The Dynamics of Interest Rate Adjustment in Response to Monetary and Fiscal Changes

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One of the central issues facing policy makers is the empirical relation between monetary and fiscal changes and the rate of interest. Does the equilibrium interest rate fall, remain unchanged, or rise as a result of a monetary and/or fiscal disturbance? Alternatively, we may ask whether in the Hicksian framework the IS curve is downward sloping, horizontal, or upward sloping? Its slope has implications not only for the conduct of monetary policy but also for the much discussed "crowding out" effect and the effectiveness of fiscal policy.

In a paper considered by many to have considerably advanced our understanding of the money-interest relationship, and which continues to be widely cited by economists of a monetarist persuasion (Laidler 1978 and Frenkel 1975, for example), Gibson 1970 empirically investigates the dynamics of the money-interest relation and in particular the time path of interest rate change in response to a change in the money stock. He essentially uses a simplified version of the Hicksian IS-LM construct to produce theoretical results that are sensitive to some special assumptions, and the test of his simplified theoretical model depends mainly on whether the structure of coefficients generated by regressing the interest rate variable on (the logarithm of) current and lagged money variables corresponds to the lag structure proposed by the model. In this study we question the empirical relevance of his *emphasized* theoretical assumptions as well as his statistical inferences since the latter are based on the former. This is done in Section I. In Section II we extend Gibson's results in a couple of directions and in so doing point to some possible limitations of his statistical methodology. Section III has a summary with some concluding comments.

I. An Overview of Gibson's Approach

Gibson's theoretical approach is summed up in the following quotation:

> The economy is initially at point E_1, where money stock is M_1^s and real (and nominal) interest rates are r_1. If income does not rise immediately following an increase in the money stock to M_2^s, the economy will move immediately to point P, along the curve L_1, drawn for a given level of income and expected rate of price change. This fall of interest rates from r_1 to r_2 is the liquidity effect. As income increases, the L curve will shift rightward until it reaches the position L_2, which intersects M_2^s at E_2, where interest rates are again at r_1. We may call the movement from P to E_2 the income effect, and it obviously just balances the liquidity effect.
>
> If now the expected rate of price change increases, L_2 will shift to the left L_3, lowering real interest rates to r_3. Nominal rates will exceed real rates by the expected rate of price increase.

As Gibson recognizes, there is no compelling reason why the income effect should just balance the liquidity effect.[1] In order to shift from point P one has to know the magnitude of the interest sensitivity of investment, the response of consumption to income, interest, and wealth, the state of capacity utilization and the values of the investment multiplier and accelerator. Other influences would be fiscal and foreign trade sector impacts, as well as the effects of induced changes in the money supply. The magnitude of the change in income following an increase in the money supply cannot be determined unless we know the magnitude of these separate effects on income. Given this change in income and/or prices, the new level of interest rates will also depend on the income elasticity of the demand for money, which will determine the extent of the shift of the L schedule; that is, the Hicksian framework suggests that the extent of the equilibrium change in income and interest rate due to a monetary disturbance is also sensitive to the assumed value of the income elasticity of the demand for money.

Gibson's major hypotheses are:

1. That "the primary direction of influence runs from the money stock to interest rates."

2. For liquidity effects to be observed at all, the coefficient of the logarithm of M_t should be negative. "A positive coefficient would imply that income effects have balanced liquidity effects and that only positive effects should follow."

3. "With full employment the, cumulative liquidity and income effects should eventually be equal so that the initial negative coefficient should be matched by a sum of positive coefficients for past M^s, raising interest rates to their initial levels. If the economy initially had unemployed resources the positive coefficients from the income effect may sum to less or more than the absolute value of the negative coefficient, depending on the shape and shifts of the investment schedule."

Gibson's major conclusions are:

1. "For quarterly data, the coefficient of the past quarter's money stock is positive and of the same order of magnitude as the current period's negative coefficient. More often than not the first positive coefficient exceeds the negative coefficient in absolute value. . . . The algebraic sum of the coefficients shows no marked tendency to exceed zero."

2. "Since the coefficients imply that interest rates return to their former levels three to five months after a once and for all change in the money stock, they imply that income changes in about the same proportion as money in three to five months."

Gibson's analysis and conclusions rest on the assumptions of a unit income elasticity of the demand for money, constancy in the expected rate of inflation over the sample period (1947–66), and a proportional change in money and *nominal* income, which is *recognized to hold only at full employment.* These, however, are very strong and unjustifiable assumptions, and one cannot rely on *historical* data (1947–66) to prove such special cases of full employment, and Laidler (1978) has shown that the value of the money multiplier on nominal and real income is the same only in the unique, and empirically most unlikely, case of a zero interest elasticity of the demand for money and an infinite interest elasticity of investment demand. Moreover, excess demand, when it prevailed, could also have been due to fiscal actions and some price changes could have originated on the supply side. For instance, equilibrium interest rates would rise if the increase in the money supply is less than the amount required to finance the higher income arising from an exogenous increase in government expenditures.

