Short Run Monetary - Fiscal Influences in a Federal State: With Application to the Canadian Economy, 1947 to 1973

by

Stanley L. Winer*

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Carleton University, Ottawa
Canada

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ABSTRACT

Whether nonfederal governments in a federal system act so as to stabilize or to destabilize the macroeconomy has been extensively explored. However, the analytically distinct question of what overall importance various jurisdictions have actually had in determining macroeconomic events has been neglected. In response to this gap, a simple approach to the investigation of monetary-fiscal influences in a federation is developed and applied.

Introduction

In this paper we develop and apply a simple approach to the investigation of monetary – fiscal influences in a federation. The application is to the Canadian economy, **1947** to **1973.**

The method presented here employs a set of government budget restraints as a central element in the assembly of data, in the derivation of reduced form estimating equations and in the interpretation of results. It is an extension of the method employed by Christ **(1973)** to accommodate both a federal system of government and an open economy with either fixed or flexible exchange rates. Three aspects of monetary-fiscal influences in the federation are therefore woven together; the relative influences of different government levels, the relative influences of various policy variables, and the influence of the world economy.

Empirical research on the first of these aspects has been neglected. Whether nonfederal governments act so as to stabilize or destabilize the macroeconomy, or reinforce or offset central stabilization policies, has been extensively explored; by Snyder **(1973)** in several O.E.C.D. countries, by Rafuse **(1965)** in the U.S., by Sheikh and Winer **(1977)** in Canada, and by others. However, this still leaves unexplored the analytically distinct question of what overall importance various jurisdictions have actually had in determining macroeconomic events. Such disaggregation in a study of monetary – fiscal influences is necessary in Canada, and in other federations such as Australia, West Germany and the United States. Control of policy instruments having potentially significant macroeconomic effects is not limited to the central authorities, as recent events in the province of Quebec have emphasized. It may not be assumed that these instruments have been used in the same way. Nor may it be assumed that

the instruments controlled by junior government levels are of the same nature as those of the federal government, even when base money is excluded from consideration.

Disaggregation by level of government also allows a consideration of the macroeconomic influence of intergovernmental flows, an increasingly-important phenomenon particular to federal states. The historical macro-economic role of these flows has not been well explored, though such flows should be expected to influence macroeconomic activity at least because different jurisdictions do not necessarily finance them in the same way.[1]

It is possible to focus on the macroeconomic importance of the federal structure only within the context of a general study of monetary - fiscal influences. Political debates in federal systems often generate the impression that the federal structure is unquestionably a major determinant of macroactivity. We present here a balanced view since we consider at the

same time the monetarist - nonmonetarist controversy in an open economy. However, we shall conclude that the evidence indicates it is probably necessary to settle both issues in order to settle either.

The openness of the economy is the source of one of the most difficult problems in any empirical consideration of the historical influences of monetary and fiscal policy variables. This is particularly so in the Canadian case. When exchange rates are fixed, it is necessary to deal with the dependence of the money and bond stocks on the change in foreign exchange reserves. Under

1. Exceptions are Maxwell **(1952)** and Knott **(1977)** who considered aspects of respectively, the American and the West German experience.

2. Previous reduced form studies of monetary - fiscal influences in Canada include Macesich (1964, *1969)* and Scadding (19**72).** None of these studies attempts disaggregation by level of government, and none gives adequate recognition to the government budget restraint.

a flexible exchange rate regime in which the change in reserves is nonzero, it is necessary to cope with the financing of exchange market intervention. Our approach to these problems is an extension of that of Brunner and Meltzer (1972), and is consistent with that of Argy and Kouri (1974) and others.

We proceed as follows. Reduced form estimating equations are developed in section two. Here we shall also reveal a priori expectations regarding signs of reduced form parameters for the Canadian case. The estimates are presented in section three. Limitations and conclusions follow in sections four and five respectively.

Reduced Form Equations for Money Income in an Open Federal State

We shall use money income as the dependent variable following Andersen-Jordan (1968), and Friedman (1971). While it is not reasonable to explain real income without also explaining the price level, and vice versa, it may be reasonable to attempt alone an explanation of the product of the two. For reasons which are given below, we shall require at least two estimating equations, one appropriate for each exchange rate mechanism that prevailed during the sample period.

We begin with the government budget restraints (sources of funds equals uses of funds) that together with equations (3) and (4) comprise the main element in the derivation of estimating equations and in the interpretation of the empirical results.[3]

(1) $G_F = (1-a)T_F - V_F(r) \cdot B_F^* - f(GC) - UC + \Delta B_F^* + \Delta H^* - \Delta R + Z_F$

federal budget restraint.

(2) $G_{NF} + GC = T_{NF} + aT_F - V_{NF}(r) \cdot B_{NF} + UC + \Delta B_{NF} + Z_{NF}$

nonfederal budget restraint.

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3. Time subscripts are omitted. Equations (1) and (2) follow Brunner and Meltzer (1972).

(3) $\Delta H^* = \Delta H + \mu \cdot \Delta R$ endogeneity of money stock.

(4) $\Delta B_F^* = \Delta B_F + (1-\mu) \cdot \Delta R$ sterilization of money stock.

where (all variables are in nominal terms unless otherwise stated)

a = proportion of federal taxes-less-transfers transferred to nonfederal governments ($0 \leq a < 1$)

B_F^*, B_{NF} = respectively, federal and nonfederal net privately held debt

$V_F(r) \cdot B_F^*$, $V_{NF}(r) \cdot B_{NF}$ = respectively, federal and nonfederal interest payments

B_F = predetermined (domestic) component of B_F^*

G_F, G_{NF} = federal purchases, and nonfederal purchases not directly related to conditional grants

H^* = monetary base (currency plus chartered bank reserves at the Bank of Canada)

H = predetermined (domestic) component of H^*

T_F = federal taxes-less-transfers, where transfers exclude interest payments

T_{NF} = nonfederal taxes-less-transfers from own sources, where nonfederal transfers exclude those related to conditional grants and exclude interest payments

GC = nonfederal purchases directly related to federal conditional grants

$f(GC)$ = federal (open-ended plus close-ended) conditional grants, assumed to be a stable function of GC

UC = federal unconditional grants to nonfederal governments

ΔR = domestic currency equivalent of the change in the stock of foreign exchange reserves

μ = degree to which the change in reserves is monetized under fixed rates, or to which exchange market intervention is financed by base money under flexible rates ($0 \leq \mu \leq 1$).

Z_F, Z_{NF} = respectively, other federal and nonfederal net sources of funds

r = domestic interest rate (it is assumed that the yield on nonfederal bonds differs only by a constant from the yield r on federal bonds)

Equation (1) is the budget restraint of a consolidated federal government and central bank. The assumption here is that the central bank is more or less expected to act its part in the conduct of macropolicy by the central government. Moreover, we lose little by consolidating provincial and municipal governments

if the latter are largely controlled by the former. Thus, we use equation (2) to represent the budget restraint of a nonfederal (provincial-municipal) government sector.[4]

In any federal state, no jurisdiction is free to choose independently the values of all its policy variables, since sources and uses of funds must be equal in every period in each jurisdiction. In the macroeconomy of a federal state, each government budget restraint interacts with the private sector, and the budget restraints of the other government levels, to determine endogenously the value of one policy variable in that restraint once the values of the rest of the policy variables in the restraint have been chosen by the appropriate authorities. We must therefore choose two endogenous policy variables, one corresponding to each of the restraints (1) and (2) above.[5] For the purposes of this study they will be T_F and T_{NF}. Since they are regarded as being endogenously determined, they will not appear in the reduced form estimating equations for money income (GNP at market prices) Y.

Equations (3) and (4) indicate the manner in which changes in foreign exchange reserves may influence the stocks of money and of federal debt, depending on the sterilization decisions of the central authorities under fixed exchange rates, or their financing of foreign exchange intervention under flexible rates. These equations embody behavioral assumptions. Equation (3) states that the net change in base money in any period ΔH^* consists of two

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4. These assumptions certainly fit the Canadian case. However, if the data permit there is no reason why, say, the bank and the central government could not be treated separately.

5. In quite different contexts, the properties of macroeconomic models with two or more government budget restraints have been considered by Hansen (1973), in a model which contains separate restraints for a central bank and a central government, and by DeGrauwe (1975) who considers the interaction of macropolicies in a group of open economies. An investigation of an open, federal state is found in Winer (1975).

components: a predetermined or domestic component ΔH, and a foreign component $\mu \cdot \Delta R$ dependent upon the change in reserves ΔR and the degree to which this change is monetized, μ. (μ could possibly have value zero). The behavioral assumption here is that the domestic component is predetermined and therefore does not depend systematically on the size of the federal deficit in the current period or on any other variable appearing in (1).[6] Equation (4) is the complement of (3). The change in the outstanding federal bond stock ΔB_F^* consists of two parts: a predetermined component ΔB_F, and, by further assumption, that part of ΔR that has not been monetized, $(1-\mu)\Delta R$. (Under fixed rates, $1-\mu$ is the degree of sterilization.)

These equations thus define two additional endogenous variables, H^* and B_F^*, and hence they also will not appear in the reduced form equations for Y. We shall return to equations (3) and (4), as well as to (1) and (2), below.

Under fixed exchange rates, all variables in (1) - (4) other than T_F, T_{NF}, H^*, B_F^*, ΔR, and r, are assumed to be predetermined in the current quarter. The remaining predetermined variables in the economy are assumed to consist of lagged income Y_{-1}, the exchange rate τ, and certain variables influencing with τ the balance of payments; the world price level P_f, interest rate r_f and income Y_f. Consequently, if we apply Taylor's theorem to each equation of any macroeconomic model containing just this set of predetermined variables, and solve, the reduced form for money income under fixed rates is:[7]

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6. We could allow for dependence of ΔH (and ΔB_F) on lagged values of any policy variable in (1), but this would not change the estimating equations. See section 4 below for elaboration on this point.

