***<u>THE EFFECTS OF MONTERAY&FISCAL POLICIES IN MACRO-ECONOMETRIC MODELS</u>**: empirical evidence from USA*

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Macro econometric researches before the ١٩٧٠s has been dominated by refinement of income-expenditure macro- econometric models attempt to reconcile the policy multipliers derived from these models with those yielded by simple reduced-forms, the refinement and estimation of the relation between inflation and unemployment, and the application of optimal control techniques to macro- econometric models ***four themes*** *provide the focus for this paper:*
The ***first section*** *reviews the implications of various macro-econometric models for monetary and fiscal multipliers. We are particularly concerned here with the degree of consensus across models and the evolution of estimated models over time. The* ***second section*** *discusses attempts to reconcile the divergent implications of income-expenditure structural models and the St. Louis reduced-form for fiscal policy multipliers. In the* ***third section*** *we develop the implications of estimated Phillips curve equations and monetarist models for the response of unemployment, output, and inflation to traditional demand management policies. And in the* ***fourth section*** *we consider the accumulated evidence on the gains from policy activism, drawing on the results of optimal control simulations with a variety of macro econometric models.*

During the last half of the ‘٧٠s increased attention has been focused on the way in which economic agents form expectations, particularly inflation expectations, and on “equilibrium” macroeconomic models embodying “rational expectations.” These models yield dramatic conclusions about both the costs of eradicating inflation and the gains *from activism. We therefore consider the implications of rational expectation models in both the third and fourth sections, although there is as yet only a small literature on empirical applications of these models to draw upon .*

COMPARISON OF POLICY MULTIPLIERS ACROSS MODELS AND TIME

In this section we review the evidence from structural models and .reduced-forms about the size and time pattern of policy multipliers We are interested in the average size of multipliers, the consensus. across models, and the evolution over time in the estimated multipliers

<u>A Comparison of Multipliers_Across_Models</u>

Christ (١٩٧٥) has burglarized the consensus across models rather pessimistically: ". . . though models forecast reasonably well over horizons of four to six quarters, they disagree so strongly about the effects of important monetary and fiscal policies that they cannot be considered reliable guides to such policy effects, until it can be determined which of them are wrong in this respect .

Tables ١, ٢, and ٣ present policy multipliers from seven econometric models (Bureau of Economic Analysis (BEA), Brookings (B), University of Michigan (MQEM), Data Resources, Inc. (DRI), Federal Reserve (Bank of St. Louis (St.L), MIT-Pennsylvania—SSRC (MPS), and Wharton as reported in Fronin and Klein (١٩٧٦). The multipliers are reported for the first quarter and fourth, eighth, twelfth, sixteenth, and twentieth quarters and for three policy changes , an increase in real government expenditures, a decline in personal taxes, and an increase in .the money supply or non- borrowed reserves

The multipliers are reported with and without the St. Louis ١ model multipliers. The latter are based on a reduced-form income equation rather than on a structural model and, particularly in the case of the fiscal multipliers, differ substantially from the multipliers based .on the structural models

in the ٤/١— ١The mean fiscal expenditure multiplier is just over by the end of year two; however, the ٤/١— ٢first quarter and builds to cumulative multiplier is still over one after five years. While there is considerable consensus about the multipliers through the first three years, the agreement deteriorates sharply. Note that in all cases the multiplier peaks within three years, generally within four to eight quarters; and cumulative fiscal multipliers fall to zero or below by th quarter ١٦th to ١٢the fifth quarter for the St. Louis model, by the for the MPS model and by the ٢٤th quarter for the BEA model. But it takes eight to ten years for the cumulative multiplier to reach zero in the Wharton and Michigan models and still longer in the Brookings and DRI models.

