

MACRO POLICY GOALS IN THE POSTWAR PERIOD:

A Study in Revealed Preference

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I. Introduction

With the development of large-scale econometric models, it has become increasingly easy to simulate the behavior of the economy under alternative policies (e.g., Fromm and Taubman [12], Klein and Taubman [17]). However, because the government usually has a multiplicity of inconsistent goals, evaluation of alternative policies is impossible without attaching specific weights to the various goals. Unfortunately, these weights are never made explicit. Thus, even if the policy planner can predict the outcome of alternative policies with reasonable certainty,¹ he has no real basis for recommending one policy mix over another.

Nevertheless, policies are chosen that have a measurable impact on economic activity. Thus, the government implicitly applies certain weights to the various target variables and policy instruments. Therefore, by analyzing the government's revealed preferences through its past behavior, it should be possible to estimate its relative rankings with regard to various targets and instruments. This paper reports on such an analysis. Revealed preference is utilized to deduce the weights the government has attached to various macro target variables and policy instruments during the post-war period.

In principle, if the government's welfare function and the constraints under which it is operating are known, an analysis of the government's past behavior should yield estimates of its relative rankings of alternative

¹Unfortunately, there is considerable question whether the policy planner can even do this. For a good discussion of this point, see Gordon [13] and Cooper [5].

goals. In practice neither of these are known and must be assumed. Unfortunately, no analysis can encompass the entire scope of government activity. Thus, it is necessary to constrain the problem to a given realm of government activity (e.g., macro economic policy) and assume that the government sub-maximizes with respect to this realm of activity. But sub-maximization is probably not consistent with global maximization. Thus, in limiting the analysis to macro economic policy and assuming that the government only maximizes with respect to macro economic variables, there is a good chance that the welfare function is misspecified. Thus, if the government is in fact globally maximizing with respect to all of its activities, it may fail to maximize with respect to economic variables alone.

Even if the government is in fact maximizing with respect to macro economic variables alone, the application of revealed preferences is hardly straightforward. To varying degrees the analysis is sensitive to the following considerations: (1) the general form of the welfare function, e.g., quadratic, logarithmic, etc.; (2) the specific form of the welfare function, e.g., the number of interactions assumed; (3) the specific targets and instruments included in the welfare function; (4) the assumed time horizon of the welfare function; (5) the constraints under which the economy is assumed to be operating.

Finally, it should be clear that any welfare weights derived from an analysis of past government behavior are ex poste weights and as such have no normative significance for future policy decisions.

In spite of the obvious difficulties in applying revealed preference to the government, the analysis seems useful. First, in rigorously outlining how the welfare weights can be derived from an assumed welfare function and assumed constraints in a macro-economic context, the analysis outlines a general methodology that could be applied to other situations where the government can be assumed to maximize an objective function with respect to known constraints. Second, the analysis can yield insights into the government's decision-making process. If, for example, the government fails to maximize either globally or with respect to economic policy alone it is likely that no consistent set of weights can be derived from an analysis that assumes the government maximizes with respect to economic policy. If in fact the government is more or less maximizing with respect to economic policy, reasonably consistent estimates of the weights should be derived regardless of the specific form of the welfare function assumed. In this case, knowledge of past trade-offs between different goals should be useful in determining their present values for current policy decisions.

Briefly, this paper takes the following form. The next section outlines the formal framework of the analysis and indicates how the weights can be derived from observable relationships between the targets and the instruments under various assumptions about the nature of the welfare function. Section III discusses the empirical results and gives estimates of the weights for the Eisenhower and Kennedy-Johnson years. The final section summarizes the results and indicates areas for future research.

II. Framework of the Analysis

To utilize revealed preference, it is necessary to assume that the government operates with regard to a known welfare function and known constraints. Theil's work in macro policy and government decision-making [20] provides a useful framework for the analysis and will be incorporated throughout this paper. Thus, assume that the government maximizes a quadratic welfare function subject to the relationships between the policy instruments and the target variables.²

The assumed quadratic welfare function can be static and extend for one time period or dynamic and extend for several. In either case, it can contain varying degrees of interaction terms between the targets and the instruments. This section first discusses how the weights can be derived from a static welfare function and then outlines how they can be derived from a dynamic welfare function. In both cases, the implication of varying degrees of interaction terms between the targets and the instruments will be discussed.

A. Static Welfare Function

Assume that at any given period t the government maximizes a quadratic utility function whose arguments consist of deviations from the desired values of the target and instrumental variables at time t , subject to the constraints of the workings of the economy. Thus, the government's

²For the sake of analytical simplicity, it is assumed that these relationships are known with certainty. Thus, there is no need to apply theorems of certainty equivalence to the analysis.

time horizon is only one period long. In the most general case the problem takes the form: maximize³

$$\begin{aligned} \text{A.1} \quad U &= \alpha'(X-X^*) + \beta'(Y-Y^*) - 1/2[(X-X^*)' A(X-X^*) \\ &\quad + (Y-Y^*)' B(Y-Y^*) + (X-X^*)' C(Y-Y^*) + (Y-Y^*)' C'(X-X^*)] \\ &\text{subject to} \\ Y &= RX + ZS \end{aligned}$$

where X = (mx1) vector of actual values of the policy instruments

X^* = (mx1) vector of desired value of the policy instruments

Y = (nx1) vector of actual values of the target variables

Y^* = (nx1) vector of desired value of the target variables

R = (nmx) matrix of reduced form coefficients relating the targets to the instruments

Z = (npx) matrix of reduced form coefficients relating the targets to the lagged endogenous and non-instrumental exogenous variables

S = (px1) vector of lagged endogenous and non-instrument exogenous variables

α = (mx1) vector of weights attached to linear deviations of desired from actual values of the policy instruments

β = (nx1) vector of weights attached to linear deviations of desired from actual values of the target variables

³ This welfare function indicates that the government maximizes linear deviations from the desired targets and instruments but minimizes squared deviations. As such it is somewhat more general than that employed by Theil in his empirical work [20]. The introduction of linear terms implies that the government does not view positive and negative deviations from the desired

A = (mxm) matrix of weights attached to squared deviations of desired from actual values of the policy instruments.

In general a_{ii} can be interpreted as the weight attached to the squared deviation of instrument i , while a_{ij} can be interpreted as the weight attached to the deviation of instrument i given the deviation of instrument j . Thus, A is a symmetric matrix. If $a_{ij} \neq 0$ for $i \neq j$, this implies that the policy maker cares about the mix of his instrumental variables.

B = (nxn) matrix of weights attached to squared deviations of desired from actual values of the target variables. Similar to the A matrix, B is symmetric. Thus, b_{ii} can be interpreted as the weight attached to the squared deviation of target i , while b_{ij} can be interpreted as the weight attached to the deviation of target i given the deviation of target j . Therefore, if $b_{ij} \neq 0$ for $i \neq j$, this implies that the policy maker cares about the relative levels of the deviations of the target variables.

C = (mxn) matrix of weights attached to the interaction of the deviations of the target variables and policy instruments. Thus, c_{ij} represents the weight attached to the deviation of target j given the deviation of instrument i . Clearly this matrix will not be

symmetric. In general if $c_{ij} \neq 0$, this implies that the policy maker cares how the target is achieved.

Substituting $Y = RX + ZS$ into the welfare function and differentiating with respect to X yields

$$\begin{aligned} \text{A.2} \quad \partial U / \partial X &= (\alpha + R'\beta) - 1/2[2A(X-X^*) + 2R'C'(X-X^*) \\ &\quad + 2R'B(RX+ZS-Y^*) + 2C(RX+ZS-Y^*)] \\ &= (\alpha + R'\beta) - [(A+R'C')(X-X^*) + (R'B+C)(RX+ZS-Y^*)] \end{aligned}$$

For a welfare maximum, this must be equal to zero. Therefore,

$$\text{A.3} \quad (\alpha + R'\beta) - (A+R'C')(X-X^*) - (R'B+C)(Y-Y^*) = 0$$

Hence

$$\text{A.4} \quad x = (A+R'C')^{-1} [(\alpha + R'\beta) - (R'B+C)y]$$

where $x = X-X^*$, $y = Y-Y^*$.⁴

Thus, any given x_i is equal to a constant term plus a linear combination of all the y 's. At any given period of time t , $x_{it} = X_{it} - X^*_{it}$ and $y_{it} = Y_{it} - Y^*_{it}$. Since all of these variables are observable over time, it is possible to estimate regressions in the form⁵

⁴It should be pointed out that the problem at hand is not to estimate the government's reaction function $X^0 = X^0(A, B, R, S)$, which shows how the government could be expected to react to changes in the structure of the economy or to changes in the weights. To estimate the X 's in these terms would considerably complicate the calculations and make the weights virtually impossible to separate from the other parameters. As long as we can assume that the government is optimizing, it should be acceptable to estimate the X 's in terms of the Y 's with their embodied weights. In doing this, we are extending the work of Wood [23], Reuber [14], and Johnson and DeWald [16], who also estimate the instruments in terms of the targets, but make no effort to derive the weights.

⁵Note that there is some chance of simultaneous bias here because $y = Y - Y^*$ and $Y = RX + ZS$. This, however, is equally true of other studies of this nature; e.g., Wood [23], Johnson and DeWald [16], Reuber [14], Havrilesky [14], and Christian [4].

$$A.5 \quad x_j = \gamma_{0j} + \sum_{i=1}^n \gamma_{ij} y_i + u_j \quad j = 1, \dots, m$$

where each coefficient is a combination of the various weights and the reduced form coefficients. However, a little reflection will indicate that without placing some rather severe a priori restrictions on the weights, it will be impossible to solve for them. For example, if the α and β vectors, and the A, B, and C matrices consist of non-negative elements, there are $m + n + \sum_{i=0}^n (m-i) + \sum_{j=0}^n (n-j) + nxm$ undetermined weights. Since each estimated coefficient is equal to a linear combination of these weights, there are only $m + mxn$ equations available that can be used to solve for the weights. In general, the unknowns will outnumber the equations. Thus, it is necessary to set a large number of the weights equal to zero. Several cases will not be considered.

1. No Interactions

In this case the A and B matrices are assumed to be diagonal while the C matrix is assumed to be null. Thus,

$$A.6 \quad x = A^{-1}[(\alpha + R'\beta) - R'By].$$

Because A and B are diagonal matrices, the expressions for x are easily derived. It may be helpful to state the system of equations explicitly.

$$A.7 \quad x_j = 1/a_j [(\alpha_j + \sum_{i=1}^n r_{ij} \beta_i) - (\sum_{i=1}^n b_i r_{ij} y_i)]$$

$$j = 1, \dots, m$$

Corresponding to each regression coefficient estimated in (A.5) is a combination of the weights outlined in (A.7). Specifically, the

relationship between the weights and the regression coefficients is given as follows:

$$\begin{aligned}
 \text{A.8} \quad \gamma_{ij} &= -(b_i/a_j)r_{ij} & i=1 \dots, n \\
 & & j=1 \dots, m \\
 \gamma_{0j} &= 1/ja(\alpha_j + \sum_{i=1}^n r_{ij}\beta_i) & j=1 \dots, m & \gamma_{0j} = 1/aj \text{ (....}
 \end{aligned}$$

where b_i = the quadratic weight attached to target i
 a_j = the quadratic weight attached to instrument j
 r_{ij} = the reduced form coefficient showing the impact
of instrument j upon target i
 β_i = the linear weight attached to target i
 α_j = the linear weight attached to instrument j

The quadratic weights are independent of the linear weights. They can, therefore, be solved separately and then used to determine the linear weights. Since there are $m \times n$ equations available to solve for the $m \times n$ quadratic weights and only m equations available to solve for the $m \times n$ linear weights, the equations expressing the quadratic weights will have to be aggregated, while restrictions will have to be placed on the linear weights. The specific methodology used to solve for the weights is given in Appendix A.

2. Interactions

In the most general case the solution of the vector x in terms of the vector y is given by expression (A.4), where each of the quadratic-weight matrices (A, B, and C) are assumed to be nondiagonal. In this

case, however, it is impossible to derive the weights from the estimated regression coefficients. First, the A and C weights enter non-linearly; second, the number of weights far exceeds the number of equations. However, the problem can be made manageable by assuming that A is diagonal, that C is null, and that B is nondiagonal but symmetric.