7. Error terms, seasonal dummies and time subscripts are omitted. A complete macroeconomic model of a federal state and a derivation of the corresponding reduced form equations, of which (5) and (6) are particular cases, is given in Winer (1975). For general analyses of the strength and weaknesses of the reduced form equation approach see Keran (1969), Goldfeld and Blinder (1972), Blinder and Solow (1974), Carlson and Spencer (1975), Modigliani and Ando (1976), and Schwartz (1976). The principal virtue of the reduced form is its robustness with respect to specification of the underlying structure. Its main fault is that a reduced form provides no information about transmission mechanisms. Apart from this, we agree with Schwartz (p. 49) that "The very same shortcomings alleged for reduced forms may also inhere in structural models."

$$(5)\quad Y = \alpha_1 + \alpha_2 B_F + \alpha_3 B_{NF} + \alpha_4 G_F + \alpha_5 G_{NF} + \alpha_6 H + \alpha_7 P_f + \alpha_8 r_f + \alpha_{10} GC + \alpha_{11} UC + \alpha_{12} Y_f + \alpha_{13} \tau + \alpha_{14} Y_{-1}$$

where (in addition to previous definitions)

P_f = domestic currency implicit price index of imports of goods and services

r_f = nominal yield on U.S. government 3-5 year bonds

Y_f = U.S. GNP

τ = price of 1 U.S. dollar in Canadian dollars

Here Z_F and Z_{NF} have been subsumed into α_1. The policy parameter μ enters in the α_i. The policy parameter 'a' does not enter (5) since T_F and therefore $a \cdot T_F$ is assumed endogenous. Note that although the price index P_f is in domestic currency terms, the exchange rate τ enters (5) since it may influence capital flows, as in Stein (1965) or Niehans (1975). The reason for the choice of lag structure will be considered below.

Under flexible rates, it is convenient to use standard balance of payments theory according to which net exports always equal net capital outflows (private plus governmental). We may thus eliminate net exports from the underlying macromodel when deriving the reduced form for money income, and hence exclude those predetermined variables P_f and Y_f which enter behavioral equations for exports and imports. On the other hand, we must include ΔR which now represents federal intervention in the foreign exchange market, and is assumed to be predetermined. Under flexible rates τ is endogenously determined, and so has been excluded from the estimating equation appropriate for flexible rates:

$$(6)\quad Y = \beta_1 + \beta_2 B_F + \beta_3 B_{NF} + \beta_4 G_F + \beta_5 G_{NF} + \beta_6 H + \beta_8 r_f + \beta_9 \Delta R + \beta_{10} GC + \beta_{11} UC + \beta_{14} Y_{-1}.$$

As net exports have been eliminated from the underlying macromodel, the marginal propensity to import no longer appears in the coefficients of (6). Thus every coefficient in (6) is different from the corresponding coefficient in (5) for this reason at least.[8]

Equations (5) and (6) are linear first difference equations with constant coefficients. For the model to be stable and economically meaningful, α_{14} and β_{14} must lie between -1 and +1. Coefficients of variables other than Y_{-1} are impact multipliers. The coefficient of lagged income can be thought of as being related to either a distributed lag expectations-formation process or a delayed adjustment process.[9]

The simplification introduced by the exclusion of all lagged variables from (5) and (6) but Y_{-1} is necessary because of a limitation on the length of available time series. Available data do not allow both disaggregation by level of government and investigation of lag structures. Consequently, we must be content with a study of short run policy influences.

The resulting situation can be understood by considering the following equation in which a variable Y depends upon a distributed lag of two variables, say X and Z:

$$(7)\quad Y_t = \theta \sum_{j=0}^{\infty} \lambda^j X_{t-j} + \gamma \sum_{k=0}^{\infty} \delta^k Z_{t-k}$$

where $0 \leq \lambda, \delta \leq 1$ and θ and γ are impact multipliers. Applying the Koyck transformation twice to this equation yields

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8. A discussion of the importance of the marginal propensity to import in a macromodel and its empirical significance in Canada may be found in Robinson (1968: 401-404). We note that just because we have used the balance of payments identity to eliminate net exports (and the variables P_f and Y_f), we have not assumed anything about the insulating properties of a flexible exchange system.

9. Christ (1973: 284).

$$(8)\quad Y_t = (\lambda + \delta)Y_{t-1} - \lambda\delta Y_{t-2} + \theta X_t - \theta\delta X_{t-1} + \gamma Z_t - \gamma\lambda Z_{t-1}.$$

If it is assumed that $\lambda\delta$, $\theta\delta$ and $\gamma\lambda$ are small relative to $\lambda+\delta$, θ and γ, (8) becomes

$$(9)\quad Y_t = (\lambda+\delta)\, Y_{t-1} + \theta X_t + \gamma Z_t$$

and the general form of the estimating equations emerges. Thus the assumption underlying the transition from more general reduced form equations for money income is that the impact effects of changes in predetermined variables 'dominate' the total effect.

The form of these equations therefore stresses the importance of impact multipliers. Moreover, since in the derivation of these equations the endogeneity of prices, the supply side of the economy and the effect of investment on capacity all have been excluded from consideration, they are more appropriate for the estimation of impact than for dynamic and long-run effects. However, it is at least as important to study the initial stages of a time path as its later ones. The underlying macroeconomy is subject to frequent exogenous stimuli. Initial conditions may dominate the endogenous response mechanism of the macroeconomy for several periods immediately following an autonomous shock. In Canada (or any small open economy), in addition, it is particularly important to study short run influences, since it is reasonable to argue that Canadian cycles are largely coincident with those in the U.S.[10] All that the Canadian policy maker might be able to do is engineer changes in the amplitude of these cycles. Finally we note that Schmidt and Waud (1973) have shown how

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10. See, for example, White (1970), or Bonomo and Tanner (1972).

misspecification of lag structures in such equations may lead to just as much error as not specifying lag structures at all. This is a serious problem since economic theory does not yet permit us to choose between lag structures, while the data (at least in the present case) does not permit the degrees of freedom required for unconstrained estimation of them.

Finally, to complete our general discussion of the model underlying (5) and (6), some further remarks about the endogeneity of T_F and T_{NF} are required. What we are assuming is that if either jurisdiction finds total sources of funds not equal to the total value of uses, then the appropriate tax-less-transfer rates will adjust accordingly. It is important to note that this does not rule out such phenomena as the federal authorities resorting to monetary expansion ΔH to a greater extent under flexible rates than under fixed rates, because of a relaxed balance-of-payments constraint. We also note that (3) and (4) insure foreign exchange operations do not (directly) precipitate any change in T_F under either exchange regime. However, the endogeneity of the tax rates is still a strong assumption. It is forced by the necessity under any other assumption of estimating an aggregate federal tax rate, as well as a corresponding rate for a consolidated nonfederal sector, since these tax rates are policy variables that would then have to appear in (5) and (6). Both Christ (1973) and Stein (1976) have resorted to the same assumption. This has the added attraction here that the aggregate degree of revenue sharing, a, does not then appear in the reduced form estimating equations and need not be estimated. This is particularly convenient since data on this intergovernmental flow is

not publicly available in Canada. In the national accounts, shared revenue is included with provincial revenue from own sources even though it is collected according to the federal tax structure.

Any other assumptions about the endogenous variables in (1) and (2) are equally strong. The necessity for such assumptions can be eliminated only if we commence with models of government behavior in which (1) and (2) are embodied as restraints on this behavior. In that case, there would be no need to specify which are the endogenous variables in these equations. In order to proceed at all in the absence of such models, therefore, we have made the most convenient assumption given the available data.

2.1 A Priori Beliefs with Respect to the Algebraic Signs of Reduced Form Parameters

Our expectations concerning signs of coefficients of equation (5) for fixed rate periods, and (6) for flexible rate periods, are found in Table 1. The signs of these parameters will not be rigorously investigated in the context of a full macromodel but will be considered on the basis of more general considerations. Any such model is useful only as a guide to the general form of the estimating equations rather than a hypothesis, since there is an infinite number of structural models that yield reduced forms for money income which are identical to these.

It is important to recall that T_F, T_{NF}, H^* and B^*_F are regarded as being endogenously determined, so that when we examine the sign of the effect on money income of a macroeconomic policy variable, all other policy variables are being held constant. In this way the choice of endogenous policy variables plays a key role not only in the construction of estimating equations, but also in the interpretation of our estimates.

We begin our discussion of a priori beliefs by considering again the endogeneity of the total stocks H^* and B_F^*. We make the following observations. With a fixed exchange rate system a change in any policy variable of any government level, including the predetermined quantities H and B_F, precipitates to some extent a purchase or sale of foreign exchange. Equations (3) and (4) imply, for example, that a purchase of foreign exchange is financed either by money creation or the sale of federal bonds, or both depending on the autonomously determined degree of sterilization $(1-\mu)$. When there is incomplete sterilization, $0 < \mu < 1$, the effect on demand due to the purchase or sale of foreign exchange will be ambiguous. The resulting change in the stock of federal bonds outstanding will tend to have an opposite effect on interest rates to that of the resulting change in base money. For example, a capital outflow results in foreign exchange sales. Corresponding to these sales are reductions in the money stock and the stock of privately held federal debt. But the former tends to increase rates in the short run while the latter has the opposite effect. With complete sterilization, $\mu = 0$, the same sale results only in the retirement of federal debt and this will also have an ambiguous effect on demand as will be argued below.