;The tax multipliers are smaller than the expenditure multipliers at the ١,٥to a peak of ٠,٦٣they build from an initial mean value of end of the second year. In the case of a tax change, there is less .consensus in the first quarter, but no deterioration in later quarters The tax multipliers tend to peak a bit later than the expenditure th quarters, and then ١٢th and ٨multipliers, generally between the .decline

There are only four comparable multipliers for monetary policy those using non-borrowed reserves). The initial quarter mean multiplier) is small and the mean multiplier peaks at the end of the third . There is less consensus about monetary compared ٧year at a value of to fiscal policy; the coefficient of variation is larger in all but one quarter for monetary policy multipliers. While the ***St. Loui****s cumulative multiplier peaks in the fourth quarter and goes to zero by ٨th quarter, large scale model multipliers generally peak after ١٦th quarters and the MPS multiplier reported by Fromm and Klein is still rising from the ١٢th to ١٦th quarters. The large scale model thus suggest that monetary policy has a more persistent effect on output t than is the case in the St. Louis model. The exception is the DRI model in which the cumulative monetary policy multiplier falls to zero .th quarter ٠by the ٢٠th quarter.*

While the multiplier results do differ across models there is clearly considerable consensus particularly over the first two years in the case of fiscal policy when we exclude the St. Louis results. The problem is evaluating how much divergence in the multipliers is consistent with using the models for policy recommendations. Later we will discuss the use of stochastic simulations which allow for multiplier uncertainty within a particular model, Here we want to note the valuable approach suggested by Chow(١٩٧٧). Chow notes that while policy recommendations derived from alternative structural models differ from each other, they may nevertheless be closer to each other than to a passive policy of constant growth rates in the policy instruments The comparison Chow suggests and implements is the improvement in economic performance in one model using optimal policy derived from a ***second model*** *relative to the economic performance under passive policy. Chow uses the multiplier properties of the Wharton and Michigan models to construct reduced-form equations for real and nominal GNP including government expenditures and non-borrowed reserves as the policy instruments and employs a conventional quadratic loss function involving deviations in real and nominal GNP from their targets (in .(each case average historical values over the period in question*

The results of this experiment are mixed. If the Michigan model were the true structure and the policy recommendations were derived

from the Wharton model, active policy would improve performance relative
to a passive policy; costs under the active policy would be under
٧٠percent of those under a passive policy although they would be ٢٥
.percent greater than if the policy were derived using the true structure
On the other hand, if the Wharton model were the true structure
,and the policy recommendations were derived from the Michigan model
the cost under an active policy would be three times the cost of a
times the cost when the true model was ١٧passive policy and about
used. And, of course, the Michigan and Wharton multipliers are quite
close at least for fiscal policies, compared to say the Brookings and
the St. Louis models. Thus there are other comparisons that would lead
.to even less favorable results for activism

<u>*A Comparison of Policy Multipliers Over Time*</u>

We expected to find a secular decline in the value of fiscal multipliers and a secular rise in monetary policy multipliers for large scale econometric models from the late '٦٠s versions to the versions of the mid to late ٧٠s. However, published information on such multipliers is relatively scarce and what is available is frequently not constructed on a comparable basis. This, of course, increases the value of the NBER/NSF model comparison studies but makes multiplier
comparisons pieced together from the literature hazardous. Perhaps the most serious problems for comparing multipliers across models or over time are differences in initial conditions and differences in the specification of policy instruments, particularly for monetary policy. The large scale models are invariably nonlinear, implying that their multipliers are sensitive to initial conditions, particularly the degree of economic slack. But there is painfully little reported evidence of the degree of this sensitivity. There are a bewildering number of possibilities for a change in tax rates and even differences in multipliers for different government expenditure components. The most serious problem, however, may be differences in assumptions about the monetary policy has ,instrument. Monetary policy, particularly in the late ٦٠s versions
.been identified with changes in short—tern interest rates

In other cases, monetary policy is identified with either the money supply or some reserve aggregate, most often non-borrowed reserves. The choice affects both monetary and fiscal multipliers since fiscal multipliers assume unchanged monetary policy; fiscal multipliers will, of course, be much larger under fixed short-term interest rates than under fixed values of the money supply or non-borrowed reserve .