These restrictions have a certain intuitive appeal. Assuming that the A matrix is diagonal is equivalent to assuming that the policy maker is indifferent to the mix of the policy tools used in achieving the desired targets. Assuming that the C matrix is zero is equivalent to assuming that the policy maker does not care how he achieves the targets. However, assuming that the B matrix is non-diagonal is equivalent to assuming that the policy maker cares about the relative levels of the targets. For example, if the policy maker's welfare derived from a given deviation of actual from desired unemployment varies with the degree of inflation, the B matrix must be non-diagonal. Since it is likely that such interactions of this type exist, it seems plausible to assume that the B matrix is non-diagonal and to estimate the weights accordingly.

The general solution of x in terms of y is the same as that given in expression A.6. However, in this case the relationship between the x's and the y's is given by the following expression:

$$\begin{aligned}
 \text{A.9} \quad x_j &= 1/a_j [\alpha_j + \sum_{i=1}^n r_{ij} \beta_i] \\
 &\quad - 1/ja [\sum_{h=1}^n r_{hj} b_{j1} y_1 + \dots + \sum_{h=1}^n r_{hj} b_{hn} y_n] - 1/a_j \\
 j &= 1, \dots, m
 \end{aligned}$$

From the regression relationships given in A.5 it is possible to relate the weights to the regression coefficients. Since the relationship between the regression constant and the weights is unchanged from the case with no interactions, we need only consider the relationships between the quadratic weights and the other regression coefficients. These are given as follows:

$$\text{A.10} \quad \gamma_{ij} = \frac{-1}{a_j} \left[\sum_{h=1}^n r_{hj} b_{hi} \right] \quad \begin{matrix} i=1, \dots, n \\ j=1, \dots, m \end{matrix}$$

Since B is symmetric, there are $m + \sum_{i=0}^n (n-1)$ unknown and $m \times n$ equations. In general, the number of equations should be greater than the number of unknowns, making a solution impossible.⁶ However, if $m=4$ and $n=6$, a solution is possible. Appendix A outlines the specific methodology that will yield a solution and indicates how the weights can be derived when $m>4$.

B. Dynamic Welfare Function

The analysis can be made somewhat more realistic by assuming that the planner's time horizon extends far more than one period. Following Theil [20], it can be shown that maximizing a dynamic welfare function subject to the dynamic reduced form of the economy yields the following condition for a welfare maximum

$$\text{B.1} \quad (\bar{\alpha} + \bar{R}' \bar{\beta}) - (\bar{A} + \bar{R}' \bar{C}) (\bar{X} - \bar{X}^*) - (\bar{R}' \bar{B} + \bar{C}) (\bar{Y} - \bar{Y}^*) = 0.$$

⁶ For example, if $m=6$ and $n=6$, as it does in this paper, there will be 36 equations but only 27 unknowns.

therefore,

$$B.2 \quad \bar{x} = (\bar{A} + \bar{R}'\bar{C}')^{-1} [(\bar{\alpha} + \bar{R}'\bar{\beta}) - (\bar{R}'\bar{B} + \bar{C})\bar{y}]$$

where $\bar{x} = \bar{x} - \bar{x}^*$ and $\bar{x}$ and $\bar{x}^*$ are (mTx1) vectors of the actual and desired values of the policy instruments

$\bar{y} = \bar{y} - \bar{y}^*$ and $\bar{y}$ and $\bar{y}^*$ are (nTx1) vectors of the actual and desired values of the target variables

$\bar{R} = (mTxnT)$ block triangular matrix of reduced form coefficients

where each (nxm) R_{tk} submatrix consists of the reduced form coefficients of the impact of instrument j initiated in period t (note that R_{tk} is null if $k > t$)

$\bar{\alpha} = (mTx1)$ vector of linear instrumental weights

$\bar{\beta} = (nTx1)$ vector of linear target weights

$\bar{A} = (mTxmT)$ matrix of quadratic instrumental weights.

Each (mxm) submatrix $\bar{A}_{tk}$ can be interpreted as

the weights attached by the policy maker in time k

to the attainment of the desired instrument in time t .

$\bar{B} = (nTxnT)$ matrix of quadratic target weights. Similar

to the $\bar{A}$ matrix, each (nxn) submatrix $\bar{B}_{tk}$ can be

interpreted as the weights attached by the policy maker

in time k to the attainment of the desired targets in time t .

$\bar{C} = (mTxnT)$ matrix of weights attached to the interactions

of instrumental and target variables. Again $\bar{C}_{tk}$ can be

interpreted as the weight given to the interaction of the

instruments initiated in period k with the targets in

period t .

As was true in the static case, it is possible to express each x_{it} as a function of a constant term and a linear combination of the y 's. However, it should be clear that the complexity of the expression is such that it is impossible to derive the weights from the estimated coefficients without making some simplifying assumptions. Following the static case, however, it can be shown that the problem can be made tractable.

In particular $\bar{C}$ is assumed to be null, while $\bar{A}$ and $\bar{B}$ are assumed to be block diagonal. Thus, they only consist of $\bar{A}_{tt}$ and $\bar{B}_{tt}$ matrices. These represent the weights attached by the policy number in the t^{th} period to the attainment of the various goals in the t^{th} period. Because the first period is taken as a base these can be viewed as representing the weights in the first through the T^{th} period.

It may be useful to write out the system of equations in block form:

$$\begin{aligned} \text{B.3} \quad \bar{x}_1 &= \bar{A}_{11}^{-1} [(\bar{\alpha}_1 + \sum_{t=1}^T \bar{R}'_{t1} \bar{\beta}_t) - (\sum_{t=1}^T \bar{R}'_{t1} \bar{B}_{t1} \bar{y}_t)] \\ &\vdots \\ \bar{x}_T &= \bar{A}_{TT}^{-1} [(\bar{\alpha}_T + \bar{R}'_{TT} \bar{\beta}_T) - (\bar{R}'_{TT} \bar{B}_{TT} \bar{y}_T)] \end{aligned}$$

Thus, each x_{it} can be expressed as a linear function of all of the y 's. In terms of the regression analysis, this yields the following relationships:

$$\begin{aligned} \text{B.4} \quad x_j^1 &= \gamma_{0j}^1 + \sum_{i=1}^n \gamma_{ij}^{11} y_i^1 + \dots + \sum_{i=1}^n \gamma_{ij}^{T1} y_i^T + u_j^1 \quad j=1, \dots, m \\ &\vdots \\ x_j^T &= \gamma_{0j}^T + \sum_{i=1}^n \gamma_{ij}^{TT} y_i^T + u_j^T \end{aligned}$$

Where γ_{ij}^{tk} represents the regression coefficient associated with instrument j in period k and target i in period t

γ_{oj}^k represents the regression constant associated with instrument j in period k

x_j^k represents the deviation between the actual and desired values of instrument j in period k

y_i^t represents the difference between the actual and desired values of target i in period t

u_j^k represents the disturbance term associated with x_j in period h

Thus, T sets of regressions must be run. In the first set each x_t is regressed upon all of the $y_t, y_{t+1}, \dots, y_{t+T}$; in the second set each x_{t+1} is regressed upon all of the $y_{t+1}, y_{t+2}, \dots, y_{t+T}$; and in the last set each x_{t+T} is regressed upon each y_{t+T} . Thus, the solution of the T^{th} period weights is entirely analogous to the static case. Since each set of k regressions ($k=1, \dots, T$) is block triangular, it is possible to substitute backward from the T^{th} block to derive all of the weights. The specific methodology used when B is diagonal and when B is non-diagonal is given in Appendix A.

III. Macro Policy Weights in the Postwar Period

A. The Regression Analysis

The period of this analysis covers the peace-time Eisenhower and Kennedy-Johnson years. As such it attempts to concentrate on a period

where economic considerations were not dominated by other factors. Specifically, the sample period covers 1954.I through 1964.IV.⁷

1. The Form of the Regressions

Because Republican and Democratic administrations are likely to place different weights on different targets and instruments, dummy variables were introduced to take these differences into account. Moreover, if there is reason to believe that a given administration changed its attitude toward certain target or instrumental variables, additional dummy variables should be introduced. Finally, because some of the series have a strong seasonal component, a dummy variable should be introduced to take this into account.

The regression analysis was performed to correspond to a static and a dynamic welfare function, whose time horizon was assumed to extend for only two periods because of the limited number of observations. In the case of the static welfare function, the weights are derived according to equation

A.6 by regressing each x_t upon all of the y_t 's (r.1). In the case of the dynamic welfare function, the weights are derived according to equation

B.4. Thus, the first period weights are derived from the regressions of each x_t upon all of the y_t 's and y_{t+1} 's (r.2); the second period weights are derived from the regressions of each x_{t+1} upon all of the y_{t+1} 's (r.3). Note that while the forms of the regressions in (r.1) and (r.3) are the same, the observations included in the regressions are not.

⁷ There may be some question whether it is more appropriate to use quarterly or annual data. Use of quarterly data implies that the policy-maker revises his decisions every quarter, while use of annual data implies that he revises his decisions annually. In view of special budget messages and tax proposals that are submitted to Congress in response to changing economic conditions, it seems clear that the decision-making period is considerably less than a year. Hence, it seems more reasonable to use quarterly than annual data in this analysis.

The specific regression equations that were estimated took the following form:

$$(r.1) \quad x_j^t = \gamma_{0j}^t + d_1 + s + \sum_{i=1}^n \gamma_{ij}^t y_i^t + \sum_{i=1}^n \lambda_{ij}^t d_1 y_i^t \quad j = 1, \dots, m \\ + \mu_{4j}^t d_2 y_4^t + u_j$$

$$(r.2) \quad x_j^t = \gamma_{0j}^t + d_1 + s + \sum_{i=1}^n \gamma_{ij}^t y_i^t + \sum_{i=1}^n \lambda_{ij}^t d_1 y_i^t \quad i = 1, \dots, m \\ + \sum_{i=1}^n \gamma_{1j}^{t+1} y_i^{t+1} + \sum_{i=1}^n \lambda_{ij}^{t+1} d_1 y_i^{t+1} \\ + \mu_{4j}^t d_2 y_4^t + \mu_{4j}^{t+1} d_2 y_4^{t+1} + u_j$$

$$(r.3) \quad x_j^{t+1} = \gamma_{0j}^{t+1} + d_1 + s + \sum_{i=1}^n \gamma_{ij}^{t+1} y_i^{t+1} + \sum_{i=1}^n \lambda_{ij}^{t+1} d_1 y_i^{t+1} \\ + \mu_{4j}^{t+1} d_2 y_4^{t+1} + u_j \quad j = 1, \dots, m$$

where $d_1 = 1$ for 61.I - 64.IV; 0 otherwise
 $d_2 = 1$ for 58.I - 60.IV; 0 otherwise
 $s = 1$ for QI and QII; 0 otherwise
 u_j^t, v_j^t, u_j^{t+1} = random disturbance terms.

The dummy variable d_1 serves to shift the coefficients for the Democratic administration. Thus, in deriving the weights for the Eisenhower years, the appropriate regression coefficient to use is γ_{ij}^{tk} ; for the Kennedy-Johnson years, the appropriate regression coefficient is $\gamma_{ij}^{tk} + \lambda_{ij}^{tk}$.

The dummy variable d_2 attempts to capture the concern with the balance of payments that began in 1958. This concern is assumed to affect the importance of the short-term interest rate (y_4); as the balance of payments deteriorated, the government paid more attention to interest-rate policy.⁸

The question of the seasonal adjustment is a difficult one. Where seasonally adjusted data were readily available, they were used since it was felt that the policy-maker probably used seasonally adjusted data in making his decisions. Similarly, where seasonally adjusted data were not available, no attempt was made to adjust them. In this case, it was felt that the policy maker made his decisions on the basis of seasonally-unadjusted data. However, because several series had strong seasonal components, an unadjusted⁶ seasonal dummy variable was introduced. It has the effect of assuming that the policy maker's linear weights change from one half of the year to the other. While this may seem unreasonable, seasonal adjustments have that implicit effect (e.g., an increase in the unemployment rate in June when students are looking for jobs is discounted by a seasonal adjustment). The introduction of the seasonal dummy merely makes seasonal discounting explicit.