In summary, equations (3) and (4) insure that all policies which influence the balance of payments under fixed rates will also have some effect in the current period on the total stocks of money and bonds, depending, of course, on our assumption about μ. The coefficients of policy variables in the estimating equations therefore measure the impact of that policy variable on money income, net of the effects the resulting change in reserves has upon H^* and B_F^* and so upon income.[11] Generally

11. The importance of equations (3) and (4) to the empirical results is explored further in Appendix B. The above discussion indicates that the 'short run' in the present analysis includes the effect of the balance of payments on domestic portfolios in the current period, and the resulting effect on current income.

speaking, the result of this feedback from the foreign sector to money and bonds will be ambiguous in its effects on demand. Only in the absence of sterilization, $\mu = 1$, will the expected direction of the effect be clear. For example, in the case of capital outflows the resulting sale of foreign exchange then corresponds only to a reduction in the money stock, which we expect to have a deflationary impact.

With a flexible exchange rate system, equations (3) and (4) become assumptions about the financing of foreign exchange intervention, ΔR. Under flexible rates, only ΔR or changes in H and B_F will result in changes in the total stocks H^* and B_F^*. This influences the balance of payments, and induces adjustment of the exchange rate which may increase or decrease the nominal value of net exports depending on the relevant short run price elasticities. However, ΔR also influences the exchange rate directly. Therefore the coefficients of H and B_F, unlike that of ΔR, do not include the effect of direct federal intervention in the exchange market.

Keeping these remarks in mind, we now consider the sign of each impact multiplier in the order in which it appears in the estimating equations. Unless noted, we assume μ is not equal to one, since the following expectations would not change if we allowed explicitly for that case.

B_F: An increase in the predetermined component of privately held federal debt adds to private domestic wealth (except to the extent that taxpayers make a downward adjustment in their perceptions of their net worth on account of the present value of the stream of future taxes that is needed to cover the interest on the debt, and except to the extent these bonds are sold abroad). This also must be accompanied by federal

tax cuts or increased transfers.[12] On the other hand it presumably raises interest rates. It is not clear whether these inflationary wealth and income effects outweigh this deflationary interest effect. Moreover, increases in the rate of interest precipitate capital inflows and a purchase of foreign exchange if the exchange rate is fixed, or an appreciation of the exchange rate if it is flexible. But these foreign sector repercussions are generally ambiguous in their effects on demand as we have argued above and so the ambiguity of the effect of an increase in B_F is further enhanced.

B_{NF}: The analysis of the effects of an increase in privately held nonfederal debt is similar to that for B_F. To the extent that either government sells bonds to nonresidents rather than to residents, the increasedsale will be immediately accompanied by an inflow of capital. Since nonfederal debt is held to a greater extent by nonresidents than federal debt, the foreign sector repercussions may be more important in determining the total effects on demand of a change in B_{NF} than of the same change in B_F.[13] The relative effects on demand of B_F and B_{NF} will

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12. Since both federal and nonfederal taxes are endogenously determined, both respond when either government undertakes a policy that affects activity. The effect on income of the response of one government level's tax-transfer system to macropolicies of the other is always to reinforce the initial effect on income of that macropolicy. For example, a change in a federal policy variable (financed by a change in federal tax rates) which has the initial effect of increasing income, will result in a cut in nonfederal tax rates to offset the increase in nonfederal tax revenue. This reinforces the increase in income initiated by the federal government's policy. Consequently, in assessing the direction of the effect on income of a change in a policy variable controlled by a particular level of government, we need only consider the endogeneity of the tax-transfer system at that level of government.

13. See Wonnacott (1972) and Sheikh and Winer (1977) for discussion of the consequences of foreign bond sales by nonfederal governments. If there is no sterilization, for example, such a sale results in federal financing by money creation of nonfederal policies, via the intermediation of foreign capital markets and the foreign exchange fund of the federal government. We say, may be more important, because the ability of a bond sale to cause a capital inflow need not depend on the identity of the original buyer. The federal government may sell more bonds domestically, but as we have noted, this indirectly causes foreign repercussions by raising interest rates.

also depend upon the relative income elasticities of the two tax systems, as well as on the relative effects of marginal changes in respective tax rates.

G_F,G_{NF}: Federal and nonfederal government purchases not related to conditional grants add to final demand directly and indirectly through the multiplier.[14] As with B_F and B_{NF}, the relative effects of increases in G_F and G_{NF} also depend on the relative income elasticities of tax revenue and the relative effects of marginal changes in tax rates. However, we should expect the import content of G_{NF} to be less than that of G_F, partly because G_F includes relatively more national defence related purchases, so that foreign sector repercussions are more important in determining the total effects on demand of an increase in G_F. Moreover, since nonfederal governments make two-thirds of all government gross capital formation and since construction is one of the most highly nontraded industries, it is reasonable to anticipate a larger impact effect of G_{NF} under fixed rates at least.[15]

H: Base money creation adds to private wealth and depresses interest rates. It also must be accompanied by tax cuts and, under fixed exchange rates, sales of foreign exchange and secondary changes in stocks to the extent that capital outflows occur. If exchange rates are flexible these capital outflows will force a depreciation. We expect the inflationary wealth, interest rate and tax cut effects to dominate the ambiguous foreign sector repercussions initiated by capital outflows in the short run.

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14. We have made the assumption in constructing the series for G_{NF} and GC that federal conditional grants and nonfederal matching expenditures are equal. This is reasonable in view of the characteristics of the major conditional grant programs. See Carter (1971: Chapter 2).

15. Of course this assumes the absence of offsetting considerations with respect to changes in the two tax systems. This is unlikely, as we shall argue below when the sign of UC is considered.

P_f: The effect of a change in P_f, denominated in domestic currency, may be expected to be analogous to the ambiguous effect of a change in the exchange rate.

r_f: An increase in foreign interest rates r_f can be expected to cause capital outflows. The consequent sterilization under fixed exchange rates has ambiguous effects on demand. A depreciation results if exchange rates are flexible and this too has ambiguous effects on demand in the short run. With no sterilization under a fixed rate regime, the money stock will decrease if r_f increases, and so demand would be expected to fall unambiguously in that case.

ΔR: A purchase of foreign exchange under flexible rates influences the exchange rate directly, and indirectly because of the change in money and bond stocks used to finance this exchange market intervention. While the change in the money stock has a unidirectional effect on demand, the changes in the exchange rate and bond stocks do not. The net effect is therefore ambiguous.

GC: An increase in GC requires both federal and nonfederal taxes to increase. An increase in GC is thus equivalent to a balanced budget increase in expenditures for the (federal plus nonfederal) aggregate government sector as a whole.[16] This multiplier may be expected to be positive.

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16. Available data in Canada do not break these grant-related expenditures into their tax and transfer components, even though elementary theory would suggest this be done. For this reason GC contains both purchases and transfers to persons. The coefficient of this variable thus refers to the effect of an increase in purchases and transfers which leaves the purchase-transfer composition of GC unchanged.

UC: Increases in unconditional grants are accompanied by federal tax increases and (equal in value) nonfederal tax cuts. Thus the short run effect on demand depends on the relative impacts on demand of changes in the federal and nonfederal tax systems. A negative sign for the reduced form coefficient of UC, for example, would indicate that the effect on demand of the federal tax increase more than offsets an inflationary nonfederal tax cut of the same nominal value. It is reasonable to expect this to be the case since the federal tax menu in the present model includes almost all direct taxes and many of the important transfer programs.[17]

Y_f: Under fixed exchange rates, an increase in foreign income Y_f stimulates final demand indirectly by increasing net exports. A purchase of foreign exchange results which has an ambiguous effect on demand. However, the direct effect of net exports on demand may be expected to predominate in the short run.

τ: Since changes in τ were small during the 'fixed' rate period of the sixties, it is not expected during this period to play a significant role in explaining money income. However, this is not a reason for leaving out from the estimating equations a policy variable that did vary.[18]

Y_{-1}: We expect stability in the time path of Y. It is insured if the coefficient of Y_{-1} is less than one in absolute value.

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17. Provinces do levy income taxes. But it is a condition of the federal authorities that they will collect these taxes on behalf of the provinces only if they are levied according to the federal tax structure. T_F in the present model includes taxes levied by provincial governments but collected by the federal government. (In the present sample period only Quebec has collected all its own income taxes, while Ontario and Quebec have collected their own corporation taxes.)

18. During the fixed exchange rate period of the sixties, variation in P_f is dominated by variation in the foreign currency prices of imports, since variation in τ is quite small. Thus collinearity between P_f and τ is not a problem during this period. It may be when the sample period is extended to include the managed float period of the early seventies.

3. Numerical Results

Tables 1 to 2a present least squares estimates of equations (5) - (6) based on unadjusted quarterly data.[20]

In order to construct series for B_F and H we have made the assumptions that μ is constant over time.[21] B_F is then computed as

$$(16)\quad B_F(1-\mu)_{t=\theta} = \sum_{t=1}^{t=\theta} (\Delta B_F^* - (1-\mu)\Delta R); \; B_F = B_F^* \text{ when } t=0$$

No analogous adjustment of the stock B_{NF} is required since nonfederal governments do not intervene directly in foreign exchange markets. Both B_F and B_{NF} include nonresident and domestically held debt; there is no allowance in the estimating equations for the separate influences of foreign held, as opposed to domestically held, government debt.[22]

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20. Under appropriate assumptions, ordinary least squares regression leads to consistent estimators of these coefficients. See Christ (1966: 369-70, 374-78 and 468). Constant terms and seasonal dummies are not reported. Data sources, including Cansim numbers when appropriate, and the data are given in Winer (1975) or are available from the author upon request. Most of the data were assembled by constructing the federal and nonfederal government budget restraints, equations (1) and (2).

21. Published statistics do not in general allow us to discover what part of a newly printed dollar has been used to purchase foreign exchange or finance government deficits without a behavioural model of the central bank and the central government. The results present below do, however, contain some information about the degree of sterilization under fixed exchange rates. See Appendix B for an examination of the importance of this assumption to the results.