In table ٤&٥ we have pieced together some policy multiplier
for alternative versions of Michigan, Wharton, and MPS models.
Michigan '٧٠ and Wharton '٦٨ models assume constant short—term

interest rates while the others assume constant un-borrowed reserves. It to us at least) that the fiscal multipliers in the late ' ٦٠s) is surprising rates while the others assume constant un-borrowed reserves. It is surprising to us at least that the fiscal multipliers in the last " ٦٠.

versions of the three models (including the two with constant short or less. One important ٢,٠term rates) are so small; they peak at difference in the later versions of Michigan and MPS models is the sharp decline in the cumulative multiplier from its peak value by the th quarter. There was a tendency in earlier versions for multipliers ١٢ for a longer period. This continues to ٢,٠— ١,٥to stabilize at about versions the ٧٩and ' ٧٥be the case in the Wharton model; in both the ' .fiscal multipliers are stable or rising during the first three years
We have been able to find comparable un-borrowed reserves multipliers at different points in time for only two models: the Wharton model and the MPS model. These are reported in Table S. In these models there is a fairly dramatic evolution of the monetary policy Wharton model the un-borrowed reserves ١٩٦٨multiplier. In the multiplier ١,٥ to ٢,٠ for real GNP reached a fairly constant level in the range after about one year. In the MPS model the multiplier is stable in the ١٠,٠ range during the second and third years. in the later versions of both models, the multiplier is continually growing over the First three years. Note also the substantial increase in the size of ٦٨the monetary policy multipliers in the Wharton model from the ' multipliers ٦٨versions. We view the Wharton ' ٧٩and ' ٧٥version to the ' ,as fairly typical of the conventional wisdom of the mid- to late ' ٦٠s .prior to the development of the MPS model

COMMENTS ON THE "ST. LOUIS" EQUATION

a single equation test of the relative importance of monetary and fiscal ,policies on nominal GNP , numerous replications have been performed across time, across countries, and across functional forms and a number of criticisms, mostly statistical in nature, have been levied against the equation. The purpose of this section is to review the criticisms that have been raised against the equation and to evaluate The .how robust the equation appears to be against these criticisms conclusions of the Andersen-Jordan investigation are by now almost universally known. The conclusion that remains most controversial is the zero cumulative fiscal multiplier for nominal GNP. This conclusion did s, nor was it ١٩٦٠not conform well to the conventional wisdom of the late for the past ,consistent with other econometric results. Consequently decade there has been considerable skepticism of the specification that yields this conclusion.

Time Periods, Functional Forms, and Distributed Lags

/Il and ٦٨-١/٥٢ The Ad equation was estimated over the period
) (AC) over the ١٩٧٠subsequently estimated by Andersen and Carlson (
monetary policy had a powerful and significant effect while the tax ٥
variable (change in high employment receipts) was insignificant and
excluded from their preferred regression and the government expenditure
variable had only a small and transitory effect. Silber (subsequently
/IV) and Democratic ٦٠/I-٥٣split the period into Republican (
/IV) administrations and found that fiscal variables were ٦٩I—/٦١)
significant in the latter but not in the former. Silber argued that these
results are consistent with the more systematic use of fiscal policy in
the latter period. At a minimum, these results suggest that the time
period used in the estimation can dramatically affect the conclusions
and that the estimates may reflect the particular policies pursued over
) has extended the ١٩٧٧More recently Friedman (.the estimation period
/Il and concluded that “even ٧٦sample period employed by AC through
we report ٦the St. Louis equation now believes in fiscal policy.” In Table
the results of the Ad and AC equations along with estimates over
), ٢alternate time periods including Silbers two sub periods (Sl and S
/Il (MR). ١٩٧٦— ١/١٩٦٠Friedman’s extended period (F), and the period
The results suggest that both money and the time period matter~ The size
and significance of fiscal policy multipliers is not definitely settled by
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that the first difference form of the estimated equation, while appropriate
over the AC period, is not appropriate over the longer period because of
heteroskedasticity, implying that the t values of coefficients reported
by Friedman are unreliable. When all variables are defined as rates of
TV /٦٩-١/٣change, Carlson finds that the results of the two periods are
period as part of the St. Louis model. In each case.
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easily correctable than others, associated with the choice of independent variables. The key issues have been: What are appropriate measures of the policy instruments? How can the possibility of reverse causation be avoided? What biases are introduced by omission of no policy exogenous variables. problem of specifying the policy instruments and in the next the .problem of endogenously of policy.