2. The Variables

Having outlined the form of the regression equations, it is necessary to define the x 's and the y 's explicitly. Note that $x_j = X$;

⁸The balance of trade variable (y_5) does not utilize d_2 , because desired and actual values of the balance of trade were assumed to coincide until 1958. Therefore, adding the dummy variable d_2 to this variable does not add additional information.

- X_j^* and $y_i = Y_i - Y_i^*$; each variable used in the regression analysis is the difference between the actual and desired values of the appropriate target or instrumental variables.⁹

The actual estimation of the weights should be quite sensitive to the specification of the actual and desired value of the instrumental and target variables. Desired values that are never achieved will cause the observed weights to be relatively low; desired values that are quite high will cause the observed weights to be relatively high. Similarly, if important target or instrumental variables are omitted, the resulting misspecification of the welfare function will cause the observed weights to be biased.¹⁰

Ideally all possible targets and instruments should be included in the analysis and their relative weights determined empirically. However, there are two major constraints imposed upon the range of variables chosen for study. First, since a knowledge of the reduced form coefficients associated with the targets and instruments is essential, they must be used in existing econometric models.¹¹ Second, it must be possible to infer the desired values of the relevant variables from government sources or published

⁹ Because there is not usually one obvious specification of the desired or actual target or instrumental variable, several definitions of the variables were used in estimating the regression equations. The variables given here represent those used in the final analysis and were chosen on the basis of over-all goodness-of-fit, t-statistics, F-ratios, etc.

¹⁰ Of course, the biases caused by omitted variables may be insignificant compared to those caused by the misspecification of the welfare function itself.

¹¹ In principle, this restraint could be eased by building an econometric model that encompassed all of the relevant targets and instruments. However, this was beyond the scope of the present study.

statements of policy makers. The first consideration precluded the inclusion of the balance of payments as a target variable; the second consideration precluded the inclusion of such monetary instrumental variables as the maximum rate on time deposits.

Six instruments and six targets were included in this analysis. The general considerations that led to their choice and the specification of their actual and desired values is given below. Detailed definitions of these variables are given in Appendix B.

a. Target variables

i) Unemployment Rate (E). The actual unemployment rate was measured by the percentage of the civilian labor force unemployed, while the desired unemployment rate was taken to be a constant 4.0%.

ii) Desired Rate of Growth (Y). GNP is used as a proxy for the rate of growth of income. Thus, the gap between potential or capacity GNP and actual GNP is indicative of the gap between the potential and actual rates of growth. Actual GNP is defined in 1958 dollars, seasonally adjusted at annual rates. Desired GNP is taken as defined by the CEA in the 1968 Economic Report of the President.

iii) Prices (P). The implicit price deflator was taken to represent price movements. Since some rise in the GNP deflator seems to be accepted as normal, a 2% rate of growth of prices, using 1958 as a base, was taken to represent the desired values of this variable.

iv) Short-term Interest Rate (RS). The actual value of this variable is given by the three-month treasury bill rate. The definition of

the desired values of this variable is difficult because the Federal Reserve Board fails to make its preferences known. Until the early 1960's, considerable weight seems to have been placed upon "the stability of the market." More recently, the balance of payments problem appears to have made the Fed sensitive to the rate structure. To the extent that market stability is important, the desired interest rate can be defined as last period's rate. Rather than change the definition of the desired interest-rate variable over the sample period, it was felt that the dummy variables would reflect the changing weight given to the "stability of the market."

v) Balance of Trade (BT). Because no econometric model has a balance of payments variable, the balance of trade was used as a proxy. The desired balance of trade was taken to equal the actual balance of trade until 1958. After that, the desired balance of trade in a given period was defined to equal the previous period's balance of trade. This definition implies that the government did not want any deterioration in its balance of trade in view of the deficits it was incurring on the capital account.

vi) Government Surplus or Deficit (SD). In considering the government deficit (and government expenditures and corporate taxes), probably the most important question is whether the administrative budget, the cash budget, or the NIA budget is relevant. For ex ante policy purposes the NIA budget can probably be discarded since it is constructed ex poste. Thus, there is no way to measure its desired values. However, projections of both the cash and administrative budgets are made in the annual budget message. Since these presumably incorporate desired expenditures and desired taxes (they assume that requested legislation is passed), they can also be

used to measure the desired surplus. Whether the cash or administrative budget is more relevant is difficult to say. While economists are agreed that the administrative budget tells little about the impact of the government upon the economy, it may well be that the policy maker is myopic and considers the administrative surplus (or even expenditures). The regression analysis indicated that this was indeed the case with regard to the government surplus, whose actual and desired values were defined in terms of the administrative budget.

b. Policy instruments

i) Government Expenditures (G). Again, it is necessary to determine whether the cash or the administrative definition of expenditures is relevant. In this case, the regression analysis indicated that the cash definition of expenditures performed better. The actual and desired value of expenditures were, therefore, defined according to the cash budget. Note that this implies that the policy maker is inconsistent since he is assumed to consider the administrative surplus, but cash expenditures in making his decisions.

ii) Personal Tax Rate (PT). Definition of the personal tax rate is difficult because it is not clear whether the statutory rate(s) or the effective rate is relevant. The statutory rate structure is the policy instrument, since this is changed by legislation. In this case, the first bracket rate would probably be the most relevant rate since it accounts for approximately 80% of all revenues. However, most econometric models use the effective personal tax rate as a variable. Since personal tax collections are not entirely exogenous, the use of this variable obviously creates

problems. Nevertheless, at the moment there does not seem to be a viable alternative. Desired values of the personal tax rate were derived by dividing the personal tax receipts projected in the budget document by the actual levels of personal taxable income.

iii) Corporate Tax Rate (CT). Although the marginal corporate rate is the true policy variable, its stability over the sample period made it unsuitable for this analysis. However, because of the volatility of corporate profits, the effective corporate rate is not entirely suitable either. Nevertheless, the problems associated with using the effective corporate rate were thought to be less than those using the marginal corporate rate. Thus, the actual corporate tax rate was defined as corporate tax receipts divided by corporate profits plus depreciation. The desired rate was defined as projected corporate tax receipts divided by corporate profits plus depreciation. In both cases, tax receipts were defined in terms of the administrative budget, which does not differ from the cash budget in this regard.¹²

iv) Rediscount Rate (RD). The rediscount rate is the rate charged to member banks when they borrow from the Fed. As such, it represents the cost of borrowing reserves. However, banks need not go to the discount window to obtain reserves, but can use the federal funds market. Thus, in some sense the rediscount rate represents the desired rate for member bank borrowing, while the federal funds rate can be said to reflect the actual rate that banks must pay if they avoid the discount window.

¹² However, there are substantial differences in the definition of corporate tax receipts in the NIA and the administrative budgets. Since the reduced form coefficients are based on econometric models that use the NIA data, these coefficients may not be entirely appropriate to use in this analysis.

v) Open Market Operations (NFR). There is considerable controversy in the literature over the proper definition of the variable that expresses changes in open market operations. Net Free reserves is an obvious candidate, but others have also been offered: unborrowed reserves plus currency [1], unborrowed Reserves [10], and Non-defensive changes in Reserves [20].¹³ The problem associated with using any of these variables is simply that there is no way of determining the desired values of these variables. Nevertheless, the recently published minutes of the Open Market Committee give sufficient information to derive a series on target values of net free reserves from 1954 to 1964.¹⁴ Thus, net free reserves are used as proxies for open market operations. The actual values of this variable are given by the unrevised data, which presumably reflects the information facing the policy makers at their time of decision. The target values of this variable are inferred from the OMC minutes.

vi) Reserve Requirements (RR). Reserve requirements play something of a proxy for the money supply. If member banks had no excess reserves, the money supply could easily be inferred from the required reserve ratios of the member banks. Since this would define the maximum money supply, in some sense it could also be said to represent the desired money supply. However, because banks generally do have some excess reserves, the actual money supply will differ from the maximum or target money supply. Similarly the actual

¹³For a full discussion of the "indicator problem" see Brunner and Meltzer [3].

¹⁴The minutes of the Federal Reserve Open Market Committee contain statements from which the desired value of net free reserves can be inferred. For a full discussion, see Fand and Buhler [11].

reserve ratio will differ from the minimum or target reserve ratio. Thus, the legal reserve ratios are taken to reflect desired values while the actual reserve ratios reflect the actual values.

3. The Regression Equations

Table 1 gives the regression equations used in the static analysis, while Tables 2 and 3 give those used in the dynamic analysis. In general, the R^2 's are high, the F's are significant, and the Durban-Watson statistics indicate no serial correlation of the residuals.¹⁵ However, a great many of the specific coefficients are not significantly different from zero. This need not be a cause for concern, however. An insignificant dummy variable simply means that the behavior of the administrations did not change over the sample period or that there was no strong seasonal component in the dependent variable. However, if the coefficient associated with a non-dummy variable is insignificant, nothing can be inferred about the behavior of the government;¹⁶ all that can be said is that the coefficient is not significantly different from zero.

The regression equations given in Table 1 can roughly be thought of as reaction functions similar to those estimated with respect to the Federal Reserve System.¹⁷ As such, they indicate how policy instruments will react

¹⁵ Note that this was not the case with respect to net free reserves or reserve requirements.

¹⁶ For example, when the B-matrix is nondiagonal, $\gamma_{ij} = 1/a_j$

$$\left[\sum_{i=1}^h r_{hi} b_{hi} \right] (i=1, \dots, n; j=1, \dots, m). \text{ Since } r_{ij} \geq 0 \text{ and } b_{ij} \geq 0,$$
there is no reason why these terms could not sum to zero.

¹⁷ See Havrilesky [14], Johnson and Dewald [16], Reuber [19], Wood [23], Christian, [4].

Table 1

Static Welfare Function

Regression Equations Used to Derive

Static Welfare Weights (x_t Regressed Upon y_t)

Dependent Variables (Instrumental Variables)

	G		PT		CT		RD		NFR		RR	
	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.
C	4.6999	1.6896	.1000	2.138	.0549	.844	.0351	.106	1.2351	4.305	.0013	1.386
d_1	4.1933	.343	-.0099	.047	-.1975	.684	-.5963	.406	-2.5862	2.035	.0064	1.449
S	-2.5202	2.683	-.0465	1.919	-.2808	8.357	-	-	-	-	-	-
E	-2.0941	1.573	.0271	1.344	-.0600	2.146	-.2726	2.037	-.0379	.328	-.0005	1.185
d_1E	12.4401	2.829	-.0011	.018	.1594	1.878	-.0823	.203	-.5272	.150	.0015	1.023
d_1Y	-.0247	.199	.0037	1.839	-.0049	1.737	-.0029	.211	.0278	2.354	-.0001	2.447
d_1Y	.7334	1.970	-.0014	2.420	.0075	.930	.0040	.049	-.0383	1.106	.0016	1.327
d_1P	.8523	1.079	.0205	1.604	-.0288	1.628	.0451	.526	.3261	4.394	-.0013	5.106
d_1P	.4513	.200	-.0184	.490	-.0269	.516	-.2949	1.119	-.6057	2.641	.0023	2.849
d_1PS	21.0405	5.7550	.1217	1.249	-.1733	1.284	-.1930	.280	.6776	1.138	-.0045	2.591
d_1RS	5.7550	.352	-.1188	.435	.7198	1.901	.4732	.251	-.3196	1.964	.0072	1.303
d_2RS	-14.2215	2.840	-.0161	.183	.2881	2.360	-.0830	.133	-.1633	.304	.0042	2.338
d_1BT	-.0237	.495	.0246	3.073	-.1434	1.296	.0075	.132	.0774	1.583	-.0003	1.642
d_1ET	.8455	1.234	.0271	2.420	-.0189	1.218	.0477	.602	-.7321	1.069	.0003	1.373
d_1SD	-.5014	5.183	.0022	2.240	.0001	.044	-.0030	.691	.0021	.550	.0000	1.139
d_1SD	-.0720	-.4760	-.0005	.581	-.0041	3.204	.0065	.979	-.0001	.231	.0000	.360