22. The aggregation of foreign held and domestically held debt is less justified at the nonfederal than at the federal level. In 1970 for example, 2.9 percent of federal debt was held by nonresidents while 30.3 percent of provincial debt and 24.9 percent of municipal debt was foreign held. See Strick (1973: 164-165).

H is computed as

$$(17) \quad H(\mu)_{t=\theta} = \sum_{t=1}^{t=\theta} (\Delta H^*_t - \mu \Delta R); \quad H = H^* \text{ when } t=0.$$

Each equation was then estimated for the alternative choices of μ:0, 1/2 and 1. Under fixed rates, μ=1 represents a situation in which, on average, no sterilization is possible even in the short run. On the other hand, μ=0 represents a situation in which sterilization is automatically conducted, at least within the quarter in which the change in reserves occurs. μ=1/2 is the intermediate case.

Table 1 contains estimation of (5) and (6) for the period 1947-2 to 1973-4.

This estimation was also conducted over several intervals chosen to coincide with either fixed or flexible exchange rates. They are: 1951-1 to 1962-1 — a floating exchange rate period; 1952-1 to 1961-1 — which omits the early and late parts of the 1950's floating period above during which exchange rates were not stable; and 1962-2 to 1970-1 — a period of fixed rates. Some results of estimation over the period 1962-2 to 1973-4 are also reported, assuming that the exchange rate was as if fixed during 1970-2 to 1973-4.[23] Table 2 contains estimates of (6) for the period 1951-1 to 1962-1 and for all choices of μ. Table 2a contains the estimates of (5) and (6) for the periods 1952-1 to 1961-1 and 1962-2 to 1970-1, and for all choices of μ.[24]

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23. The change in reserves from 70 to 73 was at least 200 million per year, while in 74, ΔR dropped to just under 60 million. This suggests that the exchange rate may have been managed between 70 and 73, even though it was de jure flexible.

24. Appendix A contains estimation of equations which, unlike (5) and (6), do not embody money illusion. In general, the results using these alternative equations support the conclusions made on the basis of (5) and (6).

All signs of coefficients in these tables are as expected with the following exceptions.[25] The coefficient of G_F for the period 47-2 to 73-4 given in Table 1, column 3 is negative. All coefficients of G_F for 62-2 to 70-1 in Table 2a, column 3 are also negative. However, in each case a 95 percent confidence interval for the true value of the coefficient of G_F contains positive values. The coefficient of GC is negative for all choices of μ in Table 2, column 9. Again, these coefficients are not significantly different from zero at the 95 percent level.

Finally, we note that the coefficient of H is negative, for a choice of μ of 1 for the subperiod 62-2 to 70-1 in Table 2a, column 5. It is also negative for μ=1/2 or 1 in Table 1 for the fixed rate periods. Together with the observation that the coefficient of r_f is <u>not</u> negative for a choice of μ of 1 under fixed exchange rates, these results suggest that a choice of μ of 1, a total absence of sterilization, or of μ=1/2 is not correct for any <u>fixed</u> rate period considered.

3.1 <u>Macroeconomic Importance of the Federal Structure</u>

We turn now to the results as they relate to the differential influences of federal and nonfederal governments and the influences of flows of funds between them.

Consider first the estimates of the influences on money income of federal and nonfederal net privately-held debt, columns 1 and 2 of Tables 1 through 2a. The rows of Table 3 tabulate the differences between these estimated coefficients. For the period as a whole (rows 1 and 2) these differences are significant. For intermediate length periods (Table 3 or 4, rows 3-5)

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25. We note as well that τ is unexpectedly significant for the period 62-2 to 70-1 when μ=0, column 12 of Table 2a.

the coefficients of federal and nonfederal debt tend not to be significantly different even at the 90 percent level. An exception is provided by the period 62-2 to 73-4 (row 6) but it is not clear to what extent this period can be treated as one of fixed exchange rates.[26]

The estimates of the influences of federal and nonfederal purchases not related to conditional grants are given in columns 3 and 4 of Tables 1 through 2a. For every sample period the coefficient of G_{NF} is larger than that of G_F. The coefficients of G_{NF} are significant during fixed and flexible rate periods in Table 1 while those of G_F are not significant under either exchange rate. Table 4 gives the differences in these estimated coefficients. These differential influences are significant for all fixed and flexible rate periods as a whole, and generally for all flexible rate subperiods.[27] For fixed rate subperiods, these differential influences are not significant.

The coefficient of GC is a measure of an aggregate government sector (impact) balanced budget multiplier. In Tables 2 and 2a, this multiplier is at most 0.82. But in Table 1, this multiplier takes on values between 1.3 and 2.5. These later estimates seem high.[28]

Consider now the estimated influences on income of unconditional grants, column 9 of Tables 1 through 2a. The coefficient of UC is always negative, as expected. This indicates that the impact of federal tax increases had

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26. The tests of the significance of the difference in coefficients reported in Table 3 (and Table 4 below) are exact, regardless of the significance of each coefficient taken alone.

27. The exception is the period 52-1 to 62-1, row 4 of Table 4.

28. The estimates of this multiplier given in Appendix A are also less than 1, except for the period 52-1 to 61-1.

a depressing influence on money income which outweighed the impact effects of an equal dollar value cut in nonfederal taxes.

These negative coefficients do not necessarily imply that in the long run unconditional grants reduce income. Presumably nonfederal governments respond to these flows by increasing purchases as well as cutting taxes or increasing transfers. Table 5 gives estimates of the lower bound of responses by nonfederal governments required to ensure the cumulative effect on income after two periods is positive.[29] These responses are assumed to be autonomous increases in nonfederal purchases G_{NF} one quarter following the unconditional grant. A value greater than 1 for this response indicates that more than 1 dollar of nonfederal purchases for every dollar of unconditional grants would have been required for $(Y_{t+1} - Y_{t-1})$ to be positive.

The fact that about 2/3 of the entries in Table 5 are larger than 1, especially for the fixed rate periods, rows 1, 5 and 6, stresses the importance of considering not only the influence of these grants on the recipient government, but also the means by which these grants are initially financed.[30] Such a consideration in the present study leads to negative impact multipliers. Larger nonfederal responses are then required to insure the ultimate effect of these grants is expansionary.[31]

29. See notes to Tables and Appendix C for derivation of the required response. As well as using previous subperiods, results based on estimation of (5) and (6) between substantial rearrangements of federal-provincial relations are also reported in Table 5. These later subperiods begin one quarter following the expiration of tax rental or tax sharing agreements prior to 1962, or fiscal arrangements acts after 1962.

30. This is invariably ignored in the literature. See for example the review article by Gramlich (1977).

31. We also conducted a test of the effect of federal-provincial negotiations on money income. Rearrangements of federal-provincial agreements have occurred about once every five years since 1945. By introducing a shift variable, with the shift occurring one quarter after the relevant legislation takes effect, it is possible to consider the net influence on income of federal and non-federal policy changes which are in response to the change in these central-local economic relations. The shift in this variable would then occur at the commencement of the subperiods in rows 7 to 10 of Table 5. This variable was not significant when included in equations (5) and (6), for any of the subperiods in rows 1 through 6, or for any combination of adjacent periods in rows through 10.

3.2 The Monetarist - Non-monetarist Controversy in a Small Open Economy

Our estimating equations of necessity also permit a consideration of the monetarist - nonmonetarist controversy.

The estimated size of the money income impact multiplier associated with a change in (the predetermined component of) the domestic monetary base, column 5 of Tables 1 and 2a, varies importantly with the exchange rate mechanism and the choice of the degree to which the (total) money stock is sterilized. For the shorter periods in Tables 2 and 2a, no unambiguous pattern with respect to either exchange rate of degree of sterilization is apparent. The influence on money income of the base relative to the influences of other policy variables is not clearly established either. These relative influences also depend upon the exchange rate mechanism and the choice of μ as well as on the sample period. However, it is clear that the domestic money stock is not all that matters in any explanation of Canadian money income.[32] During periods of fixed exchange rates U.S. income Y_f, column 11 of Table 2a, appears to be the single most important explanatory variable. With flexible rates, the U.S. interest rate r_f, column 7 of Table 2 is significant while base money is not. Moreover, nonfederal, non-grant-related purchases G_{NF} are of comparable influence in both exchange rate regimes, with the exception of the fixed rate period 62-2 to 70-1 with $\mu=0$, Table 2a, row 2.

This ambiguity disappears if we consider estimation of (5) and (6) over the period 1947-2 to 1973-4, given in Table 1. For this longer sample

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32. See Appendix B for a demonstration that failure to embody equations (3) and (4) in estimating equations can lead to upward bias in the impact effect of base money.

period, the size and significance of the coefficient of the monetary base is clearly greater in flexible than in fixed rate periods. This is certainly a Mundellian (1963) result. Moreover, for a given exchange rate mechanism, the size of the coefficient is larger the greater the degree of sterilization (or of bond financed intervention), i.e., the smaller the choice of μ. Nonfederal purchases are significantly important regardless of exchange rate, without exceptions.

4. Limitations

Before summarizing our conclusions, we acknowledge in this section several limitations of this empirical investigation in addition to those mentioned previously.

All policy variables of either level of government are assumed to be predetermined unless endogenously determined by the respective government budget restraints. Thus the reduced form estimates analyzed here are robust in the face of any behavioural model of government behaviour as long as it is one in which government decisions are based on lagged values of endogenous variables, but not current values of endogenous variables.[33] There is no explicit treatment of the financial sector. Hence the quantity of money as usually defined (cash plus deposits) does not appear here. There are various limitations in the data. For sample subperiods of less than 6 years, seasonally adjusted data was used because of the lack of sufficient degrees of freedom otherwise. Comparisons with estimates based on longer

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33. See Goldfeld and Blinder (1972: 594-597). This is reasonable in view of our use of quarterly data.

subperiods are thus made more difficult. The data could not be made to fit the budget restraints (1) and (2) exactly; Z_F and Z_{NF} were computed as residuals. Their influence is assumed to be captured by the constant terms of the estimating equations. Finally, since P_f, Y_f and τ do not appear in flexible period estimating equations, these periods provide more degrees of freedom. This makes comparison of the flexible period results with those from fixed rate periods more difficult.