-The problem of reverse causation was noted in a DeLeeuw Kalchbrenner (١٩٦٩) comment on the Ad paper. Indeed it was the concern over this issue that arose Friedman-Meiselman debates that motivated the choice of the high employment fiscal policy measures by Andersen and Jordan. DeLeeuw and Kalchbrenner's main concern is with the choice of the monetary base or money supply as the variable the Fed directly controls. They point out that the choice among the monetary base, the non-borrowed base, total reserves, and non-borrowed reserves depends on whether the Fed offsets the effect of movements in member bank borrowing on the base and of movements in currency holdings on reserves. They express no special preference among these alternate measures suggesting only that results which hold for some measures and not for others should be viewed with great caution. Their empirical results indicate that fiscal multipliers are affected by the choice of monetary instrument; in particular, fiscal multipliers of approximately the size produced in the MPS model result when no- borrowed reserves The treatment of fiscal instruments .are substituted for the monetary base in the Ad/AC equations has also drawn considerable comment. In order to avoid the bias associated with the income induced movements in tax mostly transfer payments) under preexisting) revenues and expenditures schedules of tax and transfer rates, the Ad/AC equations use high High employment receipts were tried but .employment expenditures dropped from the preferred equation due to lack of significance. The high ?employment surplus was also employed in an alternate specification.

The Measurement of Policy Instruments.

The discussion above suggests that the simple specification of both monetary and fiscal instruments employed in the Ad and AC equations may be improved upon and that such improvements might alter the relative importance of monetary and fiscal multipliers. However, the modifications suggested above have not generally resulted in dramatic .changes in the estimated multipliers in simple reduced—form equations While many of these suggestions seem valid, they have not helped to resolve the differences between the St. Louis equation and econometric Endogenously of Policy.model s

Even if we obtain measures of direct policy actions, our estimates of their effects will be biased if these actions themselves are

systematically related to economic developments. This problem has widely been noted in comments on the Ad equation, but most critics including
DeLeeuw and Kalchbrenner considered the problems in measuring the instruments the more likely source of bias. The biases associated with endogenous policy are easy to illustrate. If a policy instrument varies in response to disturbances so as to eliminate completely the instability in income, the regression of the change in the policy variable on changes in income (zero by assumption) will yield a zero coefficient on the policy instrument. Thus, endogenously of policy may result in a downward bias in the policy multiplier, with the downward ,bias a function of the effectiveness of policy. We can, therefore interpret the zero multiplier on fiscal instruments as evidence of their effectiveness rather than of their insignificance~ While the endogenously of policy may introduce biases into the estimates of policy ,multipliers from both reduced-form equations and structural models Goldfeld and Blinder (١٩٧٢) suggest on the bases of simulation results that the bias is much more serious for reduced-forms. If policy responds to economic developments with a lag, the bias is reduced but .not eliminated