Velocity *growth* is not a constant. There is accumulating evidence that the income elasticity of money demand is much less than

[1]Note that the analysis in Gibson's Figure 1 assumes a horizontal IS curve.

unity (Goldfeld 1973, Moosa 1977a and Laidler 1978), and induced changes in the quantity of money may not be insignificant (Hendershott 1968). The interest elasticity of the demand for money is one of the most decisively settled issues in empirical macroeconomics (see, for example, Laidler 1978). Hence, a positive relation exists between changes in interest rates and changes in velocity. Moreover, economies of scale in the holding of money balances produce a positive velocity-income relationship, and evidence of income economies is by now about as compelling as the evidence concerning the importance of the interest rate (see, for example, Laidler 1978). The combined total effect of all these influences would lead the new equilibrium level of interest rates to be higher, equal to, or lower than their original levels (r_1), though in the absence of very substantial induced changes in the money supply, they can be expected to be higher than the initial decline (r_2) due to the liquidity effect.

II. Some Evidence

The above qualifications are consistent with the empirical evidence (Goldfeld 1973, Moosa 1977a, Laidler 1978 and Hendershott 1968) and supported by the magnitudes of the observed changes over the sample period (1947.1–1966.4) of some of the relevant variables. This is shown in Figures 1, 2, and 3 and their average values are shown in Table 1. Figures 1, 2, and 3 display the behavior of capacity utilization q, the excess of the rate of growth of the nominal money supply DM′ over the rate of growth of real output Dy′, and