5. Conclusions

In this paper we have developed and applied a method of investigating monetary-fiscal influences on money income in a federal system. Our approach has been to use a set of government budget restraints as the central element in the assembly of data, in the derivation of reduced form estimating equations and in the interpretation of results.

A summary of the main results for the Canadian case is as follows. They are intended to bear on two potentially related issues; the macroeconomic importance of the federal structure, and the monetarist-nonmonetarist controversy.

The results as a whole confirm that disaggregation by level of government is justified when considering monetary-fiscal influences in the Canadian federation. The domestic monetary base has probably had a greater impact on money income under flexible than under fixed exchange rates, as predicted in Mundell (1963). However, we conclude that nonfederal purchases appear to have been at least as important as the autonomous component of base money, regardless of exchange rate policy.[34] Moreover, there do appear to be

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34. This is consistent with the findings of Carr, Jump and Sawyer (1976: 119) using the Trace Mark IIIR model, that "fiscal policy is an effective instrument of demand management in Canada under flexible rates."

statistically significant differences in the impact effect on money income of federal and nonfederal purchases, and correspondingly (though not so clearly) for government debt.[35]

The influence of intergovernmental grants relative to other policy variables has not been clearly established here. However, the impact effect of unconditional grants appears to have been contractionary. In the present framework this implies that a change in the federal (or federally collected) tax-transfer system has had a greater impact on money income than an identical dollar value change at the nonfederal level. Moreover, the nonfederal responses required for these grants to have a positive cumulative effect on income after two quarters may be very large, though estimates of these responses vary considerably. This stresses the importance of considering not only the influence of these grants on the recipient government, but also the means by which they are initially financed by the donor.

The results also confirm the findings of many others that domestic policy is severely circumscribed by the openness of the economy. Under fixed rates, there is some evidence that within each quarter the central authorities sterilized at least half of any change in reserves. But this sterilization certainly did not insulate the Canadian economy even in the current quarter. Under fixed exchange rates, U.S. GNP may easily be considered the single most important explanatory variable. Hence even though the fixed rate results indicate domestic base money is not all that matters in an explanation of income, to the extent that U.S. income depends on the U.S. money stock, we

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35. This result, with respect to government purchases, is in accordance with Sheikh and Winer (1977) who found evidence of differential influences on both real output and prices, using a highly disaggregated model, Candide 1.2M.

agree with Friedman (1973) that:[36] "If you want to know what happens to Canadian income, you do better to know what happens to the U.S. money stock than to know what happens to the Canadian money stock." Under flexible rates, it is U.S. interest rates which enter significantly the estimating equations rather than U.S. GNP; the above remarks still apply to the extent that U.S. interest rates depend on the U.S. money supply in the short run.

However, while the importance of discretionary domestic policy would seem to be severely limited, our results suggest it is not absent. Non-federal fiscal policy does appear to be a significant determinant of money income under either exchange regime. Whether current institutional arrangements would allow us to make use of this result at reasonable cost is another matter.

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36. Friedman (1973: 17).

TABLE 1

Estimates of Equations (5) and (6) Explaining Money Income, Together Using a Multiplicative Dummy Variable (=0 if the Exchange Rate Is Fixed De Jure; =1 Otherwise)

Sample Period 1947-2 to 1973-4.

Estimated Coefficients (and t - Ratios)

μ Exchange Rate System	Eqtn.	B_F	B_{NF}	G_F	G_{NF}	H	P_f	r_f	ΔR	GC	UC	Y_f	τ	Y_{-1}	$\bar{Y}$	DW	S	R^2
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
μ=0. Fixed	5	- .22 (-1.91)	.16 (1.23)	- .88 (-1.06)	2.13 (3.01)	.30 (.41)	- .33 (-1.51)	1.51 (1.21)		1.40 (1.98)	-9.17 (-2.47)	.46 (2.68)	27.73 (1.47)	.19 (1.61)	119.6	2.185	2.318	.9992
Flexible	6	- .32 (-4.71)	.16 (3.38)	-1.00 (-1.91)	1.43 (3.92)	2.28 (10.43)		1.90 (3.21)	.05 (.21)	1.65 (5.57)	-4.46 (-3.22)			.23 (2.55)				
μ=1/2.																		
Fixed	5	- .34 (-2.32)	.21 (1.39)	- .83 (- .90)	2.15 (2.79)	- .04 (- .12)	- .31 (-1.30)	1.44 (1.10)		1.43 (2.01)	-8.84 (-2.21)	.50 (2.67)	25.30 (1.20)	.20 (1.45)	119.6	2.023	2.491	.9991
Flexible	6	- .31 (-4.39)	.31 (5.29)	- .56 (-1.00)	1.95 (4.82)	1.66 (9.12)		1.38 (2.15)	.25 (.93)	2.38 (6.87)	- .81 (- .50)			.18 (1.74)				
μ=1.																		
Fixed	5	- .30 (-1.92)	.17 (1.04)	- .64 (- .60)	2.00 (2.44)	- .18 (-1.00)	- .32 (-1.17)	1.32 (.90)		1.32 (1.73)	-8.39 (-1.87)	.48 (2.31)	23.75 (1.0)	.28 (1.76)	119.6	1.926	2.798	.9988
Flexible	6	- .26 (-3.00)	.33 (4.52)	- .12 (- .19)	2.04 (4.40)	1.05 (7.00)		1.21 (1.68)	.26 (.85)	2.51 (6.08)	- .05 (- .03)			.27 (2.24)				

Expected Signs.								(- if μ = 1)						
	5	?	?	+	+	+	?	?	na	+	-	+	?	> - 1
	6	?	?	+	+	+	na	?	?	+	-	na	na	< + 1

See notes to tables. Federal debt, column 1, appears as $B_F(1-\mu)$. When μ=1, $B_F(1-\mu)=B_F^*$. The monetary base, column 5, appears as H_μ. When μ=0, $H_\mu=H^*$.

TABLE 2

Estimates of Equations (5) and (6) Explaining Money Income Including Lagged Money Income as an Explanatory Variable
Estimated Coefficients (and t - Ratios)

μ / Sample Period / Exchange Rate		B_F (1)	B_{NF} (2)	G_F (3)	G_{NF} (4)	H (5)	P_f (6)	r_f (7)	ΔR (8)	GC (9)	UC (10)	Y_f (11)	τ (12)	Y_{-1} (13)	$\bar{Y}$ (14)	DW (15)	S (16)	R^2 (17)	df (18)
μ = 0	Eqtn.																		
1951-1 to 1962-1	6	-.05 (-.42)	.11 (.74)	.02 (.04)	2.42 (3.40)	.34 (.54)		1.66 (2.62)	.22 (.52)	-1.02 (-.69)	-.79 (-.31)			.51 (3.47)	78.1	2.584	1.679	.9927	31
Flexible																			
μ = 1/2																			
1951-1 to 1962-1	6	-.04 (-.38)	.12 (.85)	.12 (.21)	2.53 (3.54)	.24 (.44)		1.70 (2.66)	.31 (.71)	-.95 (-.64)	-.79 (-.30)			.51 (3.44)	78.1	2.575	1.684	.9927	31
Flexible																			
μ = 1	6																		
1951-1 to 1962-1		-.04 (-.35)	.13 (.88)	.18 (.33)	2.56 (3.45)	.14 (.29)		1.71 (2.15)	.34 (.70)	-.92 (-.62)	-.68 (-.25)			.52 (3.45)	78.1	2.562	1.688	.9927	31
Flexible																			

Expected Signs For All Tables		B_F (1)	B_{NF} (2)	G_F (3)	G_{NF} (4)	H (5)	P_f (6)	r_f (7)	ΔR (8)	GC (9)	UC (10)	Y_f (11)	τ (12)	Y_{-1} (13)	
	6 Flex. Rates (15)	?	?	+	+	+	na	?	?	+	-	na	na	> - 1	
	5 Fix Rates (14)	?	?	+	+	+	?	?	na	+	-	+	?	< + 1	
								(- if μ = 1)							

na: not applicable

See Notes to Tables. Federal debt, column 1 in Tables 2-2a appears as $B_{F(1-\mu)}$ where μ = degree of monetization of change in reserves under fixed rates, or degree of money-financing of exchange intervention under flexible rates. When μ = 1, $B_{F(1-\mu)} = B_F^*$. The monetary base, column 5 of Tables 2-2a, appears as H_μ. When μ = 0, $H_\mu = H^*$.