Omitted Exogenous Variables

The third major source of bias in the choice of independent —variables in the Ad/AC equation is alleged to be the omission of non policy exogenous variables. Andersen and Jordan explained in an appendix
to their original paper why they believed that the omission of other exogenous variables did not bias their measured impact of the monetary and fiscal policy variables: these variables are presumed to be independent of monetary and fiscal policies and their average effect is registered in the constant term. Modigliani (١٩٧١) made the first detailed critique of the St. Louis reduced-form model on the grounds of omitted variables and Modigliani and Ando (١٩٧٦) reported a more extensive
set of simulation results supporting their view that omission .of exogenous variables may severely bias the results of reduced forms The ingenious simulation experiments involved estimation of an Ad type equation on data generated by non—stochastic simulations of a model. The model represents the known structure of a hypothetical economy. The simulated values of nominal income from the model are the actual" values of income in the hypothetical economy. A reduced-form" is estimated using these simulated values for income, and the resulting estimated multipliers are compared with their "true" values (the values implied by the structural model). The comparison of the reduced—form

Conclusion

The income expenditure counterattack on reduced-forms, particularly the Modigliani-Ando results on the implications of omitted exogenous variables, and the ability to dramatically alter the fiscal policy multipliers by choice of time period and functional form, have substantially weakened the case based on reduced—form equations for small and transitory fiscal effects on nominal income. The implied monetary policy multipliers, on the other hand, have proven robust, at least for .the United States

TABLE 1

Fiscal Policy - Increase in Government Expenditures

Model	IC*	RMSE(4Q)*	Multiplier					
			1Q	4Q	8Q	12Q	16Q	20Q
BEA	62	6.94	1.1	2.2	2.2	1.8	1.6	1.3
B	56I	5.13	1.8	2.8	2.7	2.4	2.0	1.5
MQEM	62I	6.20	1.4	1.7	1.4	1.0	1.0	1.1
DRI 74	61I	4.60	1.3	2.1	2.2	2.0	1.7	1.7
St.L	62I	4.98	0.5	0.5	-0.2	-0.2	-0.2	-0.2
MPS		4.23	1.2	2.2	2.2	0.7	-0.5	
W	65I	4.64	1.3	2.0	2.4	2.6	2.4	1.9
Mean (w/o St.L)			1.35	2.17	2.18	1.75	1.37	1.17
St. dev. (w/o St.L)			0.24	0.36	0.43	0.76	1.03	0.86
s.d./mean			0.18	0.17	0.20	0.43	0.75	0.74
Mean (w/St.L)			1.23	1.93	1.84	1.47	1.14	.97
St. dev. (w/St.L)			.39	.71	.98	1.01	1.11	.94
s.d./mean			0.32	0.37	0.53	0.69	0.97	0.97

* IC = initial conditions for policy simulation; RMSE = root mean square error for four quarter forecast of real GNP (billions of dollars at 1958 prices) over 1961-1967 period.

TABLE 2

Fiscal Policy - Tax Cut

Model	Multiplier				
	1Q	4Q	8Q	12Q	16Q
BEA	0.4	1.2	1.4	1.1	0.8
B	1.0	1.6	1.6	1.6	1.5
MQEM	0.6	1.2	1.1	1.1	1.2
DRI 74	0.9	1.3	1.2	0.9	0.6
St.L*	0	0	0	0	
MPS	0.4	1.3	2.1	2.2	1.8
W	0.5	1.2	1.7	1.9	1.6
Mean (w/o St.L)	0.63	1.30	1.52	1.47	1.25
St. dev. (w/o St.L)	0.26	0.16	0.37	0.52	0.47
s.d./mean	0.41	0.12	0.24	0.35	0.38
Mean (w/St.L)	0.54	1.11	1.30	1.26	1.07
St. dev. (w/St.L)	0.34	0.51	0.66	0.73	0.64
s.d./mean	0.63	0.46	0.51	0.58	0.60

* Multipliers reported for St. Louis model are based on absence of a tax variable in the model's reduced-form equation for income.