 R^2

F

DW

Se

.3312

9.1942

1.9956

1.9422

.9209

21.7360

1.9052

.0447

.7141

5.1734

1.780

.2281

.7828

7.4660

1.0959

.1971

.7620

6.6336

.9642

.00007

Dynamic Welfare Function

Regressions Used To Derive First-Period Weights
(x_t regressed upon y_t, y_{t+1})

Dependent Variables (Policy Instruments)

	G			CT			RD			NFR			RR		
	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	
C	4.5929	1.098	.1818	2.603	.1933	2.020	-.6657	1.952	1.2658	3.263	.00397	2.636			
d ₁	43.7836	1.094	.2572	.366	.1634	.169	-6.0104	1.772	-3.4165	.886	.00550	.367			
E _t	-1.6234	.837	-.0276	.740	-.1210	2.372	-.1037	.631	-.1610	.931	-.0000	.007			
d ₁ E _t	14.0143	2.702	.0465	.592	.2194	2.037	-.5729	1.647	.1506	.381	.00011	.072			
l ₁ E _t	-.0067	.032	.0033	.362	.0094	1.797	-.0003	.018	.0406	2.390	-.0006	.915			
d ₁ l ₁ E _t	1.3883	1.664	.0041	.257	.0181	.823	.1205	1.628	-.0527	.628	.00005	.157			
p _t	-3.2168	1.392	.0136	.467	-.1182	2.158	-.1342	.708	.4117	1.912	-.00150	1.746			
d ₁ p _t	13.2923	1.389	.0876	1.299	-.0456	.312	-.9407	1.764	-.3628	.599	.00300	1.267			
r _t	19.5552	2.273	.2292	1.299	-.2322	.961	.9011	1.809	2.1837	2.323	-.01133	3.100			
d ₁ r _t	20.3202	.972	.0228	.067	.8994	1.904	-2.1021	1.252	-1.5874	.833	.01125	1.516			
d ₂ r _t	-11.8035	1.768	0.0638	.507	.3802	2.207	-.7746	1.259	-.8134	1.164	.00780	2.870			
BT _t	.1509	.284	-.0153	1.613	-.0014	.109	.0097	.209	.1226	2.330	-.00027	1.309			
d ₁ BT _t	.4421	.514	.0216	1.408	.0225	1.072	.0061	.079	-.1093	1.256	.00033	.972			
SD _t	-.5174	4.309	.0021	1.745	-.0018	1.086	.0032	.720	.0078	1.550	-.00005	2.317			
d ₁ SD _t	-.0210	.090	-.0011	.613	-.0032	1.269	-.0075	.810	-.0105	1.002	.00003	.612			
E _{t+1}	1.2209	.559	.0995	2.511	.1140	2.099	-.2153	1.106	.4218	1.907	-.00004	.043			
d ₁ E _{t+1}	13.1011	1.424	.0240	.124	-.0407	.153	-1.2750	1.343	-.4797	.945	.00090	.214			
l ₁ E _{t+1}	.0415	.274	.0046	1.718	.0101	2.752	-.0261	2.068	-.0021	1.46	.00007	1.208			
d ₁ l ₁ E _{t+1}	.8863	1.711	.0032	.330	-.0071	.545	-.0483	1.031	-.0037	.069	.00004	.192			
p _{t+1}	4.1619	2.105	.0199	.565	.1085	2.250	.9609	.347	-.0039	.020	.00054	.695			
d ₁ p _{t+1}	-6.8120	1.286	-.0070	.519	.0876	.476	-.2674	.411	-.4788	.648	-.00076	.263			
r _{t+1}	2.1255	.309	-.0210	.196	-.2761	1.391	.8980	1.429	1.5616	2.188	-.00054	1.935			
d ₁ r _{t+1}	31.4917	1.157	.3868	.597	.3786	.424	-5.4803	1.768	-2.0629	.586	.00590	.431			
d ₂ r _{t+1}	-2.3314	.111	.0458	.353	.2166	1.199	-1.3283	2.260	-1.5012	2.249	.00514	1.979			
BT _{t+1}	.0952	.159	.0009	.094	.0189	1.389	.0017	.023	.0928	1.712	.00008	.358			
d ₁ BT _{t+1}	.1010	.111	.0042	.261	.0025	.1121	-.0352	.742	-.0789	.943	.00001	.017			
l ₁ SD _{t+1}	.1233	1.272	.0003	.249	-.0088	.708	.0043	.954	.0159	3.118	-.00005	2.347			
d ₁ SD _{t+1}	.0797	.275	-.0014	.841	-.0001	2.707	-.0207	.255	-.0180	1.954	.00004	1.206			
l ₁ S	2.5473	1.725	-.0637	.160	-.3482	6.375	-	-	-	-	-	-			

Table 2 continued

	G		PT		CT		RD		NFR		RR	
	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.
R2	.9175		.9145		.9609		.9256		.9026		.8681	
F	5.5625		5.3513		12.2828		6.9123		5.1500		3.6579	
LM	2.4563		2.3780		2.0454		2.2711		1.8040		1.4007	
Sc	1.8939		.0323		.0943		.1616		.1335		.00074	

Dynamic Welfare Function

Regressions Used to Derive Second-Period Weights

$$(x_{t+1}) \text{ regressed upon } y_{t+1}^{(1)}$$

Dependent Variables (Instrumental Variables)														
	PT			CT			RD			NFR			RR	
	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.	coef.	t-stat.
C	4.3631	1.676	.0935	2.036	.0520	.775	.0537	.193	1.2661	4.533	.0022	2.384		
d ₁	5.4099	.421	-.0223	.110	-.2224	.719	-1.5043	1.079	2.5730	2.010	.0045	1.062		
S	-2.5130	2.563	-.0623	2.561	-.2882	7.914	-	-	-	-	-.0008	1.573		
E	-1.9974	1.432	.0192	.931	-.0635	2.168	-.2591	2.109	-.0203	.181	-.0004	1.025		
d ₁ E	13.1632	2.632	.0131	.209	.1577	1.685	-.4840	1.196	-.0507	.136	.0013	.947		
Y	-.0161	1.231	.0030	1.541	-.0052	1.774	-.0015	.121	.0296	2.569	-.0001	1.935		
d ₁ Y	.7334	1.920	-.0006	.0746	.0713	.813	-.0310	.790	-.0364	1.067	.0001	1.008		
P	.8636	1.059	.0183	1.549	-.0247	1.624	.0414	.526	.3212	4.450	-.0012	4.963		
d ₁ P	.7341	.308	-.0226	.606	-.0321	.575	-.4506	1.792	-.5927	2.567	.0015	2.613		
RS	19.3853	3.268	.2053	2.059	-.1388	.923	-.5169	.766	.2546	.411	-.0045	2.188		
d ₁ RS	6.0754	.3580	-.1588	.693	.7081	1.309	.3954	.515	.0984	.062	.0074	1.371		
d ₂ RS	-13.1482	2.246	-.0931	1.063	.2548	1.853	.2570	.413	.2814	.492	.0034	1.805		
BT	-.0214	.043	-.0244	3.204	-.0143	1.252	.0080	.154	.0280	1.642	-.0002	1.273		
d ₁ BT	.8941	1.249	.0271	2.508	.0183	1.128	.0163	.229	-.0722	1.070	.0002	1.100		
d ₁ SD	-.4922	4.381	.0016	1.725	-.0002	.166	-.0023	.560	.0031	.829	-.0001	2.754		
d ₁ SD	-.0580	.364	-.0014	.436	-.0042	3.021	.0203	.325	-.0021	.370	.0000	.902		
R ²	.8166		.8469		.9169		.7735		.8047		.8024			
F	7.7168		9.5899		19.1310		6.5857		7.9470		7.0406			
DW	1.9653		1.7611		1.9136		2.0437		1.2160		1.381			
Se	1.9995		.0307		.04597		1.1754		.1916		.0004			

to changes in target variables. However, they differ from those of previous studies in that the dependent variables measure differences between the actual and desired values of the policy instruments. Therefore, the expected sign of the independent variables (which measure differences between the actual and desired values of the target variables) is generally ambiguous. For example, the unemployment coefficient in the government expenditure equation for the Eisenhower years indicates that an increase in the gap between actual and desired levels of unemployment will lead to a reduction in the gap between the actual and desired levels of government expenditures. This indicates that actual expenditures increase faster than desired expenditures in the face of rising unemployment. However, a priori, it is equally plausible that desired expenditures would increase faster than actual expenditures. Similar problems occur with interpreting the sign of the other coefficients of each regression.

More generally, the analysis of this paper indicates that individual reaction functions have little meaning as such. Since the government rarely acts on a given policy instrument independent of the others, each relationship between the targets and the instruments expresses a complex relationship between the weights and the reduced-form coefficients. Therefore, to understand the government's behavior, it is necessary to analyze the totality of the "reaction functions." It is to such an analysis that we will now turn.

B. The Structure of the Economy

An integral part of the analysis is the assumption that the policy maker is aware of the structure of the economy and has at his command the

reduced-form coefficients relating the instruments to the targets. Since, however, the policy maker even now is not entirely sure what impact a change in a given policy instrument will have upon the various target variables, it is likely that he was even less certain during the period of analysis when econometric models were in a primitive stage at best. Nevertheless, assuming that the reduced-form coefficients were known throughout the sample period, enables us to estimate the weights implied by the policy maker's behavior. Note, however, that irrational behavior on the part of the policy maker may indicate imperfect knowledge of the structure of the economy rather than a failure to maximize with respect to economic policy.

Because the MIT-FRB model is oriented toward policy decisions, it was chosen as representing the underlying structure of the economy. While use of this model presents certain empirical problems, these appear to be less than those associated with other models (e.g., Wharton [10], OBE [18], Brookings-SSRC [9], Ando-Goldfeld [1]).

First is the problem of estimating the reduced form coefficients. Because the MIT-FRB model contains many non-linearities, it does not have a unique reduced form. Although the model could be linearized around a given point in time, the resulting reduced-form coefficients would only apply for that point of time. Obviously this problem would also exist if impact multipliers were derived through simulation experiments. However, it is considerably easier to estimate the impact multipliers associated with the MIT-FRB model than to derive comparable reduced form coefficients. Consequently, simulation experiments were made for the time period beginning

1957.IV and 1961.I to reflect the response of the target variables to changes in the policy instruments in the Eisenhower and Kennedy administrations.¹⁸ While the impact multipliers derived from simulation experiments are not strictly reduced-form coefficients, the link between the two is probably sufficiently strong that relatively little bias is introduced by using the impact multipliers to derive the weights.

Second is the problem of the incompatibility of the data used in the MIT-FRB model and this analysis. Because the MIT-FRB model uses NIA data, the impact multipliers derived from this model will not strictly correspond to the impact multipliers implied by the analysis. For example, the multipliers associated with the corporate tax variable using NIA data should differ from those using Treasury data. Moreover, in the case of the corporate tax rate and net free reserves, the variables used in this analysis had a different definition from those used in the MIT-FRB model. While both of these problems could be solved by re-estimating the MIT-FRB model, using different data and different definitions to correspond to this analysis, this undertaking was thought to be beyond the scope of the present study.

Table 4 gives the first and second quarter impact multipliers used to derive the weights. In general, they appear to be comparable to those estimated for the Ando-Goldfeld [1] and Brookings-SSRC [12] models.

¹⁸ These two quarters were chosen since they represent the turning point of the economy. While different periods of simulation would have yielded different impact multipliers, it was felt that these two experiments were representative.