TABLE 2a

Estimates of Equations (5) and (6) Explaining Money Income Including Lagged Money Income as an Explanatory Variable

Estimated Coefficients (and t-Ratios)

μ Sample Period Exchange Rate		B_F (1)	B_{NF} (2)	G_F (3)	G_{NF} (4)	H (5)	P_f (6)	r_f (7)	AR (8)	CC (9)	UC (10)	Y_f (11)	τ (12)	Y_{-1} (13)	$\bar{Y}$ (14)	DW (15)	S (16)	R^2 (17)	df (18)
μ=0	Eqtn.																		
1952-1 to 1961-1 Flexible	6	-.10 (-.72)	.10 (.57)	.03 (.03)	2.18 (0.91)	.19 (.28)		1.78 (2.19)	.89 (1.04)	.01 (.00)	-.96 (-.26)			.51 (2.98)	78.2	2.109	1.717	.9908	23
1962-2 to 1970-1 Fixed	5	-.06 (-.80)	.06 (.48)	-.54 (-.75)	.34 (.65)	1.35 (3.10)	-.26 (-.66)	2.35 (2.96)		.34 (.69)	-1.84 (-.83)	.85 (6.61)	-197.72 (-2.24)	-.23 (-1.22)	151.6	2.215	1.066	.9995	16
μ=1/2																			
1952-1 to 1961-1 Flexible	6	-.09 (-.70)	.11 (.63)	.09 (.07)	2.22 (1.89)	.11 (.18)		1.81 (2.22)	.98 (1.16)	.08 (.03)	-.82 (-.24)			.52 (3.02)	78.2	2.105	1.719	.9907	23
1962-2 to 1970-1 Fixed	5	-.23 (-1.97)	.14 (.93)	-1.39 (-1.38)	.25 (.30)	.26 (.81)	.10 (.17)	1.50 (1.59)		.30 (.38)	-1.66 (-.60)	.81 (4.98)	-208.04 (-1.58)	.03 (.16)	151.6	1.983	1.343	.9991	16
μ=1																			
1952-1 to 1961-1 Flexible	6	-.09 (-.69)	.12 (.65)	.14 (.11)	2.22 (1.85)	.04 (.07)		1.81 (2.22)	1.02 (1.17)	.11 (.04)	-.70 (-.20)			.53 (3.07)	78.2	2.101	1.722	.9907	23
1962-2 to 1970-1 Fixed	5	-.16 (-1.23)	.12 (.72)	-.95 (-.88)	.86 (1.04)	-.11 (-.69)	-.16 (-.27)	1.40 (1.42)		.82 (1.08)	-1.63 (-.56)	.78 (4.61)	-125.98 (-.95)	.04 (.18)	151.6	1.816	1.407	.9990	16

TABLE 3

Differential Incluences on Money Income of $B_{F(1-\mu)}$ and B_{NF} Based

On Equations Including Lagged Money Income as an Explanatory Variable.

Differences of Estimated Coefficients (and t-Ratios)

	Sample Period	Exchange Rate	μ=0	μ=1/2	μ=1	$B_F(\mu=0)$	$B_F(\mu=1/2)$	B_F^*	B_{NF}
						Means (and Standard Deviations)			
			(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	1947-2 to 1973-4	Fixed	-.38 (-1.8)	-.55 (-2.5)	-.47 (-1.7)	136.7 (24.4)	144.4 (29.2)	152.1 (34.4)	110.8 (68.6)
(2)		Flexible	-.50 (-5.1)	-.62 (-4.5)	-.59 (-4.1)				
(3)	1951-1 to 1962-1	Flexible	-.16 (-.7)	-.16 (-.7)	-.17 (-.8)	115.1 (8.5)	118.9 (9.6)	122.7 (10.7)	66.2 (21.4)
(4)	1952-1 to 1961-1	Flexible	-.20 (-.8)	-.20 (-.8)	-.21 (-.8)	112.8 (6.8)	117.6 (7.6)	122.3 (8.6)	64.7 (17.2)
(5)	1962-2 to 1970-1	Fixed	-.12 (-.7)	-.37 (-1.6)	-.28 (-1.1)	148.0 (9.4)	158.6 (9.4)	169.2 (9.8)	154.0 (27.6)
(6)	1962-2 to 1973-4	As if Fixed	-.35 (2.4)	-.36 (2.0)	-.26 (-1.4)	158.4 (18.9)	171.6 (22.2)	184.8 (25.8)	177.9 (43.2)

TABLE 4

Differential Influences on Money Income of G_F and G_{NF} Based on

Equations Including Lagged Money Income as an Explanatory Variable

Differences of Estimated Coefficients (and t-Ratios)

	Sample Period	Exchange Rate	μ=0	μ=1/2	μ=1	G_F	G_{NF}	GC	UC
						Means (and Standard Deviations)			
			(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)	1947-2 to 1973-4	Fixed	-3.01 (-2.8)	-2.98 (3.2)	-2.64 (-2.5)	7.5 (3.7)	10.8 (7.8)	5.6 (6.8)	0.9 (1.0)
(2)		Flexible	-2.43 (-4.0)	-2.51 (-3.6)	-2.16 (-2.8)				
(3)	1951-1 to 1962-1	Flexible	-2.40 (-2.6)	-2.41 (-2.6)	-2.38 (-2.5)	6.2 (0.9)	6.0 (1.8)	1.2 (0.9)	0.3 (0.3)
(4)	1952-1 to 1961-1	Flexible	-2.15 (-1.6)	-2.13 (-1.2)	-2.08 (-1.0)	6.4 (0.6)	5.9 (1.5)	1.0 (0.7)	0.3 (0.3)
(5)	1962-2 to 1970-1	Fixed	-.88 (-1.0)	-1.64 (-1.5)	-1.81 (-1.6)	8.8 (1.9)	14.3 (3.7)	7.7 (3.2)	1.2 (0.4)
(6)	1962-2 to 1973-4	As if Fixed	-1.19 (-1.2)	-1.34 (-1.1)	-.97 (-.8)	10.5 (3.1)	17.9 (6.6)	11.6 (6.5)	1.7 (0.9)

TABLE 5

Non-Federal Autonomous Response $\Delta G_{NF_{t+1}} / \Delta GC_t$ Required to Insure $Y_{t+1} - Y_{t-1}$ Is Positive, Based on Equations (5) and (6) Including Lagged Money Income as an Explanatory Variable

Lower Bound on Required Response.

	Sample Period	Exchange Rate	μ=0	μ=1/2	μ=1		Sample Period	Exchange Rate	μ=0	μ=1/2	μ=1
			(1)	(2)	(3)				(4)	(5)	(6)
(1)	1947-2 to 1973-4	Fixed	5.1	4.0	5.4	(7)	1947-2 to 1950-3	Fixed	0.1	2.3	2.3
(2)		Flexible	3.8	0.5	0.0	(8)	1952-2 to 1957-1	Flexible	3.2	3.2	3.2
(3)	1951-1 to 1962-1	Flexible	0.5	0.5	0.4	(9)	1957-2 to 1962-1	Flexible	2.6	2.3	2.2
(4)	1952-1 to 1961-1	Flexible	0.6	0.6	0.5	(10)	1962-2 to 1967-1	Fixed	1.3	0.2	0.2
(5)	1962-2 to 1970-1	Fixed	4.2	6.8	2.0						
(6)	1962-2 to 1973-4	As if Fixed	2.2	2.2	2.3						

See notes to Tables

NOTES TO TABLES

1. All data used in regression equations are in hundreds of millions of seasonally unadjusted current dollars except r^, Y^. and **T** which are respectively in percent (the nominal yield on U.S. **3-5** year bonds), billions of (seasonally adjusted) U.S. dollars, and dollars Canadian per dollar U.S. , and P^. which is a Canadian currency price index with **196l = 100.**

2. All sample periods refer to the number of observations of the dependent variable **V**

3. Estimates of constant terms and seasonal dummies are not reported.

4. t statistics are in brackets.

5. Y is the mean of money income in the sample period in hundreds of millions of current dollars per quarter.

6. DW is the Durbin-Watson statistic. The Durbin 'H' statistic, appropriate when lagged values of the dependent variable appear on the right hand side, is not reported in Tables **1** to **2a** since it was undefined in all but one case.

7. S is the standard error of the residuals.

8. R is the squared multiple correlation coefficient, unadjusted for degrees of freedom.

9. df is the degrees of freedom, equal to the number of observations less the number of explanatory variables in the regression.

Table **1**

1. Each variable was entered twice in the estimating equations given in Table **1** using a multiplicative dummy variable **(=0** if the exchange rate is fixed de jure, **=1** otherwise).

2. The number of fixed exchange rate periods is 46 (excluding **1947-1**); the number of flexible exchange rate periods is **6l.** The fixed rate periods are **1947-2** to **1950-3** and **1962-2** to **1970-1.** The flexible rate periods are **1950-4** to **1962-1** and **1970-2** to **1973-4.**

3. The periods **1961-2** to **1962-1** and **1970-2** to **1973-4** may be classified as either de facto, as opposed to de jure, fixed or flexible. Thus there are **4** possible 'de facto' classifications for the period **1947-2** to **1973-4** as a whole. All four were tried. It did not matter much to the results how the transitional period from fixed to flexible rates in the early sixties was classified. But treating the recent float **(1970-2** to **1973-4)** as a period of effectively managed or fixed rates did produce results quite different from treating this period as one of floating rates.

Tables **2** and **2a**

1. Numbering of columns corresponds to that of Table **1.**

Tables 3 and 4

1. Calculations are based on estimates given in Tables 1 to 2a.

2. The t statistic in round brackets is appropriate for a test of the null hypotheses that the difference in the indicated coefficients is not significantly different from zero.

Table 5

1. $\Delta G_{NF_{t+1}} / \Delta UC_t = \dfrac{-(1 + \Delta Y_t / \Delta Y_{t-1}) \cdot \Delta Y_t / \Delta UC_t}{\Delta Y_t / \Delta G_{NF_t}}$ is the autonomous response required to ensure $Y_{t+1} - Y_{t-1} = 0$, when it is assumed that nonfederal governments adjust G_{NF} with a one period lag to changes in inter-governmental flow variables. See Appendix C for the derivation of this result.

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The Problem of Money Illusion: Some Alternative Estimating Equations

In addition to equations (5) and (6) we have also chosen to estimate equations for money income which do not embody money illusion.