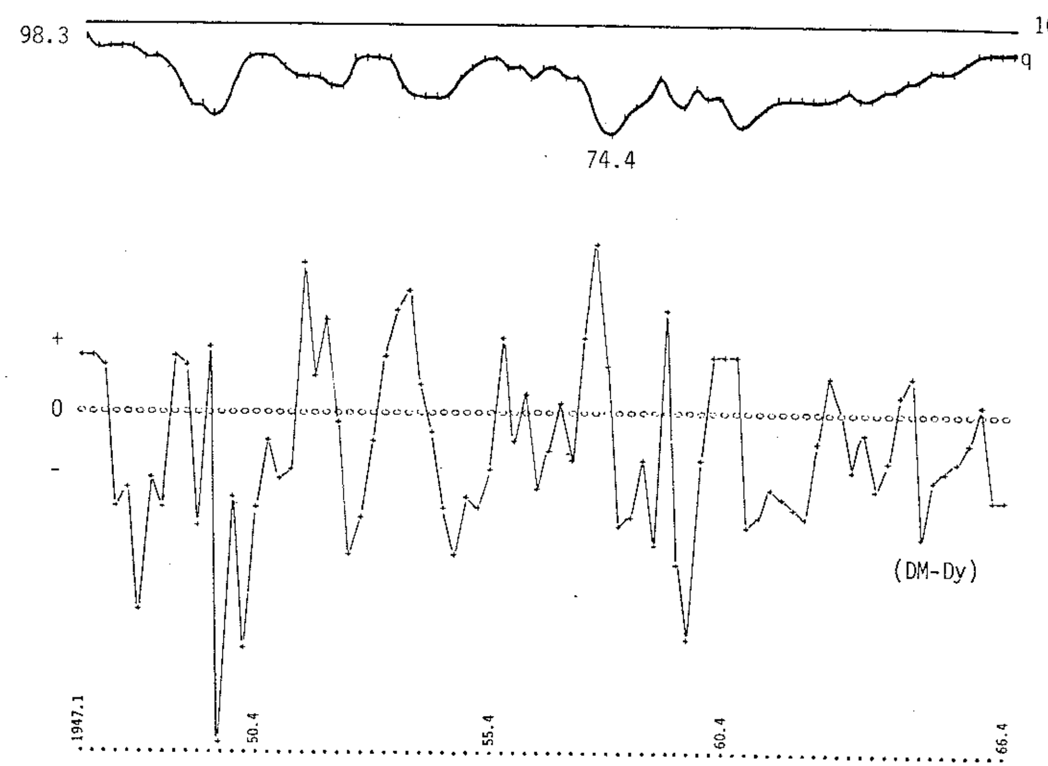

Figure 1. Capacity Utilization and Monetary Stimulus

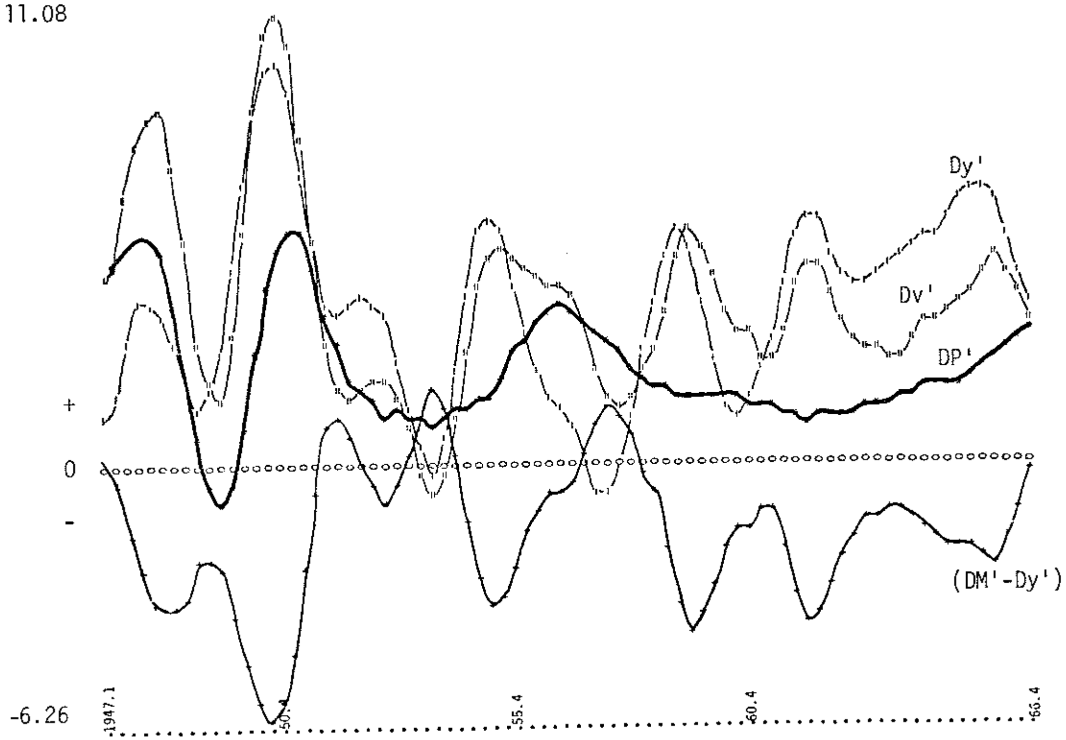

Figure 2. Income, Velocity, Prices and Monetary Stimulus

the rates of growth of velocity Dv′, prices DP′ and real government expenditures on goods and services Dg′.[2,3] The prime following a variable represents its systematic component and the method used to extract the systematic component of a time series is a lag-adjusted improvisation of the Almon (1965) procedure utilizing a second-degree polynomial with the beginning and end lag points constrained to be zero. The accuracy, of this method is seen by comparing, for example, the mean values of DP and DP′, which are 1.76 and 1.75 respectively, and are consistent with the theoretically expected value of zero of the unsystematic component. Its usefulness for *comparative* purposes is supported by evidence of its ability to provide unbiased estimates of the systematic component of variables in the quantity theory identity DM + DV = DP + Dy. Observe for example that, in Fig. 2, when (DM′ − Dy′) equals zero, DP′ equals the estimate of the fourth variable, Dv′. As a further illustration of the efficiency of this procedure Figure A1 in the Appendix plots the values of DP and DP′; the only reason for using filtered values is to facilitate the graphical exposition, and the polynomial smoothed Almon variables are ideally suited for illuminating the main underlying relationships between the variables. The extent of monetary stimulus is measured by (DM′ − Dy′) under the assumption of a unit income elasticity of the demand for money, and by (DM′ − DM*′) under the assumption of economies of scale in the holding of money balances, where DM*′ = 0.60Dy′.

[2]Our measure of capacity utilization q is the Wharton capacity utilization index. The other data were obtained from the *Federal Reserve Bulletin* and the *Survey of Current Business*. Our measure of money is M1, real output y is represented by real GNP, real government expenditures g include federal, state and local government expenditures, the price level P is represented by the implicity deflator for GNP, and the interest rate r is represented by the yield on 3–5 year Treasury bonds. Dr in Table 1 is the rate of growth of the interest rate. A prefix D indicates a proportional rate of growth.

[3]Note that the proper measure of excess demand is the rate of growth of real and not nominal government expenditures (see, for example, Stein 1978).