Table 4

Multipliers Used in Weight Derivation*

		First period impact multiplier of instrument on targets when instrument is:						Second period impact multiplier of instrument on targets when instrument is:					
		G	PT	CT	Rd	NFR	RR	G	PT	CT	Rd	NFR	RR
Eisenhower													
years	a)												
E		-.1240	.1000	.0090	.0200	.0550	.0680	-.0720	.0310	.0090	.0020	-.0910	.1050
Y		1.9011	-1.4758	-.1511	-.0271	.9200	-1.1480	.3679	.0429	-.1170	-.0439	1.3442	-1.5029
P		-.0070	.0080	-.0030	-.0010	-.0040	.0070	.0120	-.0120	-.0030	.0010	-.0110	.0100
RS		-.0570	-.0540	-.0060	.0230	-.6320	.6230	.0120	-.0100	-.0070	-.0010	-.0270	.0269
BT		-.1260	.1190	.0090	.0020	-.0540	.0610	-.0210	.0050	.0090	.0010	-.0750	.0780
SD		-.1240	.1000	.3590	-.0090	.3090	-.3830	-.0760	.0310	-.0500	-.0120	.4310	-.9830
Kennedy													
years	b)												
E		-.1100	.0900	.0080	.0010	-.0340	.0410	-.0310	.0330	.0060	.0010	-.0590	.0630
Y		1.6834	-1.6367	-1.379	-.0210	.7270	-.8298	.3076	-.0593	-.1055	-.0347	1.0308	-1.7045
P		-.0230	.0200	-.0030	0.0	-.0080	.0090	0.0	-.0050	-.0020	.0010	-.0120	.0140
RS		-.1260	-.0460	-.0050	.0240	-.6280	.5710	.0140	-.0090	-.0040	-.0010	-.0030	.0580
BT		-.1260	.1190	.0090	.0020	-.0540	.0610	-.0210	.0050	.0090	.0010	-.0750	.0780
SD		-.1110	.0900	.3780	-.0090	.2710	-.3570	-.0300	.0330	-.0330	-.0100	.3620	-.3280
		* E = Unemployment rate in percent						G = Government Expenditures in billions					
		Y = GNP, billions of dollars						PT = Effective personal tax rate in percentage points					
		P = Price index i.e., 1958 = 100.0						CT = Effective corporate tax rate in percentage points					
		RS = Short term interest rate in percentage points						Rd = Rediscout rate in percentage points					
		BT = Balance of Trade in billions of dollars						NFR = Net free reserves in billions of dollars					
		SD = Federal surplus in billions						RR = Required reserve ratio					
a)		Derived from simulation experiments with MIT-FRB model, with 1957.IV used as initial time period.											
b)		Derived from simulation experiments with MIT-FRB model with 1961.I used as initial time period.											

* E = Unemployment rate in percent

Y = GNP, billions of dollars

P = Price index i.e., 1958 = 100.0

RS = Short term interest rate in percentage points

BT = Balance of Trade in billions of dollars

SD = Federal surplus in billions

G = Government Expenditures in billions

PT = Effective personal tax rate in percentage points

CT = Effective corporate tax rate in percentage points

Rd = Rediscunt rate in percentage points

NFR = Net free reserves in billions of dollars

RR = Required reserve ratio

a) Derived from simulation experiments with MIT-FRB model, with 1957.IV used as initial time period.

b) Derived from simulation experiments with MIT-FRB model with 1961.I used as initial time period.

C. The Estimated Weights

Given the regression coefficients and the impact multipliers, it is possible to derive the weights under four specifications of the welfare function: 1) Static welfare function, B-matrix diagonal; 2) Dynamic welfare function, B-matrix diagonal; 3) Static welfare function, B-matrix non-diagonal; 4) Dynamic welfare function, B-matrix non-diagonal.

Before turning to the empirical results, however, it may be useful to discuss briefly the expected sign of the weights.

The linear weights can be either positive or negative, depending upon whether increases in the difference between the actual and desired values of the variables increase or reduce welfare. For example, the weight associated with income should be positive; that associated with the unemployment rate should be negative.

The own-quadratic weights should be positive since any reduction in the squared deviation of actual from desired values should increase welfare. However, this need not always be the case. For example, as income rises above its desired values, welfare should increase. But, a positive own-quadratic weight would indicate that welfare would decline in this case. Similarly, as unemployment falls, welfare may well increase, even though the gap between actual and desired values is increasing. Positive own-quadratic weights indicate that the policy maker is indifferent between positive and negative movements with regard to the given variables. While this may well be the case, it is not necessarily so.

The signs of the off-diagonal quadratic weights are difficult to determine a priori. They may be positive or negative, since they indicate the

direction of the change in welfare resulting from change in the gap between actual and desired values of a given variable, given the existing gap between the actual and desired values of another variable. For example, the sign of the weight reflecting the interaction between unemployment and income should be positive. As unemployment rises, the utility derived from a given increase in income should rise. Similarly the weight reflecting the interaction between unemployment and prices should be negative. As unemployment rises, the disutility derived from price increase should increase (or the utility should fall). Similar considerations make it possible to outline the expected sign of the interaction weights between the target variables. These signs are given in Table 5. The question marks indicate that the sign is ambiguous. For example, as income increases, the utility derived from an increase in interest rates may rise or fall, depending upon how the policy maker views a rise in interest rates per se.

Table 5

Expected Sign of Quadratic Weights
Associated with Target Variables

	E	Y	P	RS	BT	SD
E	+	+	-	?	-	-
Y		+	+	?	+	+
P			+	?	+	+
RS				+	?	?
BT					+	?
SD						+

Tables 6, 7, and 8 give the weights derived in the static and the dynamic cases where the target matrix is assumed to be diagonal. The results are generally unreasonable. The quadratic weights are often negative indicating that the policy maker views an increase in the gap between desired and actual with favor. While this could be reasonable if the gap were widening in a positive direction throughout the sample period (e.g., income was always above its desired level), this was not the case for any of the variables whose sign is "wrong." The linear weights are not much more reasonable. The target weights are generally all positive, which also goes against expectations. Thus, if the policy maker used the welfare function indicated here, one would have to conclude that he was not maximizing with respect to economic policy.

If, however, the target matrix is assumed to be non-diagonal and to contain interaction terms, the situation looks considerably brighter. Tables 9, 10, 11 give the policy weights in the case of the static welfare function, while Tables 12, 13, and 14 give the second period weights in the case of the dynamic welfare function.¹⁹ Several points should be made in interpreting these tables. First, because the weights could only be derived when the number of targets is 6 and the number of instruments is 4, there are two sets of estimates: one using primarily fiscal instruments, government expenditures (G), personal income taxes (PT), corporate income taxes (CT), and net free reserves (NFR); and one using primarily monetary instruments, government expenditures (G), net free reserves (NFR), the

¹⁹The first-period weights in the dynamic case have not yet been derived.

rediscount rate (RD), and reserve requirements (RR). Second, in deriving the linear weights the two sets of instrument-weights were combined to derive a set of six weights rather than four weights. In each set, the overlapping weights (G, NFR) should be different, while the non-overlapping weights should be the same (PT, CT, RD, RR). However, because the weights were normalized in G, NFR is the only weight that is not common to the two sets of the instrument weights. Finally, all of the quadratic target weights are normalized as a factor E20, while all of the other weights are in standard form. Thus, relative to the quadratic target weights, all the other weights are insignificant.

Because all the weights are insignificant relative to the quadratic target weights it may be acceptable to dismiss them. However, it should be pointed out that their signs are roughly comparable to those of the previous case, particularly with regard to the linear target weights. This consistency is encouraging, but indicates that the policy maker was not concerned with linear deviations from the desired values of the policy variables.

The difference between the quadratic target weights in the two welfare functions is startling and needs some explanation. Probably the most plausible is that the matrix used to derive the non-diagonal target weights is close to non-singular and, therefore, has large elements in its inverse. However, the discrepancy between the magnitude of the target and the instrument weights is puzzling in this case.

The relative magnitude of the quadratic weights generally conforms to a priori expectations, but there are some surprises. The Kennedy-Johnson administration gave relatively more weight to full employment than the

Eisenhower administration. However, all administrations seemed to value price stability the most highly, with the relative weight being the greatest for the Kennedy-Johnson administration. In view of the general feeling that Republicans tend to view price stability as more important than full employment, this finding is somewhat surprising. Moreover, in all cases the income weight is quite low, indicating that neither administration viewed income growth as being very important per se. Of course, the sample period ended prior to the 1964 tax cut, and therefore, neglects the income growth in the latter part of the 1960's. The weight attached to the balance of trade variable increases throughout the period and is quite high for the Kennedy-Johnson years, indicating that the balance of payments problem was a prime concern in the 1960's. Finally, neither the interest rate nor the surplus variables were weighted highly in either administration.

Comparison of the weights derived using the "fiscal" and the "monetary" instruments is interesting. Roughly, each set of weights can be interpreted as the Treasury weights and the Federal Reserve weights. In all periods, the Fed seems to give relatively more weight to employment and income and less to prices than does the Treasury. In the Eisenhower years, the Fed gave relatively more weight to the balance of trade, while during the Kennedy-Johnson years, the Treasury seemed to give relatively more weight to the balance of trade. Finally, for the Kennedy-Johnson years, all of the Treasury weights are high relative to the Fed weights, while for the Eisenhower years, these relative magnitudes are reversed. Thus it would appear that the Democrats placed primary emphasis on fiscal policy, the Republicans on monetary policy.

Summary and Conclusions

In conclusion then, the government does appear to be maximizing in a rough sort of a way with regard to economic policy and does seem to consider interactions between the target variables. Thus, the government not only seems to care about the magnitude of the deviations of the target variables from their desired values, but also about the relative magnitudes of these deviations. In contrast, the relationship between the actual and desired values of the policy instrument seems to be of less concern. With regard to specific targets, Democrats do seem to care more about full employment than Republicans, but they also seem to care more about price stability too. In fact, during the period between 1960 and 1964 price stability and the balance of payments seem to have been the prime concern of the Kennedy-Johnson administration.

Of course, the tentative nature of these findings must be stressed. Doubtless other specifications of the welfare function or other specifications of the structure of the economy would yield different weights. Thus, this paper should be viewed as a preliminary report. Nevertheless, the findings of this paper are suggestive. Hopefully, they will serve as a catalyst for others to determine the true policy weights that occurred in the postwar period.

Table 6

Estimated Welfare Weights When The
Target (B) Matrix is Diagonal:

Eisenhower Administration, Pre 1958

	Static Case		Dynamic Case			
	Own-Period Weights		First-Period Weights		Second-Period Weights	
	QI, II	QIII, IV	QI,II	QIII, IV	QI, II	QIII, IV
Quadratic Weights						
Targets						
E	1.0000	1.0000	-.1567	-.1567		
Y	-.0013	-.0013	-.0023	-.0023	1.0000	1.0000
P	1.5690	1.5690	-3.9073	-3.9073	-.0010	-.0010
RS	-3.0992	-3.0992	1.7569	1.7569	1.6102	1.6102
BT	.1094	.1094	.0195	.0195	-2.6783	-2.6783
SD	-.0353	-.0353	-.1382	-.1382	-.0078	-.0078
					-.0315	-.0315
Instruments						
G	.0017	.0017	.0106	.0106		
PT	1.1654	1.1654	-.3593	-.3593	.0007	.0007
CT	.0288	.0288	-.9624	-.9624	-.0718	-.0718
RD	-.0025	-.0025	-.0093	-.0093	.0044	.0044
NFR	-.0109	-.0109	.0394	.0394	-.0009	-.0009
RR	-2.2304	-2.2304	13.7937	13.7937	-.0026	-.0026
					-.5782	-.5782
Linear Weights						
Targets						
E	12.0594	5.2737	6.7757	6.3804		
Y	1.0087	.4754	.3478	.3284	.8347	+.5415
P	7.2515	3.4071	.3825	3.6128	.0546	.0708
RS	.2476	.1053	.1477	.13950	.0338	.1752
BT	2.8795	1.7773	-1.5969	-1.5082	.0094	.0070
SD	.1192	.0355	.0515	.0486	.0010	.0673
					+.0042	.0056
Instruments						
G	.0080	.0037	.0737	.1193		
PT	.1165	.0624	-.0653	-.0423	.0031	.0016
CT	.0015	.0065	-.1860	.1491	-.0067	-.0022
RD	-.0001	-.0001	.0062	.0061	.0002	-.0011
NFR	-.0134	-.0134	.0499	.0499	-.0001	-.0001
RR	-.0029	-.0029	.0538	.0538	-.0033	-.0033
					-.0013	-.0008

Table 7

Estimated Welfare Weights When The
Target (B) Matrix is Diagonal:

Eisenhower Administration, Post 1958

		Static Case		Dynamic Case			
		Own-Period Weights		First-Period Weights		Second-Period Weights	
		QI, II	QIII, IV	QI, II	QIII, IV	QI, II	QIII, IV
Quadratic Weights							
Targets							
E		1.0000	1.0000	-.1702	-.1702	1.0000	1.0000
Y		-.0013	-.0013	-.0003	-.0003	-.0010	-.0010
P		1.5690	1.5690	-3.7276	-3.7276	1.6102	1.6102
RS		-.6878	-.6878	-2.1849	-2.1849	-.7218	-.7218
BT		.1095	.1095	.0214	.0214	.0078	.0078
SD		-.0354	-.0354	-.0029	.0029	-.0315	.0315
Instruments							
G		.1029	.1029	.0013	.0013	-.1093	-.1093
PT		2.8293	2.8293	-.0193	-.0193	-7.2057	-7.2057
CT		-.0609	-.0609	-.0566	-.0566	.1025	.1025
RD		-.0103	-.0103	.0079	.0079	.0104	.0104
NFR		-.0467	-.0467	.1506	.1506	.0042	.0042
RR		-9.8510	-9.8510	-.0039	-.0039	10.1543	10.1543
Linear Weights							
Targets							
E		78.2751	35.1859	139.9260	187.6870	125.9190	47.5439
Y		6.3453	2.9489	9.7782	9.6629	10.1755	3.9153
P		46.0406	21.7928	107.5410	106.2760	73.0794	28.9291
RS		1.8951	.9145	4.1525	4.1035	2.8152	1.1846
BT		12.4230	6.8599	-44.8970	-44.3678	21.3683	8.3608
SD		.8053	.4224	1.4478	1.4308	1.2332	.5692
Instruments							
G		.4836	.2243	.0518	.0838	-.5340	-.2578
PT		.2829	.0155	-.0035	-.0023	-.6737	-.2248
CT		-.0033	.0138	-.0110	.0088	.0053	-.0242
RD		-.0004	-.0004	-.0378	-.0378	.0080	.0008
NFR		-.0577	-.0577	.1906	.1906	.0560	.0560
RR		-.0013	.0013	-.0000	-.0000	.0223	.0143

Table 3

Estimated Welfare Weights When The
Target (B) Matrix is Diagonal:

Kennedy-Johnson Administration

		Static Case		Dynamic Case			
		Own-Period Weights		First-Period Weights		Second-Period Weights	
		QI, II	QIII, IV	QI, II	QIII, IV	QI, II	QIII, IV
Quadratic Weights							
Targets							
E		1.0000	1.0000	.0665	.0665	1.0000	1.0000
Y		-.0005	-.0005	-.0012	-.0012	-.0018	-.0018
P		.0068	.0068	.4851	.4851	.0180	.0180
RS		-1.4438	-1.4438	-.3234	-.3234	-.7259	-.7259
PT		-.0069	-.0069	.0063	.0063	.0070	-.0070
SD		-.0110	-.0110	-.0039	-.0039	-.0060	-.0060
Instruments							
G		.0008	.0008	.1239	.1239	-.0052	-.0052
PT		1.2183	1.2183	-.0765	-.0765	+.3422	.3422
CT		-.0047	-.0047	-.0233	-.0233	+.0034	.0034
RD		-.0014	-.0014	.0003	.0003	.0004	.0004
NFR		.0124	.0124	-.0570	-18.3304	2.6255	2.6255
Linear Weights							
Targets							
E		6.7767	2.7856	-11.9029	-11.4172	2.2344	-6.535
Y		.3505	.2494	1.5934	1.5277	.0813	.0859
P		2.2183	3.5415	45.5575	43.6747	4.3736	3.1103
RS		.1367	.0645	.2306	.2214	.0232	.0029
BT		-1.5775	.2689	22.8566	21.9144	2.2249	1.1839
SD		.0396	.0493	.6576	.6267	.0566	.0385
Instruments							
G		.0071	.0051	5.9981	6.3511	.0534	.0406
PT		.4098	.0531	-.0536	-.0287	-.0242	-.0029
CT		.0007	.0020	-.0084	-.0002	-.0006	-.0016
RD		.0009	-.0090	-.0020	-.0020	-.0006	-.0006
NFR		-.0168	-.0168	.1226	.1226	.0103	.0103
RR		-.0253	.0253	-.1723	-.1723	-.0176	-.0155

Table 9

Estimated Welfare Weights When Target (B) Matrix is Non-Diagonal
 Static Case - Own Period Weights

Eisenhower Administration, Pre 1958

Instruments Used: G, PT, CT, RD, NFR

Target Weights Quadratic^b

	E	Y	P	RS	BT	SD
Quadratic Weights Targets ^a						
E	.0276	.0013	.0257	.0006	-.0073	.0003
Y		.0001	-.0050	.00004	.0004	-.00005
P			1.6760	-.0032	-.2119	.0165
RS				.00002	.0003	-.00003
BT					.0295	-.0210
SD						.0002

Instruments

	Instrument Weights (Quadratic)					
	G	PT	CT	RD	NFR	RR
G	1.0000					
PT		141.235				
CT			-14.8914			
RD				65.6800		
NFR					150.7725	
RR						159613.68

Linear Weights

	QI, QII	QIII, QIV
E	429.200	853.40
Y	22.670	44.83
P	172.000	341.20
RS	6.603	13.28
BT	-89.060	-181.30
SD	2.538	5.279

Targets

E	429.200	853.40
Y	22.670	44.83
P	172.000	341.20
RS	6.603	13.28
BT	-89.060	-181.30
SD	2.538	5.279

a) Numbers given in terms of E20

b) This matrix is symmetric

Instruments Used: G, RD, NFR, RR

Target Weights^b

	E	Y	P	RS	BT	SD
Target Weights ^b						
E	.7389	.0530	.4277	.0213	.0453	.0212
Y		.0051	.0286	-.0002	.0242	.0017
P			.2521	.0160	-.0194	.0185
RS				.0031	-.0283	.0051
BT					.3617	-.0534
SD						.0089

Instrument Weights

	G	PT	CT	RD	NFR	RR
G	1.0000					
PT		141.235				
CT			-14.8910			
RD				65.680		
NFR					1054.760	
RR						-159613.687

QI, QII QIII, QIV

E	+1599.00	3192.0
Y	84.08	167.6
P	515.60	+1029.0
RS	15.73	+31.54
BT	-333.90	-671.0
SD	8.231	16.67

Table 10

Estimated Welfare Weights When Target (B) Matrix is Non-Diagonal

Static Case - Own Period Weights

Eisenhower Administration, Post 1958

Instruments Used: G, PT, CT, NFR

Quadratic Target Weights ^b						
E	Y	P	RS	BT	SD	

Quadratic Weights

Targets^a

E	.0326	.0016	.0073	.0007	-.0113	.0053
Y	.0001	-.0072	.0005	.0006	-.00007	
P	2.5401	-.0047	-.3226	.0250		
RS		.00003	.0005	-.00005		
BT		.0418	-.0032	.0002		
SD						

Instruments

Quadratic Instrument Weights					
G	PT	CT	RD	NFR	RR

G	1.0000	57.3849	2.8577	3.7741	59.7660	185564.06
PT						
CT						
RD						
NFR						
RR						

Linear Weights QI, QII, QIII, IV

Targets

E	342.100	683.400		
Y	17.740	35.410		
P	174.600	+342.800		
RS	6.358	12.710		
BT	-77.690	-155.800		
SD	2.381	4.720		

a) Numbers given in terms of E20

b) Symmetric matrix

Instruments Used: G, RD, NFR, RR

Quadratic Target Weights ^b						
E	Y	P	RS	BT	SD	

+1.1117	-.0207	+.1205	+.0441	-.4867	+.0784	
	-.0025	+.0100	+.0008	-.0188	+.0021	
		+.1061	+.0301	-.3136	+.0524	
			+.0046	-.0377	+.0074	
				+.2523	.0569	
					+.0117	

Quadratic Instrument Weights					
G	PT	CT	RD	NFR	RR

1.0000	57.3849	2.8577	3.7741	117.7931	185564.06

QI, II QIII, IV

417.200	833.50		
21.681	43.300		
193.730	38.690		
6.944	13.890		
-93.410	-187.300		
2.747	5.451		

Table 11

Estimated Welfare Weights When Target (B) Matrix is Non-Diagonal

Static Case - Own Period Weights

Kennedy-Johnson Administration

Instruments Used: G, PT, CT, RD, NFR

Instruments Used: G, RD, NFR, RR

		Quadratic Target Weights ^b						
		E	X	P	RS	BT	SD	
Quadratic Weights								
Targets ^a								
E	.7915	-.1331	-5.2390	-.03216	.1370	-.0663		
Y		+.3172	.8491	.0649	-.5733	.0092		
P			16.5400	.0720	12.7000	25.0500		
RS				.0002	.1001	.0012		
BT					+10.1800	.1325		
SD						.0036		
		Quadratic Target Weights ^b						
		E	Y	P	RS	BT	SD	
E	.2851	.0190	.1340	.0051	-.0159	-.0027		
Y		.0014	.0110	.0003	-.0000	-.0002		
P		.1031	.0024	.0131	.0003	.0015		
RS			.0001		-.0003	-.0001		
BT					.0174	-.00001		
SD						.00003		
		Quadratic Instrument Weights						
Instruments		G	PT	CT	RD	NFR	RR	
G	1.0000							
PT	-12926.86							
CT	20.2493							
RD	.2760							
NFR	1068.395							
RR	780.756							
		Quadratic Instrument Weights						
		G	PT	CT	RD	NFR	RR	
G	1.0000							
PT	-12936.355							
CT	20.2493							
RD	.2760							
NFR	-13.5802							
RR	780.756							
		Quadratic Instrument Weights						
Linear Weights		QI, II	QIII, IV					
Targets								
E	-478.10	-1773.0						
Y	145.10	269.4						
P	5535.00	11340.0						
RS	6.76	120.2						
BT	1296.0	2794.0						
SD	76.91	156.2						

a) Numbers given in terms of E20

b) Symmetric Matrix

Table 12

Estimated Welfare Weights When Target (B) Matrix is Non-Diagonal

Dynamic Case - 2nd Period Weights

Eisenhower Administration, Pre 1958

Instruments Used: G, PT, CT, NFR

Instruments Used: G, RD, NFR, RR

Quadratic Target Weights ^b							
Quadratic Weights							
Targets ^a							
E	Y	P	RS	BT	SD		
E	.0195	.0009	.0492	.0034	-.0093	.0005	
Y		.00008	-.0081	+.00004	.0009	-.00008	
P			2.8040	-.0052	-.3556	.0276	
RS				.00002	.0006	-.00005	
BT					.0456	-.0035	
SD						.0003	
Instruments							
Quadratic Instrument Weights							
G	PT	CT	RD	NFR	RR		
G	1.0000						
PT		60.270					
CT			-6.8234				
RD				3.2196			
NFR					153.784		
RR						23518.11	
Linear Weights							
QI, II				QIII, IV			
E	147.60	335.6					
Y	7.848	17.69					
P	26.58	76.08					
RS	0.32	1.62					
BT	-28.35	-67.92					
SD	+0.53	1.49					
Quadratic Target Weights ^b							
E	Y	P	RS	BT	SD		
E	.5069	.0302	.3061	.0242	-.0812	.0317	
Y		.0016	.0185	.1675	-.0077	.0023	
P			.1842	.0142	-.0435	.0183	
RS				.0008	.0002	.0009	
BT					-.0357	.0024	
SD						.0008	
Quadratic Instrument Weights							
G	PT	CT	RD	NFR	RR		
G	1.0000						
PT		60.2700					
CT			-6.8234				
RD				3.2196			
NFR					260.409		
RR						23518.11	

a) Figures expressed in terms of E20

b) Symmetric Matrix

Estimated Welfare Weights When Target (B) Matrix is Non-Diagonal
Dynamic Case - 2nd Period Weights