Consider equation (5) which is appropriate for fixed exchange rate periods. If money illusion is not embodied in (5), division of both sides by prices P should yield real income as a function of real quantities and/or relative prices. Equation (5) divided by P may be written as

$$(A1)\quad \frac{P\cdot y}{P} = \frac{\alpha_1}{P} + \alpha_2 \frac{P\cdot b_F}{P} + \alpha_3 \frac{P\cdot b_{NF}}{P} + \alpha_4 \frac{P\cdot g_F}{P} + \alpha_5 \frac{P\cdot g_{NF}}{P}$$

$$+ \alpha_6 \frac{P\cdot h}{P} + \alpha_7 \frac{P_f}{P} + \alpha_8 \frac{r_f}{P} + \alpha_{10} \frac{P\cdot gc}{P} + \alpha_{11} \frac{P\cdot uc}{P}$$

$$+ \alpha_{12} \frac{P\cdot(P_f/P)(y_f)}{P} + \alpha_{13} \frac{\tau}{P} + \alpha_{14} \frac{P_{-1}y_{-1}}{P} ,$$

where lower case letters are analogous to previously defined variables, but are in real terms.

If $\alpha_1 = \alpha_8 = \alpha_{13} = 0$, y depends only on relative prices and real quantities. In that case when all prices double, and P_f (but not τ) is assumed to be one of those prices, all relative prices and real quantities including y are unchanged. But the constant term α_1 cannot be expressed as the product of a price and a real quantity, nor can the foreign interest rate r_f. Moreover, the exchange rate is not considered here as one of those prices that doubles when a test for the presence of money illusion is performed, because the purchasing power parity doctrine dictates that τ equals the ratio of domestic to foreign price levels. Consequently, equation (5) implies real income is a function of the price level.

An equation like (5) or (6) results if, for example, we assume the structural equations of the underlying model to be linear in the predetermined variables. However, if alternative assumptions are made about the functional form of the structural equations of this model, for example that behavioral equations are log linear rather than linear in predetermined variables other than r_f and τ, we may write the reduced from as:

$$(A2)\quad Y = \alpha_1 \cdot B_F^{\alpha_3} \cdot B_{NF}^{\alpha_3} \cdot G_F^{\alpha_4} \cdot G_{NF}^{\alpha_5} \cdot H^{\alpha_6} \cdot P_f^{\alpha_7} \cdot GC^{\alpha_8} \cdot UC^{\alpha_9} \cdot Y_f^{\alpha_{10}} \cdot Y_{-1}^{\alpha_{11}} \cdot e^{\alpha_{13} r_f + \alpha_{14} \tau}.$$

This functional form for money income is one which does not embody money illusion if a certain restriction on the coefficients is maintained.

Dividing (A2) by P yields

$$(A3)\quad y = \alpha_1 b_{NF}^{\alpha_2} \cdot b_F^{\alpha_3} \cdot g_F^{\alpha_4} \cdot g_{NF}^{\alpha_5} \cdot h^{\alpha_6} \cdot (P_f/P)^{\alpha_7} \cdot gc^{\alpha_8} \cdot uc^{\alpha_9} \cdot ([P_f/P] \cdot y_f)^{\alpha_{10}} \cdot (P_{-1}/P) y_{-1}^{\alpha_{11}} \cdot e^{\alpha_{13} r_f + \alpha_{14} \tau} \cdot p^{\sum_{i=2}^{11} \alpha_i - 1}.$$

Thus (A3) implies y depends only on relative prices and real quantities if

$$(A4)\quad \sum_{i=2}^{11} \alpha_i = 1.$$

Imposing (A4) on (A3) by substitution for α_{11} and transforming (A3) as amended into log form yields the estimating equation for fixed exchange rate periods:

$$(A5)\quad \log (Y/Y_{-1}) = \log \alpha_1 + \alpha_2 \log (B_F/Y_{-1}) + \alpha_3 \log (B_{NF}/Y_{-1})$$

$$+ \alpha_4 \log (G_F/Y_{-1}) + \alpha_5 \log (G_{NF}/Y_{-1})$$

$$+ \alpha_7 \log (P_f/Y_{-1}) + \alpha_8 \log (GC/Y_{-1})$$

$$+ \alpha_9 \log (UC/Y_{-1}) + \alpha_{10} \log (Y_f/Y_{-1})$$

$$+ \alpha_{13} r_f + \alpha_{14} \tau.$$

The analagous equation for flexible rate periods is derived from (A5) by imposing the additional restriction $\alpha_7 = \alpha_{10} = 0$, and adding the term $\alpha_{12} \log (\Delta R/Y_{-1})$. Equation (A5) so restricted, equation (A6), need not be stated explicitly.*

Equations (A5) and (A6) are not to be viewed as being unambiguously better than (5) and (6) a priori. It may be argued that we should expect some temporary money illusion, or something that is equivalent to it, because some changes in economic variables may not be perfectly anticipated within each quarter.

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* Since ΔR is sometimes negative, $\log(\Delta R/Y_{-1})$ must be omitted and $\log ([C + \Delta R]/Y_{-1})$ such that $C + \Delta R > 0$, C = constant, used instead. However, only estimation of (A6) excluding this variable ($\alpha_{12} = 0$) is reported. This variable was never significant. Moreover, its inclusion tended to make the coefficients of $\log(G_F/Y_{-1})$ more negative.

The results of estimation over periods corresponding to those in Tables 2 and 2a are given in Table Aa. Tables Ab and Ac contain tests on the difference in coefficients, corresponding to Tables 3 and 4 respectively.

Let us consider briefly results using (5) - (6) to those when (A5) - (A6) are used. Equations (5) and (6) appear to work reasonably well. In particular, the lagged income term, column 13 in Tables 1 to 2a, does not capture an overwhelming part of the variation in income. However, with flexible exchange rates, a test of the hypothesis that money illusion is absent is clearly not rejected at the 95 percent level.* Hence it would seem that results using (A6) are to be preferred to estimates of (6). But the same test in fixed rate periods yields the opposite conclusion. Moreover, the Durbin-Watson statistics for (A6) lie in the inconclusive region. Consequently, it would appear that the choice between (5) - (6) and (A5) - (A6) depends on <u>a priori</u> belief with respect to the existence of money illusion in the short run.

Finally, we note the entries in Table Aa are not impact multipliers. However, let d log (Y/Y_{-1})/d log (X/Y_{-1}) = b, where X ≡ GC, and b is the estimate of the coefficient of GC in equation (A5) or (A6) given in column 9. Assuming the elasticity to be measured at the mean of X and Y, and setting $dY_{-1} = 0$ since we are interested in impact multipliers, an estimate of the impact multiplier dY/dX is $b \cdot (\bar{Y}/\bar{X})$. The appropriate $\bar{Y}$ is given in Tables 1 to 2a, column 14. The appropriate $\bar{X}$ is given in Tables 3 and 4, columns 4 to 7.

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* The test consists of estimation of the unconstrained log form of (A5) and (A6), and use of the t statistic appropriate for a test of the null hypothesis that $\Sigma\alpha$ is not significantly different from 1. These t values are given in Table Aa, column 14.

TABLE Aa

Estimates of Equations (14) and (15) Explaining Money Income (Deflated by Lagged Income) Which Do Not Embody Money Illusion.

Variables Deflated by Lagged Money Income (Before Logs Taken).

Estimated Coefficients (and t - Ratios).

μ Sample Period Exchange Rate		$\log B_F$ (1)	$\log B_{NF}$ (2)	$\log G_F$ (3)	$\log G_{NF}$ (4)	$\log H$ (5)	$\log P_f$ (6)	r_f (7)	$\log GC'$ (9)	$\log UC$ (10)	$\log Y_f$ (11)	τ (12)	$\Sigma\alpha$ $[R^2]$ (14)	DW (15)	S (16)	R^2 (17)	df (18)
μ= 0. 1951-1 to 1962-1 Flexible	Eqtn. A6	.02 (.15)	-.02 (-.24)	.01 (.25)	.26 (3.20)	.25 (1.36)		.02 (1.93)	-.003 (-.12)	-.01 (-1.17)			.75 [.9879] t = -1.1	2.496	.028	.9606	33
μ= 1/2													.78 [.9881]	2.538	.028	.9613	33
1951-1 to 1962-1 Flexible	A6	.01 (.11)	.03 (.29)	.03 (.47)	.28 (3.42)	.22 (1.62)		.02 (1.97)	.001 (.03)	-.01 (-1.29)			t = -1.0				
μ= 1													.77 [.9882]	2.585	.028	.9613	33
1951-1 to 1962-1 Flexible	A6	(.04) (.56)	.05 (.48)	.04 (.80)	.29 (3.55)	1.13 (1.67)		.02 (1.94)	.004 (.16)	-.01 (-1.29)			t = -1.1				

See notes to tables. Federal debt, column 1 in Table Aa appears as $\log B_F(1-\mu)/Y_{-1}$. When μ=1, $B_F(1-\mu) = B_F^*$. The Monetary base, column 5 of Table Aa appears as $\log H_\mu/Y_{-1}$. When μ=0, H_μ=H*.

TABLE Aa continued

Estimates of Equations (14) and (15) Explaining Money Income (Deflated by Lagged Income) Which Do Not Embody Money Illusion.

Variables Deflated by Lagged Money Income (Before Logs Taken).

Estimated Coefficients (and t - Ratios).