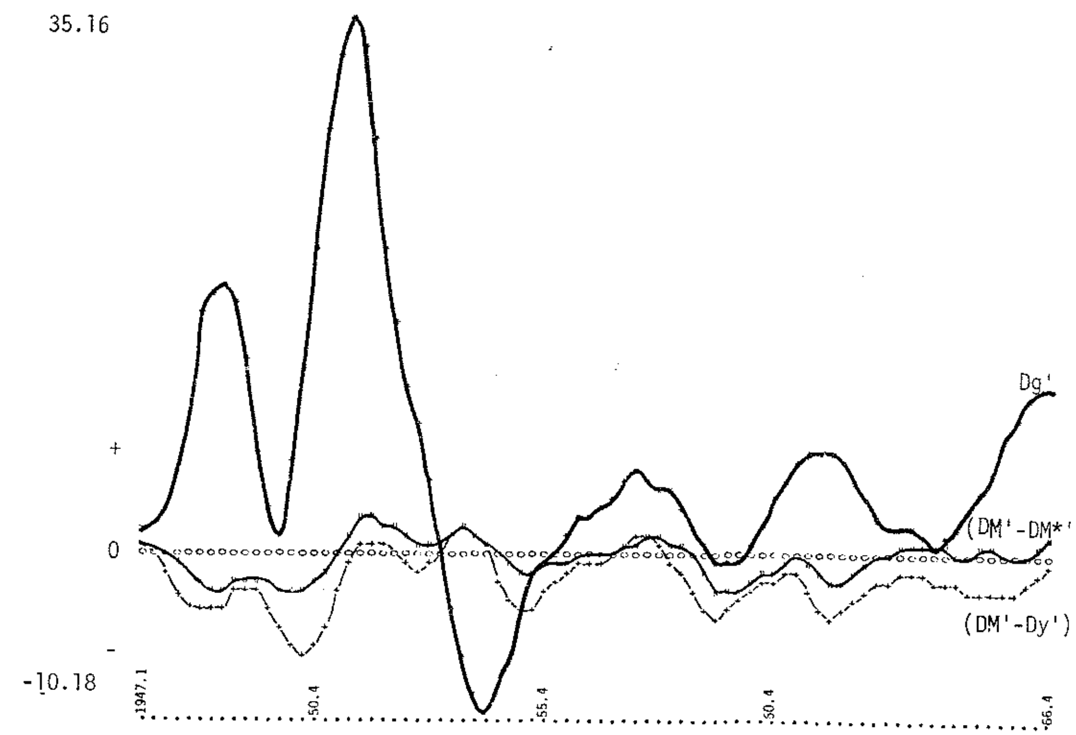

Figure 3. Government Expenditures and Monetary Stimulus

TABLE 1 Average Values

	Dy	*Dv*	*Dp*	*Dg*	*DM − Dy*	*DM − DM**	*q*	*DM*	*Dr*
1947.1–1966.4	3.99	4.05	2.35	6.56	−1.71	−0.11	87.59	2.28	2.24
1947.1–1957.4	3.59	4.31	2.84	8.42	−1.48	−0.03	89.48	2.11	2.79
1958.1–1966.4	4.48	3.75	1.76	4.29	−1.99	−0.20	85.29	2.49	1.57

See footnote 2 for data sources and definitions.

Figures 1, 2, and 3 and Table 1 show that capacity was not always fully utilized, at times substantially underutilized, and that even though monetary policy was generally *contractionary* ((DM′ − Dy′) < 0)[4] price increases (and hence their expectation) were not constant and at times substantial, though on average quite small; that the rate of growth of velocity was large in both the short and long runs; that fiscal policy was generally

[4](DM′ − Dy′) and (DM − Dy) were positive in only 14 and 20 out of 80 quarters respectively (Figures 1 and 2). (DM′ − DM*′) was positive in 33 out of 80 quarters. These were periods of recession and growth recession.

expansionary; that Dg′, Dv′ and DP′ had a U-shaped trend and (DM′ − Dy′) and (DM′ − DM*) had a ⋃-shaped trend. The data suggest that, *over the sample period,* it was fiscal policy that was largely responsible for the growth in output and prices and this was made possible by the substantial growth in velocity induced mainly by government-expenditure-related increases in income and interest rates (Table 1). Monetary policy which was generally contractionary ((DM′ − Dy′) < 0) had a restraining influence on both output and prices.

An analogue of the above in a dynamized Hicksian framework would be large rightward shifts in the IS curve and relatively smaller leftward shifts in the LM curve causing increases in output, prices and interest rates. Gibson's conclusions are based on shifts of the LM curve along an assumed *horizontal* IS curve causing income to change while leaving equilibrium interest rates unaffected. The data suggest, instead, that, in general, large rightward shifts of the IS curve and relatively smaller leftward shifts of the LM curve caused *both* income and interest rates to increase. The initial impact of these fiscal changes on the bond market reinforced the impact of the initial "liquidity effect" (of relative monetary contraction), exerting upward pressure on the interest rate. The subsequent fiscal multiplier effects on income evidently counteracted and dominated the later "income effects" (of monetary contraction) exerting additional upward pressure on the interest rate causing the *equilibrium* interest rate to increase.

Gibson's (admittedly) mis-specified reduced form equations, that have the interest rate depend only on the logarithm of current and past money stock, may not dynamically disentangle these monetary and fiscal influences on the interest rate. In ignoring the impact of fiscal influences on the interest rate, his specification ignores completely an apparently dominant force responsible for interest rate changes *over the sample period.* The interaction of these separate monetary and fiscal effects provide reasons to doubt the power of the adopted reduced form method of employing current and lagged values of the money stock to explain the dynamics of money-induced changes in the nominal interest rate where the more recent money stock variables are expected to have a negative coefficient (the liquidity effect) and the less recent money stock variables are expected to have a positive coefficient (the income effect). The unidirectional influence from money to interest need not be dominant and the author's simple regression test to determine two-way causality is suspect. Gibson's inclination to accept the poorer estimate of i on ln M (because the signs of the lagged money stock variables fit the proposed hypothesis) over the slightly better estimates of ln M on current and past interest rates is evidently not justified. The highly significant positive influence of the current interest rate of ln M_t could suggest the importance of a quick endogenous response of the money supply.

Gibson's typical regressions using monthly data are:

$$\ln M_1 = \underset{(2.2581)}{4.6610^*} \; \underset{(3.7972)}{+9.5957^* i_t} \; \underset{(3.8213)}{-2.1764 i_{t-1}} \; \underset{(3.8022)}{-1.8626 i_{t-2}} \; \underset{(3.8434)}{-1.6054 i_{t-3}} \; \underset{(3.8561)}{+0.0356 i_{t-4}} \; \underset{(3.8705)}{+0.7994 i t-5} \; \underset{(3.8535)}{+2.55181 i t-6} \; +0.6586 i_{t-7}$$

$$\underset{(3.8338)}{+0.0899 i_{t-8}} \; \underset{(3.8141)}{-1.5523 i_{t-9}} \; \underset{(3.8171)}{-2.0591 i_{t-10}} \; \underset{(3.8368)}{-1.2420 i_{t-11}} \; \underset{(2.3413)}{+7.6332^* i_{t-12}}$$

