. Thus, the main purposes of this study are:

a. To formulate a rational expectations model embodying the interdependence between monetary and fiscal policy variables in which the policy ineffectiveness proposition does not necessarily hold.

b. To decompose monetary and fiscal policies into anticipated and unanticipated components in order to test the policy ineffectiveness proposition, and to present further empirical evidence on the issue.

A theoretical model was developed to decompose monetary and fiscal changes into anticipated and unanticpated components. The model consisted of IS and LM relationships and a Sargent-Wallace supply function. From this basic model, two sub-models can be developed with each corresponding to different money supply mechanisms. Two different money supply mechanisms were employed. One was derived from the budget restraint literature, which reflected the fiscal framework of money supply mechanisms. In other words, an increase in the money supply responds to the government's fiscal operations, operations such as financing budget deficits. The other was derived from the Fed's stabilization policy goals, a reaction function monetary mechanism. These models provided a foundation from which to analyze the impact of anticipated and unanticipated monetary and fiscal changes on real output. The models were estimated by 3SLS and OLS, using annual and quarterly data from the United States for the period 1954-1983.

By examining and comparing the evidence obtained from both models, the following conclusions obtain.

First, both models consist of IS and LM relationships and a Sargent-Wallace supply function. The IS curve takes into account the fiscal policy variables. A money supply mechanism reflecting the fiscal framework of money supply is incorporated in model A. The Fed's reaction function monetary mechanism is incorporated in model B. Both models are general equilibrium models with each corresponding to different money supply mechanisms. The expectation error obtained from each model implies that the policy ineffectiveness proposition does not necessarily hold. That is, each model is structured so that the effectiveness of policy question is an empirical one. The behavior of real output may be dependent not only on the systematic influence of authorities' choices but also on the random disburance terms. The authorities could thus conduct policy actions to fool the agents systematically.

Second, the most important finding is that for each model for both annual and quarterly data, the empirical estimates indicate that anticipated monetary and fiscal policy actions do not have any systematic effect on real output. Thus, the policy ineffectiveness proposition is valid.

Third, the empirical results further indicate that agents instantaneously modify their expectations about the behavior of real output; the authorities cannot conduct policy actions to fool the agents systematically.

The results confirm that only unanticipated fiscal and monetary components have significant effects on real output in both models. In all the regression results, the unanticipated fiscal components have a significant effect on real output. In some models, it is unanticipated government expenditures that are significant; in the others, it is unanticipated tax revenues. Unanticipated money supply changes are significant in only one model-- model A with annual data. The models are not sufficiently robust, though, to address the issues of whether unanticipated fiscal variables are more important, in some sense, than the unanticipated monetary variable. What the results do show, however, is that anticipated fiscal and monetary policy variables have not discernible systematic influence. Thus, countercyclical monetary and fiscal policy actions play no role in stabilizing the fluctuation of economy.

Finally, with regard to testing the policy ineffectiveness proposition, both models performed quite well empirically, with both annual and quarterly data.

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