μ Sample Period Exchange Rate		log B_F (1)	log B_{NF} (2)	log G_F (3)	log G_{NF} (4)	log H (5)	log P_f (6)	r_f (7)	log GC (9)	log UC (10)	log Y_f (11)	τ (12)	Eq. $[R^2]$ (14)	DW (15)	S (16)	R^2 (17)	df (18)
μ = 0	Eqtn																
1952-1 to 1961-1 Flexible	A6	.01 (.05)	-.01 (-.79)	-.08 (-.78)	.29 (3.08)	.37 (1.81)		.02 (1.46)	.02 (.63)	-.02 (-1.87)			.57 [.9879] t = 1.5	2.594	.024	.9707	25
1962-2 to 1970-1 Fixed	A5	-.20 (-1.34)	.19 (.81)	-.02 (-.22)	.02 (.21)	.13 (.55)	-.04 (-.22)	.01 (.95)	.03 (.67)	-.01 (-.39)	1.04 (2.97)	-.93 (-.94)	1.34 [.9976] t = 2.6	2.058	.015	.9833	17
μ = 1/2																	
1952-1 to 1961-1 Flexible	A6	.04 (.41)	-.06 (-.47)	-.06 (-.60)	.31 (3.17)	.24 (1.61)		.01 (1.40)	.02 (.77)	-.02 (-1.85)			.53 [.9877] t = -1.5	2.631	.026	.9700	25
1962-2 to 1970-1 Fixed	A5	-.34 (-1.29)	.28 (1.00)	-.02 (-.23)	.00 (.02)	-.0001 (-.00)	.09 (.50)	.01 (.83)	.02 (.45)	-.01 (-.41)	1.10 (2.73)	-1.68 (-.91)	1.55 [.9976] t = 2.8	2.092	.015	.9826	17
μ = 1																	
1952-1 to 1961-1 Flexible	A6	.08 (.85)	-.04 (-.29)	-.05 (-.45)	.32 (3.16)	.14 (1.45)		.01 (1.34)	.03 (.84)	-.02 (-1.79)			.49 [.9876] t = -1.5	2.651	.026	.9694	25
1962-2 to 1970-1 Fixed	A5	-.27 (-.86)	.20 (.70)	-.003 (-.03)	.05 (.35)	-.02 (-.92)	.06 (.26)	.004 (.67)	.03 (.66)	-.01 (-.31)	1.01 (2.45)	-.87 (-.67)	1.45 [.9975] t = 2.4	2.078	.015	.9820	17

TABLE Ab

Differential Influences on Money Income (Deflated by Lagged Income) of $B_{F(1-\mu)}$ and B_{NF} (Deflated by Lagged Income) Based on Equations Which Do Not Embody Money Illusion

Differences of Estimated Coefficients (and t - Ratios)

Sample Period	Exchange Rate	μ=0	μ=1/2	μ=1
		(1)	(2)	(3)
(3) 1951-1 to 1962-1	Flexible	.04 (0.3)	-.02 (-.1)	-.01 (-.1)
(4) 1952-1 to 1961-1	Flexible	.02 (0.1)	.10 (0.5)	.12 (0.6)
(5) 1962-2 to 1970-1	Fixed	-.39 (-1.1)	-.62 (-1.3)	-.47 (-.9)

TABLE Ac

Differential Influences on Money Income (Deflated by Lagged Income) of G_F and G_{NF} (Delated by Lagged Income) Based on Equations Which Do Not Embody Money Illusion.

Differences of Estimated Coefficients (and t - Ratios)

Sample Period	Exchange Rate	μ=0	μ=1/2	μ=1
		(1)	(2)	(3)
(3) 1951-1 to 1962-1	Flexible	-.25 (-2.6)	-.25 (-2.8)	-.25 (-2.6)
(4) 1952-1 to 1961-1	Flexible	-.37 (-2.3)	-.37 (-2.3)	-.37 (-2.2)
(5) 1962-2 to 1970-1	Fixed	-.04 (-.3)	-.02 (-.1)	-.05 (-.3)

See Notes to Tables

Appendix B

Estimation When Sterilization is Ignored, or H and B_F Are Endogenous

The assumptions about sterilization of a constant fraction of the balance of payments, equations (3) and (4), imply that the total stocks of base money and federal debt do not enter <u>together</u> any reduced form equation for money income. To expose the role these assumptions play in determining the results of Tables 1 through 2a, it is instructive to compare these results to the results of estimation when H^* and B_F^* are used at the same time as explanatory variables. The total stocks of H^* and B_F^* would enter the reduced form equations for money income either if equations (3) and (4) were ignored, or if ΔH^* and ΔB_F^* were considered to be predetermined thus leaving ΔH and ΔB_F as the components of the (predetermined) changes in the total stocks 'left over', for financing of the federal deficit for example, after sterilization had been financed.

Table B1 presents estimates of equations (5) and (6) except that B_F^* and H^* appear together, for the sample periods found in Tables 2 to 2a. The most apparent differences between these previous results which do explicitly allow for sterilization and those of Table B1 are in the fixed exchange rate period 62-2 to 70-1, expecially with respect to the coefficients of G_{NF}, H^*, P_f, GC and Y_{-1}. This is as expected. Changes in reserves are more important in periods of fixed exchange rates since federal intervention in the foreign exchange market, ΔR, has been of relatively small magnitude during flexible rate periods. Nonetheless, Table B1 indicates that lack of attention to the financing of ΔR in flexible periods results in estimates of the influence of base money that are as large or larger than those estimates given in Tables 2 and 2a.

Table B2 presents estimates of equations (A5) and (A6) similarly amended. As for the results given in Table B1, these estimates differ more from the corresponding estimates in Table Aa for the fixed exchange rate periods. The difference is most apparent if the coefficients of G_{NF}, H^* and P_f are compared. Again, with flexible rates the estimate of the coefficient of H^* when financing of foreign exchange market intervention is ignored is as large or larger than if such financing is made explicit, except for the period 51-1 to 62-1 with μ=1.

Finally, we note that just as for flexible rate periods, the coefficient of base money in Tables B1 and B2 under fixed rates is larger than the corresponding estimates in the earlier Tables.

TABLE B1

Estimates of Equations (5) and (6) Explaining Money Income Including Lagged Money Income as an Explanatory Variable.
Sterilization is Ignored or H_{μ} and $B_{F(1-\mu)}$ Are Endogenous.

Estimated Coefficients (and t-Ratios).

Sample Period and Exchange Rate System.	D_F^* (1)	B_{NF} (2)	G_F (3)	G_{NF} (4)	H^* (5)	P_f (6)	r_f (7)	ΔR (8)	GC (9)	UC (10)	Y_f (11)	τ (12)	Y_{-1} (13)	$\bar{Y}$ (14)	DW (15)	S (16)	R^2 (17)	df (18)
1951-1 to	-.04	.11	.05	2.45	.34		1.67	.25	-1.04	-.84			.52	78.1	2.589	1.680	.9927	31
1962-1 Flexible.	(-.37)	(.70)	(.08)	(3.48)	(.59)		(2.61)	(.65)	(-.69)	(-.33)			(3.46)					
1952-1 to	-.09	.10	.05	2.23	.19		1.80	.96	.00	-.94			.52	78.2	2.110	1.719	.9907	23
1961-1 Flexible.	(-.68)	(.57)	(.04)	(1.94)	(.28)		(2.20)	(1.13)	(.00)	(-.28)			(3.01)					
1952-2 to	-.10	.08	-.79	.06	1.44	-.12	(2.33)		.10	-1.85	.86	-235.12	-.21	151.6	2.318	1.050	.9995	16
1970-1 Fixed.	(-1.06)	(.63)	(-1.25)	(.12)	(3.68)	(-.27)	(2.98)		(.22)	(-.88)	(6.74)	(-2.69)	(-1.21)					

See Notes to Tables

TABLE B2

Estimates of Equations (A5) and (A6) Explaining Money Income (Deflated by Lagged Income) Which Do Not Embody Money Illusion.

Sterilization Is Ignored or H_{μ} and $B_{F(1-\mu)}$ Are Endogenous.

Variables Deflated by Lagged Money Income (Before Logs Taken).

Estimated Coefficients (and t - Ratios)

Sample Period and Exchange Rate System.	log B_F^* (1)	log B_{NF} (2)	log G_F (3)	log G_{NF} (4)	log H^* (5)	log P_f (6)	r_f (7)	log GC (9)	log UC (10)	log Y_f (11)	τ (12)	$\Sigma\alpha_1$ [R^2] (14)	DW (15)	S (16)	R^2 (17)	df (18)
1951-1 to 1962-1 Flexible.	.01 (.07)	-.02 (-.23)	.01 (.22)	.26 (3.20)	.27 (1.43)		.02 (1.92)	-.002 (-.10)	-.01 (-1.20)			.73 [.9880]	2.4962	.028	.9605	33
1952-1 to 1961-1 Flexible.	.01 (.07)	-.10 (-.79)	-.08 (-.78)	.30 (3.12)	.36 (1.81)		.02 (1.46)	.02 (.63)	-.02 (-1.85)			.60 [.9878]	2.595	.026	.9707	25
1962-2 to 1970-1 Fixed.	-.28 (-.93)	.21 (.73)	-.08 (-1.09)	-.03 (-.22)	.24 (1.13)	-.04 (-.15)	.01 (.94)	.01 (.22)	-.01 (-.40)	1.10 (2.78)	-1.47 (-1.28)	1.46 [.9976]	2.119	.015	.9824	17

See Notes to Tables

Appendix C

Derivation of Lower Bound on Nonfederal Responses Required to Insure an Increase in UC Leads to an Increase in Y After Two Periods

We define the impact on income of these nonfederal autonomous responses as

$$(C1) \qquad b_4 \cdot \psi(UC) = b_4 \cdot (\Delta G_{NF_{t+1}} / \Delta UC_t)$$

where b_4 is the estimate of the coefficient of G_{NF} in column 4, Tables 1 to 2a. With respect to equations (5) and (6), the impact multiplier of a step change in UC is

$$(C2) \qquad \Delta Y_t / \Delta UC_t = b_{10}$$

where b_{10} is the estimated coefficient of UC, Tables 1 to 2a, column 10. The effect on Y after one period is then

$$(C3) \qquad \Delta Y_{t+1} / \Delta UC_t = (1+b_{13})b_{10} + b_4 \cdot \psi(UC_t)$$

where b_{13} is the estimated coefficient of Y_{-1}, Tables 1 to 2a, column 13. The elements of Table 5 are derived by setting the RHS of (C3) equal to zero and solving for ψ.