$$\text{SE } Y \cdot X = 0.04775 \quad R^2 = 0.844 \quad \text{D-W} = 0.130$$

$$i = i_b$$

$$i_b = \underset{(0.0145)}{-0.3737^*} \; \underset{(0.1393)}{-0.3873^* M1_t} \; \underset{(0.2141)}{+0.0754 M1_{t-1}} \; \underset{(0.2137)}{+0.1483 M1_{t-2}} \; \underset{(0.2093)}{+0.2103 M1_{t-3}} \; \underset{(0.2179)}{-0.0209 M1_{t-4}} \; \underset{(0.2166)}{+0.0550 M1_{t-5}}$$

$$\underset{(0.2242)}{+0.1603 M1_{t-6}} \; \underset{(0.2298)}{+0.0161 M1_{t-7}} \; \underset{(0.2324)}{+0.0588 {}_{t-8}} \; \underset{(0.2387)}{-0.0223 M1_{t-9}} \; \underset{(0.2453)}{-0.0382 M1_{t-10}} \; \underset{(0.2461)}{-0.0848 M1_{t-11}} \; \underset{(0.1549)}{-0.0897 M1_{t-12}}$$

$$\text{SE } Y \cdot X = 0.00494 \quad R^2 = 0.815 \quad \text{D-W} = 0.121$$

Next we pursue Gibson's methodology and regress, using quarterly data, the 3–5 year Treasury bond rate on the current and lagged values of the logarithm of M1. This is shown in Table 2. Unlike Gibson, however, we present regressions with lag distributions of different lengths and, unlike Gibson's neglect of the logic of his own theoretical construct, break down our sample period into periods of relatively higher and lower capacity utilization and rates of growth of government expenditures, velocity, prices and income (1947.1–1957.4 and 1958.1–1966.4). Unlike Gibson our method of estimation also involves a serial correlation correction using the generalized least squares procedure of Cochrane-Orcutt (1949). The first, second and third row of each cell represent the coefficient of the earlier, later and full periods respectively. Also shown is the sign distribution for the coefficient of the particular lag variable(s).

The results in Table 2 show that the sum of the coefficients is substantially positive irrespective of the period studied and irrespective of the length of the lag distribution.[5] The sign structure in the earlier period, when the rates of growth of government expenditures, velocity, prices, and interest rates were relatively much larger (Table 1), is contrary to the prediction of the Gibson model in that, irrespective of the length of the lag distribution, the coefficient of the current money variable is *positive* followed by a negative coefficient. In the later period we do have a positive coefficient of period t-1 following a negative coefficient of period t. However, the structure of coefficients up to the period t-3 for even the later period is inconsistent with the requirements of the model because negative coefficients exceed positive coefficients in number (antepenultimate column, Table 2). The sum of the lag coefficients beyond lag t-3 is also negative irrespective of the length of the lag distribution and again the number of negative coefficients exceeds the number of positive coefficients. For the ten-period lag we find that, despite their positive sum, eight out of the eleven coefficients are *negative.* The only positive coefficients are the coefficients of period t-1, t-8 and t-9.[6]

These results are inconsistent with the predictions of the Gibson model and the (negative) pattern in the later period is not consistent with an expected cyclical adjustment of the interest rate due to permanent income instead of current income being the relevant variable in the demand for M1 money function. However, recent evidence (Goldfeld 1973, Moosa 1977a) rules out a cyclical adjustment because it suggests that M1 is held mainly for transaction purposes with current income rather than permanent income being the relevant variable in the demand-for-M1 function. If so, the fluctuating coefficients of the earlier period cannot be readily explained.[7]

When we compare the lag structures of the earlier and later periods (for the ten-period lag) we observe that except for the fourth and seventh periods the matching lag coefficients have opposite signs suggesting that the full period results may be hybrid.[8] When the

[5]The coefficients are much larger than Gibson's estimates because a yield of five percent, for example, is expressed as 5.00 whereas Gibson expressed it as 0.05.

[6]Note that the (net) positive sum of the later period is very heavily weighted by the positive coefficient of period t-1.

[7]The holding period for M1 is likely to be quite short. Consequently price expectations can be expected to be formed largely on the basis of the more recent inflation experience. As such the positive coefficients could reflect not only the income effect but also some price expectation effect. However, not only is the empirical magnitude of the latter likely to be quite small (Goldfeld 1973, Moosa 1977a), making the heavy reliance on the price expectations effect unjustifiable, but also the effect of inflation expectations on money demand cannot be detected over the later sub-period (Moosa 1977b), apparently because of the relatively low rates of inflation experienced (Johnson, 1972).

[8]The formal procedure of the Chow test (Chow 1960) indicates that the dependent variable was governed by the same relationship in both the periods. The Chow test may, however, give misleading results when used on equations estimated with a serial correlation correction.