Instruments Used: G, PT, CT, NFR

Instruments Used: G, RD, NFR, RR

Quadratic Weights					
Targets ^a			Instruments		
E	Y	P	RS	BT	SD
.0206	.0009	.0461	.0004	-.0091	.0005
	.00007	-.0076	.00004	.00079	.00007
		+2.633	-.0492	-.3339	.0260
			.00002	0.0006	.00005
				.0429	-.0033
					.0003

Quadratic Target Weights ^b					
E	Y	P	RS	BT	SD
	.0003	.0122	-.0013	.0265	-.0030
	.0003	.0017	-.00004	.0019	-.0002
		.0054	-.0009	.0154	-.0019
			-.0001	.0083	-.0002
				.0009	.0009
					-.0003

Instruments

[illegible]

Linear Heights QI, II
OIII, IV

Targets

E	103.40	182.9	64.62	105.20
Y	5.426	9.54	3.39	5.46
P	37.52	61.43	26.11	38.60
RS	1.19	1.88	0.88	1.27
BT	-21.67	-39.09	-0.13	-22.83
SD	0.57	9.26	0.38	.54

a) Figures given in terms of E20

b) Symmetric Matrix

Table 14

Estimated Welfare Weights When Target (B) Matrix is Non-Diagonal
Dynamic Case - Second Period Weights

Kennedy-Johnson Years

Instruments Used: G, PT, CT, RD, NFR					
Quadratic Target Weights ^b					
E	Y	P	RS	BT	SD
-.0257	+.0035	.0829	.0004	.0514	.0012
Y	.0042	-.1254	-.0009	.0773	-.0014
P		.0196	.0196-2.2030	.0243	.0243
RS			.0002	-.0166	.0002
BT				1.4060	-.0241
SD					.0002
Instruments					
Quadratic Instrument Weights					
G	PT	CT	RD	NFR	RR
1.0000					
	-495.62	-2.616			
			1.288		
				608.519	
					-3543.00
Linear Weights					
Targets					
QI, II	QIII, IV				
E	-714.80	-1462.0			
Y	71.95	142.1			
P	330.0	6709.0			
RS	30.94	61.05			
BT	937.7	1886.0			
SD	46.09	92.0			
Instruments Used: G, RD, NFR, RR					
Quadratic Target Weights ^b					
E	Y	P	RS	BT	SD
.0002	.0158	.1680	.0029	.0364	-.0022
	-.00009	-.0143	.0003	-.0122	.00003
		-.4261	.0033	-.2677	.0024
			.00005	.0008	-.00004
				-.1477	.0047
					-.0000
Instruments					
Quadratic Instrument Weights					
G	PT	CT	RD	NFR	RR
1.0000					
	-495.62	-2.6160			
			1.282		
				22.4610	
					-3543.00
Linear Weights					
Targets					
QI, II	QIII, IV				
E	-29.63	-91.93			
Y	4.27	6.72			
P	283.8	446.8			
RS	2.19	3.53			
BT	38.30	82.96			
SD	3.13	6.079			

a) Figures given in terms of E20

b) Symmetric Matrix

Appendix A

Derivation of the Macro-Policy Welfare Weights from the Regression Coefficients

By regressing each of the deviations between the actual and desired values of the instrumental variables (the x's) upon all of the deviations between the actual and desired values of the target variables (the y's) and taking appropriate transformations of the regression coefficients, it is possible to derive estimates of the relative weights attached to the targets and the instruments. In the ensuing analysis, four specifications of the welfare function will be assumed:¹

1. One period horizon; A and B matrices diagonal.
2. Two period horizon;² A and B matrices diagonal.
3. One period horizon; A matrix diagonal; B matrix nondiagonal but symmetric.
4. Two period horizon; A matrix diagonal; B matrix nondiagonal but symmetric.

Before discussing the specific relationships between the estimated regression coefficients and the weights, it may be useful to summarize the notation used throughout this analysis:

¹In all cases the C matrix is assumed to be null.

²Because of the size of the sample period and the number of variables needed to encompass differences in behavior between the Eisenhower and Kennedy-Johnson years, it is only feasible to estimate the weights for a two period horizon.

x_j^k = deviation between actual and desired instrument j in period k .

y_i^t = deviation between actual and desired target i in period t .

γ_{ij}^{tk} = regression coefficient associated with the i^{th} target in period t and the j^{th} instrument in period k .

γ_{oj}^k = regression constant associated with instrument j in period k .

u_j^k = disturbance term associated with instrument j in period k .

r_{ij}^{tk} = reduced form coefficient indicating the impact of instrument j initiated in period k upon target i in period t .

a_j^k = quadratic weight associated with instrument j in period k .

b_i^t = quadratic weight associated with target i in period t .

α_j^k = linear weight associated with instrument j in period k .

β_i^t = linear weight associated with target i in period t .

In the static case the following regressions are performed:

$$(1) \quad x_j^1 = \gamma_{oj}^1 + \sum_{i=1}^n \gamma_{ij}^{11} y_i^1 + u_j^1 \quad j = 1, \dots, m$$

In the dynamic case the following regressions are performed:³

$$(2.a) \quad x_j^1 = \gamma_{oj}^1 + \sum_{i=1}^n \gamma_{ij}^{11} y_i^1 + \sum_{i=1}^n \gamma_{ij}^{21} y_i^2 + u_j^1$$

$$(2.b) \quad x_j^2 = \gamma_{oj}^2 + \sum_{i=1}^n \gamma_{ij}^{22} y_i^2 + u_j^2$$

$$j = 1, \dots, m$$

³ Note that the regressions in (1) only differ from those in (2.b) by the omission of the first observation. In (1) each x_j^t is regressed against all the y_i^t , while in (2.b) each x_j^{t+1} is regressed against all the y_i^t . Thus, the two specifications are virtually identical.

Each regression coefficient associated with the target variables is a combination of the quadratic A-weights, the quadratic B-weights, and the reduced-form coefficients; each regression is a combination of the linear α -weights, the linear β -weights, the quadratic A-weights and the reduced form coefficients. The quadratic weights can be solved independently and then taken as given to determine the linear weights. Thus, we will first consider the derivation of the quadratic weights and then of the linear weights.

I. Quadratic Weight Derivation

A. A and B matrices diagonal; one-period time horizon.

As shown in the text, the quadratic weights bear the following relationship to the regression coefficients:

$$(3) \quad \gamma_{ij}^{11} = r_{ij}^{11} (b_i^1 / a_j^1) \quad \begin{matrix} i = 1, \dots, n \\ j = 1, \dots, m \end{matrix}$$

Define

$$(4) \quad \tilde{\gamma}_{ij}^{11} \equiv \gamma_{ij}^{11} / r_{ij}^{11} = -b_i^1 / a_j^1 \quad \begin{matrix} i = 1, \dots, n \\ j = 1, \dots, m \end{matrix}$$

Then sum $\tilde{\gamma}_{ij}^{11}$ over i and over j to derive the following relationships:

$$(5.a) \quad \sum_{j=1}^m \tilde{\gamma}_{ij}^{11} = -b_i^1 \left(\sum_{j=1}^m 1/a_j^1 \right) \quad i = 1, \dots, n$$

$$(5.b) \quad \sum_{i=1}^n \tilde{\gamma}_{ij}^{11} = -1/a_j^1 \left(\sum_{i=1}^n b_i^1 \right) \quad j = 1, \dots, m$$

Set $b_1^1 = 1$; then the solution to the weights is given as follows:

$$(6.a) \quad b_i^1 = \frac{\sum_{j=1}^m \tilde{y}_{ij}^{11}}{\sum_{j=1}^m y_{1j}^{11}} \quad i = 2, \dots, n$$

$$(6.b) \quad a_j^1 = - \frac{\sum_{i=1}^n b_i^1}{\sum_{i=1}^n \tilde{y}_{1i}^{11}} \quad j = 1, \dots, m$$

B. A and B matrices diagonal; two-period time horizon.

In this case the relationship between the weights and the regression coefficients is given by:

$$(7) \quad y_{ij}^{tk} = - r_{ij}^{tk} (b_i^t / a_j^k) \quad i = 1, \dots, n$$

$$j = 1, \dots, m$$

$$t, k = 1, \dots, T$$

The derivation of the second-period weights is identical to that of the one-period case and is given by:

$$(8.a) \quad b_i^2 = \frac{\sum_{j=1}^m \tilde{y}_{ij}^{22}}{\sum_{j=1}^m \tilde{y}_{1j}^{22}} \quad i = 2, \dots, n$$

$$a_j^2 = \frac{\sum_{i=1}^n b_i^2}{\sum_{i=1}^n \tilde{y}_{1i}^{22}} \quad j = 1, \dots, m$$

Where $\tilde{y}_{ij}^{tk} \equiv y_{ij}^{tk}$ r_{ij}^{tk} and $b_1^2 \equiv 1$.

To derive the a_j^1 weights, sum the y_{ij}^{21} coefficients over i and solve for a_j^1 . Thus,

$$(9.a) \quad a_j^1 = - \frac{\sum_{i=1}^n b_i^2 r_{ij}^{21}}{\sum_{i=1}^n y_{1i}^{21}} \quad j = 1, \dots, m$$

Similarly, to derive the b_j^1 weights, sum the γ_{ij}^{11} coefficients over j and solve for b_i^1 :

$$(9.b) \quad b_i^1 = - \sum_{j=1}^m \gamma_{ij}^{11} / \sum_{j=1}^m (r_{ij}^{11} / a_j^1) \quad i = 1, \dots, n$$

C. A-matrix diagonal B-matrix nondiagonal but symmetric.

In this case, the relationship between each γ_{ij}^{tk} coefficient, the A-weights, the B-weights, and the reduced form coefficients takes the following form.

$$(10) \quad \gamma_{ij}^{tk} = 1/a_j^k \left[\sum_{h=1}^n r_{hj}^{tk} b_{hi}^t \right] \quad i = 1, \dots, n$$

$$j = 1, \dots, m$$

$$t, k = 1, 2$$

Since $b_{ij} = b_{ji}$ for $i \neq j$, there are $m + \sum_{i=0}^n (n-i)$ unknowns and $m \times n$ equations. If there are more unknowns than equations, the weights can be derived by setting an appropriate number of the weights equal to zero. If $m=4$ and $n=6$, the system has exactly one degree of freedom. By setting $b_1=1$, it is possible to derive a unique set of relative weights. If there are more equations than unknowns and $m \geq 4$ while $n \geq 6$, it is possible to solve for the weights by using overlapping subgroups of the variables. While the weights are not unique in this case, the various solution sets give some notion of the range of the weights. This procedure is used in the empirical analysis where $m = n = 6$. Let us then consider the derivation of the weights when $m=4$ and $n=6$.

To derive the weights when B is nondiagonal some additional notation is needed. Let

$$E_{tk} = [(m \times n) \times \sum_{i=0}^n (n-i)] \text{ matrix of reduced form coefficients}$$

in the following form:

r_1^{tk}	r_2^{tk}	r_3^{tk}	r_4^{tk}	r_5^{tk}	r_6^{tk}	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	r_1^{tk}	0	0	0	0	r_2^{tk}	r_3^{tk}	r_4^{tk}	r_5^{tk}	r_6^{tk}	0	0	0	0	0	0	0	0	0
0	0	r_1^{tk}	0	0	0	0	r_2^{tk}	0	0	0	r_3^{tk}	r_4^{tk}	r_5^{tk}	r_6^{tk}	0	0	0	0	0
0	0	0	r_1^{tk}	0	0	0	0	r_2^{tk}	0	0	0	r_3^{tk}	r_4^{tk}	r_5^{tk}	r_6^{tk}	0	0	0	0
0	0	0	0	r_1^{tk}	0	0	0	0	r_2^{tk}	0	0	0	r_3^{tk}	0	0	r_4^{tk}	r_5^{tk}	r_6^{tk}	0
0	0	0	0	0	r_1^{tk}	0	0	0	0	r_2^{tk}	0	0	0	r_3^{tk}	0	0	r_4^{tk}	0	r_5^{tk}
0	0	0	0	0	0	r_1^{tk}	0	0	0	0	r_2^{tk}	0	0	0	r_3^{tk}	0	0	r_4^{tk}	r_5^{tk}

Where

$$r_i^{tk} = \begin{bmatrix} r_{i1}^{tk} \\ \vdots \\ r_{im}^{tk} \end{bmatrix}$$

= (mx1) column vector whose r_{ij}^{tk} elements consist of the impact of instrument j initiated in period k upon target i in period t.