TABLE 3

Monetary Policy

Model	MV*	Multiplier				
		1Q	4Q	8Q	12Q	16Q
BEA	RU	0	0.2	0.4	0.7	0.7
DRI	RU	0.3	4.1	8.3	6.5	2.8
St.L	M1	1.1	4.4	2.8	1.2	-0.4
MPS	RU	0.3	3.2	8.4	12.4	14.5
W	RU	1.4	4.5	7.2	8.6	8.0
Mean (w/o St.L)		0.5	3.0	6.08	7.05	6.50
St. dev. (w/o)		1.24	0.65	0.63	0.69	0.95

* MV = monetary variable (M1 = narrow money supply; RU = nonborrowed reserves; initial conditions same as in Table 1.

TABLE 5

Unborrowed Reserve Multipliers
(Real GNP/Nominal Reserves)

	Wharton 68[c]	Wharton 75[b]	Wharton 79[d]	MPS 69[e]	MPS 75[b]
1	0.0	1.4	1.2	0.7	0.3
4	1.5	4.5	4.8	5.4	3.2
8	2.1	7.2	9.1	10.0	8.4
12	1.7	8.6	13.3	12.4	9.4

Notes - See Table 4.

TABLE 4

Real Non Defense Government Expenditure Multipliers - Real GNP

Q	Michigan 70[a]	Michigan 75[b]	Wharton 68[c]	Wharton 75[b]	Wharton 79[d]	MPS 69[e]	MPS 75[b]
1	1.5	1.4	2.0	1.3	1.1	1.3	1.2
4	2.1	1.7	2.0	2.0	1.7	1.8	2.2
8	1.9	1.4	2.0	2.3	1.8	1.6	2.2
12	n.a.	1.0	2.1	2.6	1.7	1.1	0.7

a S. H. Hymans and H. T. Shapiro, "The DHL-III Quarterly Model of the U.S. Economy," Research Seminar in Quantitative Economics, University of Michigan, 1970, Table 4, p. 22.

b C. Fromm and L. R. Klein, "The NBER/NSF Model Comparison Seminar: An Analysis of Results," in L. R. Klein and E. Burmeister (ex), Econometric Model Performance, Pennsylvania, 1975, Table 6, p. 402.

c M. K. Evans and L. R. Klein, The Wharton Econometric Forecasting Model, Economics Research Unit, University of Pennsylvania, 2nd ed., 1968, Table 5, p. 58.

d Unpublished Wharton multiplier simulations kindly provided by R. M. Young, Wharton Econometrics Forecasting Associates.

e F. DeLeeuw and E. M. Gramlich, "The Channels of Monetary Policy," Federal Reserve Bulletin, June 1969, Table 4, p. 489. Shock applied fully to federal real wage payments.

TABLE 6

Time Periods

Sample	AJ 52/I-68/II	AC 53/I-69/IV	S1 53/I-60/IV	S2 61/I-69/I	F 53/I-76/II	MR 60/I-76/II
M	5.83 (7.25)	5.57 (8.06)	5.58 (.43)	9.20 (2.35)	4.94 (6.3)	5.72 (1.07)
G	0.17 (0.54)	0.05 (0.17)	-1.77 (.90)	1.75 (2.11)	1.42 (4.3)	2.44 (5.57)
T			2.36 (.67)	-3.92 (2.78)		-1.67 (2.90)
R^2	.60	.66	.652	.73	.66	.69
Se	4.01	3.84	4.23	3.30	7.54	7.84

TABLE 7

Functional Form

Sample	AC 53/I-69/IV	F 53/I-76/II	C 53/I-76/II	AS 69/II-77/I	MR1 60/I-76/II	MR2 60/I-76/II
Form*	Delta	Delta	Dot	Dot	Delta	Dot
M	5.57 (8.06)	4.94 (6.3)	1.06 (5.59)	.90 (1.93)	5.72 (5.31)	.75 (3.08)
G	0.05 (0.17)	1.42 (4.3)	.03 (.40)	.36 (2.07)	2.44 (5.57)	.37 (2.82)
T					-1.67 (2.90)	-.29 (2.25)
R^2	.66	.66	.40	.56	.69	.42
Se	3.84	7.54	3.75		7.84	3.02

* Delta: first difference specification
Dot: rate of change specification