TABLE 2 Sign Structure of Coefficients*

Lag	*Coefficients of 3–5 year Treasury bond rate*						*Sign Dist.* +	*Sign Dist.* −	*Negative Signs (%)*	*Coeffs. of Treas. Bill Rate*
t	11.25	11.69	10.64	10.83	8.08	7.00	6		0	7.55
	−17.69′	−18.31′	−22.28′	−20.92	−19.39	−21.10′		6	100	−25.78′
	−14.65′	−13.19′	−12.12′	−11.01′	−10.23	−13.33′		6		−19.13′
t−1	−6.10	−6.37	−4.05	−4.19	−2.78	−4.53		6		2.65
	47.88′	46.12′	45.84′	46.52′	44.87′	48.69′	6			39.42′
	30.74′	28.61′	29.07′	28.91′	29.17′	30.67′	6			37.81′
t−2	9.82	11.58	10.60	10.68	12.26	21.47	6		41	12.18
	−8.19	−2.14	−3.31	−3.02	−1.72	−4.52		6	64	26.17
	−6.12	2.32	0.67	0.77	1.67	1.59	5	1		10.25
t−3		−1.86	5.79	5.85	4.64	2.96	4	1		13.42
		−6.93	−3.46	−4.88	−5.27	−2.95		5		−14.62
		−7.83	2.47	2.24	0.53	0.04	1	4		−1.10
t−4			−8.42	−8.01	−8.20	−11.24		4		−16.56
			−6.82	−0.78	−0.62	−2.07		4		−10.76
			−10.41	−7.28	−5.24	−5.71		4		−13.91
t−5				−0.13	1.17	0.39	2	1		15.86
				0.47	−1.11	−0.27	1	2		16.46
				−0.93	−2.49	−1.83		3		10.25
t−6				−0.44	3.59	7.96	2	1	71	−12.59
				−9.94	−2.26	−3.39		3	79	−10.88
				−3.11	5.13	5.30	2	1		−3.10
t−7					−0.22	−3.31		2		2.00
					−11.42	−10.04		2		−5.58
					−10.53	−9.99		2		−4.09
t−8					−5.37	−9.64		2		−15.67
					4.33	0.35	2			−10.95
					1.53	−4.88	1	1		−23.21′
t−9						−9.96		1		2.48
						8.29	1			9.15
						3.44	1			15.05
t−10						15.59	1		50	9.78
						−6.55		1	50	−5.65
						4.61	1			1.62
cons.	−70.39′	−70.72′	−68.41′	−68.63	−61.76	−78.82′	6			−101.18′
	−108.41′	−91.20′	−46.05′	−33.63′	−33.46	−28.62	6			−31.98
	−45.88	−45.60′	−44.66′	−44.27′	−44.23′	−45.75′	6			−49.15
SUM	14.97	15.04	14.56	14.59	13.17	16.69	6			21.02
	22.00	18.74	9.97	7.45	7.41	6.34	6			6.90
	9.97	9.91	9.68	9.59	9.01	9.91	6			10.28
R^2	0.928	0.928	0.93	0.93	0.932	0.94				0.95
	0.89	0.891	0.891	0.898	0.90	0.90				0.94
	0.954	0.955	0.957	0.957	0.959	0.96				0.94
F	124.89	90.56	72.18	47.75	35.06	29.87				33.47
	86.37	63.39	48.90	35.07	26.17	20.07				33.29
	451.76	341.25	279.82	195.42	152.23	123.94				80.14
r						0.75				
b						0.44				
MAE						0.85				

*The first, second and third row of each cell represent the coefficients of the periods 1947.1–1957.4, 1958.1–1966.4 and 1947.1–1966.4 respectively. A prime (′) next to a coefficient indicates that it is significant at the five percent level.

**Breakdown is for lag periods t, t−1 to t−3, t−4 to t−8 and t−9 to t−10.

earlier period results are used to predict the interest rate in the later period we find that the correlation and regression coefficients of actual on predicted values of 0.75 and 0.44 respectively differ from unity by substantial margins. About half the prediction error is due to bias and about a third is due to the regression coefficient differing from unity; the mean absolute error of 0.85 is about twenty percent of the mean value of 3.95 of the interest rate in the later period. The prediction errors also show a tendency to get systematically larger the more distant the forecast date.

Gibson's attempt to draw statistical inferences using a full employment theoretical model as the *emphasized* frame of reference has obvious limitations because excess capacity was more the rule rather than the exception over the simple period 1947–1966 (Table 1 and Fig. 1). The possibility of bi-directional or simultaneous causality, the evidence in Table 2 that the sum of the coefficients exceeds zero in both the periods, the negative sum of the coefficients beyond lag t-3 in both the periods as well as their predominantly negative sign in the later period, the distinctly opposite sign structure of the coefficient in the two sub-periods, the evident presence of economics of scale in the holding of M1 money balances (Goldfeld 1973, Moosa 1977a, Laidler 1978), and the probably significant influence of omitted non-monetary factors on income, prices and interest over the sample period, all argue against drawing any inferences concerning the lag in the effect of money on income by simply observing the time taken for the coefficients to sum to zero, as does Gibson.[9]

Gibson used the rates on three month Treasury bills and a Treasury and Corporate Aaa bonds of more than ten years to maturity as proxies for the interest rate, and he found no significant differences in the results using these alternative interest rates. We have instead used the rate on intermediate term Treasury bonds of three to five years maturity. As a check on whether our different results could have been due to our use of a different interest rate variable the rate on three month Treasury bills was also tried. No significant differences emerged as can be seen by an examination of the results using the bill rate which, to conserve space, are presented in the last column of Table 2 (for only the ten-period lag) for the full as well as both sub-periods. Neither were the additional results reported below found to be qualitatively different when the Treasury bill rate replaced the Treasury bond rate as the proxy for *the* theoretical interest rate. This similarity in the results might of course be expected because of the high correlation between these rates.[10]

Next, we try to estimate the sum and structure of the coefficients of the money variable holding constant the effect of government expenditure changes on the interest rate. Our method is to regress the interest rate variable (represented by the 3–5 year Treasury bond rate) on the logarithms of current and past M1 and real government expenditures (on goods and services)g using the Almon (1965) procedure.[11] If on the basis of

Because of omitted non-monetary variables the coefficients may not measure only the effect of monetary change. Even if they did they need not sum to zero if there are economies of scale in the holding of M1 money balances.