Moreover let

$C_{tk} = [(m \times n) \times m]$ matrix of γ_{ij}^{tk} coefficients in the form

$$C_{tk} = \begin{bmatrix} \gamma_{11}^{tk} & & 0 \\ & \ddots & \\ 0 & & \gamma_{1m}^{tk} \\ \vdots & & \vdots \\ \gamma_{n1}^{tk} & & 0 \\ & \ddots & \\ 0 & & \gamma_{nm}^{tk} \end{bmatrix}$$

$\bar{b}_t = [\sum_{i=0}^n (n-i) \times 1]$ vector of B-weights in period t.

$\bar{a}_k = (m \times 1)$ vector of A-weights in period k.

1. One-period time horizon.

In the case of the one-period time horizon the general system relation of the weights to the regression coefficient is given by

$$(11) \quad \begin{bmatrix} E_{11} & \vdots & C_{11} \end{bmatrix} \begin{bmatrix} \bar{b}_1 \\ \bar{a}_1 \end{bmatrix} = 0$$

The system will only be determinate if the weights are normalized on a given instrument, say a_1^4 .

⁴ Because of the nature of the E_{11} matrix, deleting a given column will usually cause the partitioned matrix to become singular. This will not occur, however, if the system is normalized on an instrument weight.

Let:

$\hat{a}_1 = [(m-1) \times 1]$ column vector of A-weights with a_1 deleted

$\hat{C}_{11} = [n \times (m-1) \times E(n-1)]$ matrix corresponding to C_{11} with the first column deleted

Then the weights can be derived by solving the following system of equations

$$(12) \quad \begin{bmatrix} E_{11} & \hat{C}_{11} \end{bmatrix} \begin{bmatrix} \bar{b}_1 \\ \hat{a}_1 \end{bmatrix} = -[C_1]$$

where $C_1 = [1 \times \Sigma(n-1)]$ column vector corresponding to the first column of the C_{11} matrix.

2. Two-period time horizon.

The solution to the second-period weights is analogous to the solution of the weights in the atatic case and is simply given by

$$(13) \quad \begin{bmatrix} \bar{E}_{22} & \hat{C}_{22} \end{bmatrix} \begin{bmatrix} \bar{b}_2 \\ \hat{a}_2 \end{bmatrix} = -[C_2]$$

To derive the first period weights, substitute into the relationships given in the first-period block of equations (i.e., equation 2.a). Thus

$$(14.a) \quad \begin{bmatrix} E_{11} & C_{11} \end{bmatrix} \begin{bmatrix} \bar{b}_1 \\ \hat{a}_1 \end{bmatrix} + \begin{bmatrix} E_{21} & C_{21} \end{bmatrix} \begin{bmatrix} \bar{b}_2 \\ \hat{a}_1 \end{bmatrix} = 0$$

Therefore,

$$(14.b) \quad \begin{bmatrix} E_{11} & C_{11} + C_{21} \end{bmatrix} \begin{bmatrix} \bar{b}_1 \\ \hat{a}_1 \end{bmatrix} = -[E_{21}][\bar{b}_2]$$

However, there are 25 unknowns and only 24 equations in the equations given in (14.b). Thus it is necessary to set one $b_{ij}^1 = 0$.

Let

$\hat{E}_{11} = [(n \times m) \times (\Sigma(n-1)-1)]$ matrix corresponding to E_{11}
with the last column missing corresponding to $b_{66}^1 = 0^5$

$\hat{b} = [\Sigma(n-1)-1 \times 1]$ vector of B-weights with one b_{66}^1 removed.

Then the first-period weights can be solved using the following system of equations:

$$(15) \quad \begin{bmatrix} \hat{E}_{11} & : & C_{11} + C_{21} \end{bmatrix} \begin{bmatrix} \hat{b}_1 \\ \vdots \\ \bar{a}_1 \end{bmatrix} = - [E_{21}] [b_2]$$

II. Linear Weights

The relationship between the linear weights and the regression constant is independent of the nature of the B matrix. However, it does vary, depending upon whether the welfare function has a one-or-two period horizon.

A. One-period horizon

In this case, the relationship between the regression constant and the weights is as follows:

$$(16.a) \quad \gamma_{oj}^1 = 1/a_j^1 (\alpha_j^1 + \sum r_{ij}^{11} \beta_i^1)$$

In matrix form this is given by

$$(16.b) \quad \bar{\alpha}_1 + \bar{R}_{11}' \beta_1 = \bar{A}_1 \bar{C}_{01} \quad \text{where}$$

⁵ It is necessary to set $b_{66}^1 = 0$ to ensure the invertibility of the partitioned matrix.

- $\bar{\alpha}_x = (mx1)$ vector of linear instrumental weights in period k.
 $\bar{\beta}_t = (nx1)$ vector of linear target weights in period t.
 $\bar{A}_k = (mxm)$ diagonal matrix of quadratic A-weights in period k.
 $\bar{G}_{ok} = (mx1)$ vector of regression constants in period k.
 $\bar{R}_{tk} = (nmx)$ matrix of reduced form coefficients (r_{ij}^{tk}) showing the impact of instrument j initiated in period k upon target i in period t.

Since there are $m+n$ unknowns, but only m equations, it is necessary to set n unknowns equal to zero. In this paper $m=n=6$. Thus if all $a_j^k = 0$, the β -weights can be derived by solving the following system of equations:

$$(17) \quad \bar{R}_{11}' \epsilon_1 = \bar{A}_1 \bar{G}_{01}$$

Similarly if all $\beta_i^t = 0$, the α -weights are easily derived

$$(18) \quad \bar{\alpha}_1 = \bar{A}_1 \bar{G}_{01}$$

In the dynamic case there are two systems of equations:

$$(19.a) \quad \gamma_{oj}^1 = \frac{1}{a_j} [\alpha_j^1 + \sum_{i=1}^n r_{ij}^{11} \beta_i^1 + \sum_{i=1}^n r_{ij}^{21} \beta_i^2] \quad j=1, \dots, m$$

$$(19.b) \quad \gamma_{oj}^2 = \frac{1}{a_j^2} [\alpha_j^2 + \sum_{i=1}^n r_{ij}^{22} \beta_i^2] \quad j=1, \dots, m$$

These relationships can be expressed in matrix form as follows:

$$(20.a) \quad \bar{\alpha}_1 + \bar{R}'_{11} \bar{\beta}_1 + \bar{R}'_{21} \bar{\beta}_2 = \bar{A}_1 \bar{G}_{02}$$

$$(20.b) \quad \bar{\alpha}_2 + \bar{R}'_{22} \bar{\beta}_2 = \bar{A}_2 \bar{G}_{02}$$

The β -weights can be derived by setting $\bar{\alpha}_1 = \bar{\alpha}_2 = 0$.

Then

$$(21.a) \quad \bar{R}'_{22} \bar{\beta}_2 = \bar{A}_2 \bar{G}_{02}$$

$$(21.b) \quad \bar{R}'_{11} \bar{\beta}_1 = \bar{A}_1 \bar{G}_{01} - \bar{R}'_{21} \bar{\beta}_2$$

Similarly the α -weights can be derived by setting

$\bar{\beta}_1 = \bar{\beta}_2 = 0$. Then

$$(22.a) \quad \bar{\alpha}_1 = \bar{A}_1 \bar{G}_{01}$$

$$(22.b) \quad \bar{\alpha}_2 = \bar{A}_2 \bar{G}_{02}$$

Appendix B

Variables Used In Regression Equations

I. Target Variables

A. GNP: $DY = GNP - GNP^*$

GNP = GNP, seasonally adjusted, quarterly totals
at annual rates, billions of 1953 dollars (KIA, 1.2)

GNP^* = GNP, 1955 II; for other observations, rates of
growth as follows:

48 I - 55 I : 3% per year

55 II - 62 IV : 3.5% per year

63 I - 65 IV : 3.75% per year

(Economic Report of the President, 1958)

B. Unemployment: $DU = U - U^*$

U = % of civilian labor force unemployed, seasonally
adjusted, quarterly.

$U^* = 4\%$

C. Prices: $DP = P - P^*$

P = GNP deflator, quarterly average, seasonally
adjusted (NIA 8.1)

P^* = GNP Deflator; 1958 = 100 $\pm$ 2% per year.

D. Interest Rate: $DRS = RS - RS^*$

RS = 3-month treasury bill rate, market yield,
quarterly average, not seasonally adjusted (FEB).

[Let rs_i = interest rate in month i;

then $RS = (rs_1 + rs_2 + rs_3) / 3$]

RS^* = 3-month treasury bill note, market yield, quarterly
average of lagged monthly values:

[$RS^* = (r_0 + r_1 + r_2) / 3$]

E. Government Surplus: $DS = S - S^*$

S = actual surplus ($\pm$), administrative budget, billions of current dollars, quarterly totals at annual rates, not seasonally adjusted (TR, Table 1).

S^* = Estimated administrative budget surplus ($\pm$). Surplus in year t , QI and QII given by estimates in January of year t for fiscal year t (budget document FY $t+1$). Surplus in year t QIII and QIV given by estimates in January of year t for FY $t+1$.

F. Balance of Trade: $DB = BT - BT^*$

BT = Balance of Trade (X-M), billions of current dollars, quarterly at annual rates, seasonally adjusted (BS, 1967).

BT^* = BT ; 48I - 58IV

$BT(01)$; 59I - 66IV

II. Instrumental Variables:

A. Government Expenditures: $DG = G - G^*$

G = Total federal government expenditures, cash budget, quarterly totals at annual rates, billions of current dollars, not seasonally adjusted (BS, 1967, p. 94).

G^* = Estimated cash budget expenditures. Expenditures for year t , QI and QII given by estimates in budget document FY $t+1$ for FY t ; QIII and QIV given by estimates in budget document FY $t+1$ for FY $t+1$.

B. Personal Tax Rate: $DPT = PT - PT^*$

PT = actual effective personal tax rate quarterly,
not seasonally adjusted.

$= \text{actptrec} / \text{act pty.}$

actptrec = actual personal tax receipts,
quarterly at annual rates, billions of current dollars,
not seasonally adjusted.

actpty = actual personal taxable income, quarterly
at annual rates, billions of current dollars, not
seasonally adjusted (generated by FRB-MIT model)

desrhop 10 = desired effective personal tax rate, quarterly, not
seasonally adjusted

$= \text{desptrec} / \text{actpty};$

desptrec = projected personal tax receipts. Estimates
for year t, QI and QII given by estimates in Budget
Document FY t+1 for FY t; QIII and QIV given by
estimate in Budget document FY t+1 for FY t+1.

C. Corporate Tax Receipts: $DRC = TC = TC^*$

$TC = \text{actctax} / \text{CTY}$

actctax = corporate tax receipts, administrative budget, billions
of current dollars, not seasonally adjusted, quarterly
at annual rates (TR)

CTY = corporate profits plus depreciation, billions of
current dollars, not seasonally adjusted, quarterly
at annual rates (NIA 1.14)

$TC^* = \text{descrec} / \text{CTY}$

descrec = estimated corporate tax receipts, administrative budget. Estimates for year t_1 , QI and QII given by estimates in Budget Document FY $t+1$ for FY t ; QIII and QIV given by estimates in Budget Document FY $t+1$ for FY $t+1$

D. Rediscount Rate: $DR = RD - RD^*$

RD = federal funds rate, quarterly average of daily figures, not seasonally adjusted.

RD^* = rediscount rate, quarterly average of daily figures, not seasonally adjusted.

E. Net Free Reserves: $DNFR = NFR - NFR^*$

NFR = Net free reserves, billions of current dollars, quarterly averages, not seasonally adjusted (FRB)

NFR^* = Target net free reserves, billions of current dollars, quarterly averages, not seasonally adjusted (OMC Minutes)

F. Reserve Requirements: $DRR = RR - RR^*$

RR = Total Reserves / monetary base

RR^* = Required Reserves / monetary base (monetary base defined by MIT-FRB required reserve series)

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