[9]Note the positive correlation in Table 1 between the rates of growth of government expenditures, interest rates and velocity in the earlier and later periods. Despite the presence of a contractionary monetary policy ((DM − Dy) < 0) interest-induced increases in velocity growth due to increases in the rate of growth of government expenditures permitted the expansion of output and was also mainly responsible for the pressure on prices.

[10]It might be added that if the results using alternative rates were found to be different they would have further attenuated Gibson's theoretical approach and empirical method, which are questioned in this paper, because there is no a priori reason to assume that one of these rates is better than the others as a proxy for *the* theoretical interest rate.

[11]As noted in footnote 3 it is real rather than nominal government expenditures that is the relevant measure of excess demand (Stein 1978).

1947.1-1957.4

$$r = -74.59 + \sum_{0}^{10} 18.71 \ln.M_{-i} - \sum_{0}^{10} 3.12 \ln.g_{-i} \qquad R^2 = 0.94$$
$$(-6.72) \qquad (6.35) \qquad (-3.46) \qquad r = 0.73 \quad b = 0.55 \quad MAE = 0.70$$

1958.1-1966.4

$$r = -30.18 + \sum_{0}^{10} 17.24 \ln.M_{-i} - \sum_{0}^{10} 11.39 \ln.g_{-i} \qquad R^2 = 0.87$$
$$(-1.59) \qquad (2.10) \qquad (-1.88)$$

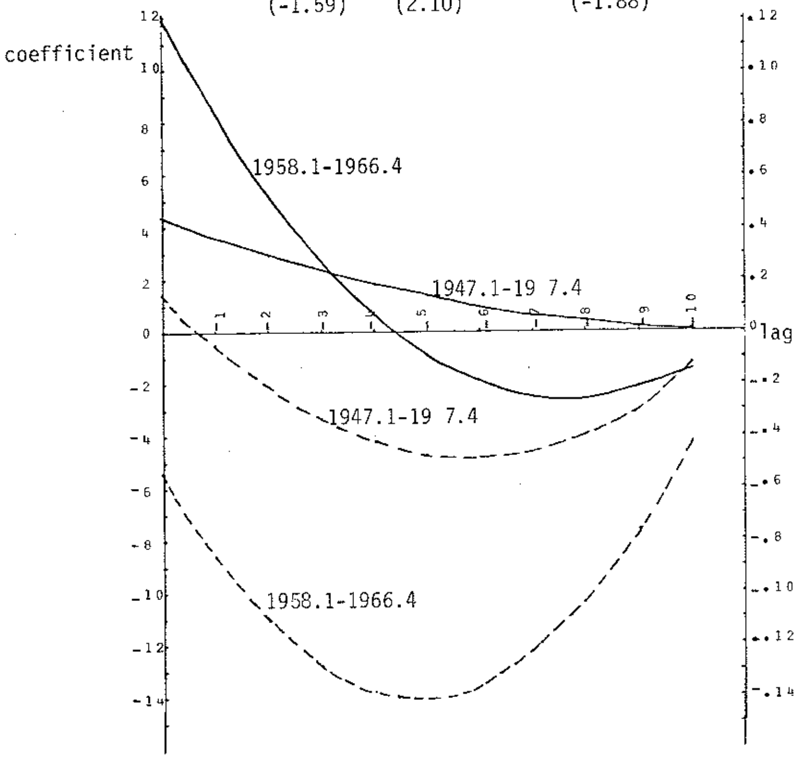

Figure 4. The solid line tracks the coefficient of the money variable and the broken line tracks the coefficient of the government expenditure variable and is measured on the right-hand vertical axis.

recent evidence (Goldfeld 1973 and Moosa 1977a) we rule out permanent income as the relevant variable in the demand-for-M1 function then a cyclical adjustment to equilibrium must be ruled out. As such we use a ten-period second-degree polynomial and again the equations are estimated using the Cochrane-Orcutt (1949) serial correlation correction.[12]

[12]Allowing for a cyclical approach to equilibrium by using a third and fourth degree polynomial does not alter our overall conclusions, however.

Figure 4 plots the coefficients of the lag structure and also shows the estimated equations for the earlier (1947.1–1957.4) and later 1958.1–1966.4) periods. The solid lines track the coefficients of the money variable and the broken lines the coefficients of the government expenditure variable. The sum of both lag coefficients in both sub-periods is statistically significant with the sum of the lag coefficients of the money variable being *positive* and the sum of the lag coefficients of the government expenditure variable being *negative*.[13] Such a (sign) relationship can be rationalized by assuming that the expenditure curve (IS) was upward sloping and intersected the LM curve from *above*. It would be a counterfactual assumption, however, because it implies an unstable system (Modigliani 1944) and it does not explain the observed positive (U-shaped trend) relation over the sample period between the rates of growth of government expenditures and real output (Figures 2 and 3). This casts doubt on the power of the empirical model to provide unbiased estimates of the dynamics of interest rate adjustment in response to monetary and fiscal shocks and one may be skeptical about whether the structure of lag coefficients reflects liquidity and income effects.[14] Neither can the ability of the earlier period equation to predict the interest rate in the later period be considered impressive judging by the values of the regression and correlation coefficients of actual on predicted values. The tendency of the prediction errors to get systematically larger through time is also discouraging. When the prediction period is extended to 1974 the regression coefficient of actual on predicted values is only 0.37 and the mean absolute error of 2.19 is forty-three

[13]The sum of the lag coefficients of the money variable is significantly positive even when the government expenditure variable is left out of the equation. This is to be expected given the results of Table 2.

[14]It is unlikely that this unexpected sum and sign structure of coefficients of the monetary and fiscal variables reflects effects of anticipated inflation because, according to Gibson's criteria, this will imply that monetary policy was inflationary, which is implausible, and that fiscal policy was deflationary, which is counterfactual; Table 1 and Fig. 4 show that (DM – Dy) was negative (and large) and the rate of growth of government expenditures positive and relatively large, as was the rate of growth of velocity. If, according to the monetarist model, inflation was (directly or ultimately) fiscal-induced it was apparently velocity-accommodated rather than money-accommodated, and there is no evidence to suggest that velocity growth was in turn money-induced. Gibson's reduced form approach is, however, incapable of determining such a causal chain because that would require a structural dynamic macroeconomic model that is in full feedback mode.

percent of the mean value of the interest rate of 5.11 for the period 1958.1–1974.4. For 1974.4 the actual and predicted values differ by a little more than one hundred percent.

III. Summary and Conclusions

We followed in this study the identical statistical method of Gibson of regressing the current interest rate on the logarithm of current and past values of the money stock. However, unlike Gibson, who indiscriminately applied a full employment model to situations of less than full employment, but according to the requirement of Gibson's theoretical model, we broke down our sample period into one of higher and lower capacity utilization and rates of growth of government expenditures, prices, interest rates, and velocity, and improved upon Gibson's statistical procedure by estimating the regressions using a serial correlation correction. By Gibson's own criteria the size and/or the sign structure of coefficients is found to be inconsistent with the predictions of his model and there is no reason to infer from our results, as does Gibson from his, that causality is unidirectional from money to interest, that the income effect just balances the liquidity effect and that the lag in the effect of money on income is between one and two quarters. Moreover, when the government expenditure variable, omitted by Gibson, is added to the estimated equation the results are no more encouraging. The positive coefficient of the money variable may be rationalized by assuming an upward sloping expenditure curve but the negative coefficient of the government expenditure variable is disturbing because it is inconsistent with widely accepted assumptions about the parameters of the real and monetary sector equations and with the observed stability of the economy, causing some skepticism about whether the size and sign structure of lag coefficients of the money variable generated by the particular statistical method represents a reliable measure of liquidity and income effects. On the other hand if the lag coefficients are considered plausible then the consequences of monetary and fiscal changes were radically different from those currently assumed.

In short, the results of this paper are significant for two related reasons. First, because knowledge of the empirical relation between monetary and fiscal disturbances and the subsequent amount and time path of changes in the interest rate is important for the conduct of economic policy and second, because of the continuing widespread reference to the Gibson results (for example, Frenkel 1975 and Laidler 1978) when making policy prescriptions, as well as use of some variant of this empirical method for the generation of additional results (Sims, 1970). Our results show that there is room for considerable skepticism about the empirical relation between monetary and fiscal disturbances and subsequent changes in interest rates if we are left to draw inferences solely from an examination of the sum and sign structure of coefficients on current and laged values of explanatory variables. This forces one to fall back on a priori reasoning.

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Appendix

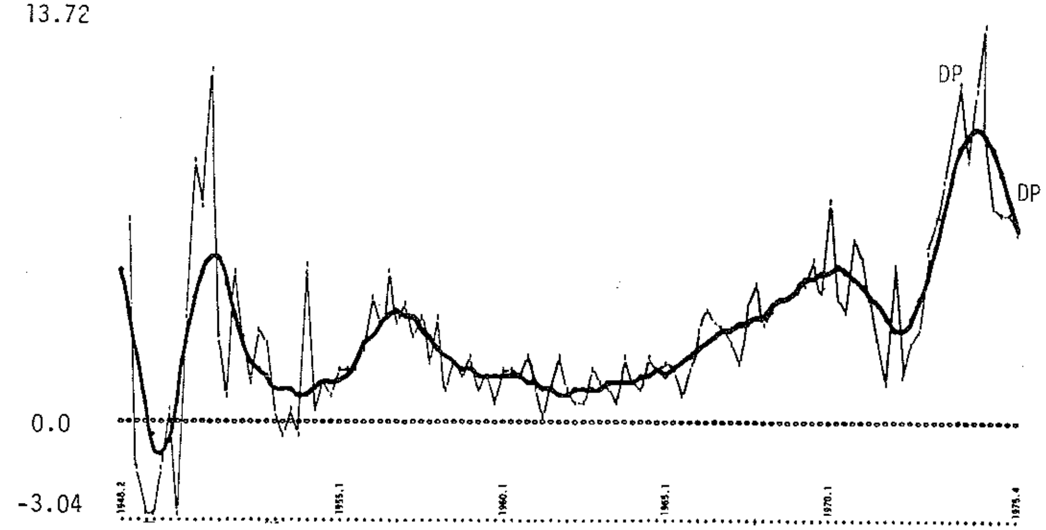

Figure A1. The Rate of Inflation—Actual and Systematic Components