A Modified Federal Reserve of St. Louis Spending Equation for Canada, France, Germany, Italy the United Kingdom, and the United States*

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A scientific law is based on repeated observations that tend to confirm a hypothesis. This paper reports an attempt to replicate the estimated Federal Reserve of St. Louis spending equation as recorded in Table 1 not only for U. S. data extended outside the original sample to the 1970s, but also to data for 5 other countries.

The method of estimation involved ordinary least squares and polynomial distributed lags over 5 quarters. The well known results tended to confirm the "monetarist" hypothesis that only changes in money had a fast but permanent effect on total spending. Changes in government spending had a significant initial effect; but this was almost totally offset over the 5 quarter lag period.

Econometricians around the world have criticized these results with respect to both estimation technique and specification.[1]

Part 1 of this paper maintains the exact specification of the St. Louis spending equation but extends the sample period to the mid-1970s and to data for Canada, France, Germany, Italy, and the United Kingdom in addition to the United States.

Part 2 modifies the equation in several ways proposed by critics: (1) not constraining the ends of the lag distribution to zero, (2) including another category of autonomous spending in addition to government

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[1] For example, Franco *Modigliani* and Albert *Ando*, "Impacts of Fiscal Actions on Aggregate Income and the Monetarist Controversy: Theory and Evidence" in Jerome L. *Stein* (editor), Monetarism, 1976, 17 - 40 and "Comments" by Lawrence R. *Klein*, 50 - 51; Robert J. *Gordon*, 52 - 66; and Michael R. *Darby*, 67 - 68.

Table 1

The Original St. Louis Spending Equation[a)]

Sample Period: 1953 I - 1969 IV
Constraints: 4th Degree Polynominal
$(m - 1 = e - 1 = 0;\ m_5 = e_5 = 0)$

$$\Delta Y_t = \underset{(3.46)}{2.67} + \sum_{i=0}^{4} m_i \Delta M_{t-i} + \sum_{i=0}^{4} e_i \Delta E_{t-i}$$

$m_0 = 1.22$	(2.73)	$e_0 = .56$	(2.57)
$m_1 = 1.80$	(7.34)	$e_1 = .45$	(3.43)
$m_2 = 1.62$	(4.25)	$e_2 = .01$	(.08)
$m_3 = .87$	(3.65)	$e_3 = -.43$	(− 3.18)
$m_4 = .06$	(.12)	$e_4 = -.54$	(− 2.47)
$\Sigma m_i = 5.57$	(8.06)	$\Sigma e_i = .05$	(.17)

$R^2 = .66$; $SE = 3.84$; $DW = 1.75$.

Symbols are defined as:

ΔY_t = dollar change in total spending (*GNP* in current prices) in quarter t

ΔM_{t-i} = dollar change in money stock in quarter $t - i$

ΔE_{t-i} = dollar change in high-employment Federal expenditures in quarter $t - i$.

Note: "t" statistics appear with each regression coefficient, enclosed by parentheses. R^2 is the percent of variation in the dependent variable which is explained by variations in the independent variables. *SE* is the standard error of the estimate. *DW* is the Durbin-Watson statistic.

a) Leonall C. *Andersen* and Keith M. *Carlson*, "A Monetarist Model for Economic Stabilization," Review, Federal Reserve Bank of St. Louis, April 1970, pp. 7 - 25. The key spending equation in the model is based on Leonall C. *Andersen* and Jerry L. *Jordon*, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Review, Federal Reserve Bank of St. Louis, November 1968, pp. 11 - 24. A reestimation of the model appeared in Leonall C. *Andersen* and Keith M. *Carlson*, "St. Louis Model Revisited," International Economic Review, Vol. 15, No. 2, June 1974, pp. 305 - 327.

spending as an independent variable, and (3) transforming the variables to percent changes (first differences in logarithms). As in the original St. Louis specification, the money stock is assumed to be autonomous though this assumption has often been questioned, even by one of the authors of the present paper.[2] Neither has the reduced form estimation

[2] William G. *Dewald* and Robert V. *Kennedy*, "Monetary and Fiscal Actions: Some Tests of Their Relative Importance in Australia" in J. W. *Nevile* and D. W. *Stammer* (editors), Inflation and Unemployment. Penguin Books, 1972, 70 - 87.

approach been changed. Such assumptions are considered part of the maintained hypothesis for the exercise at hand.

I. Replicating the Original St. Louis Spending Equation

Sources of data are listed in an appendix. The exact St. Louis specification was used: ends of lag distributions constrained to zero, 5 quarter lags for the effects of both money and government spending, and 4th degree polynomials for the lag distribution. The results are presented in Table 2.

We estimated that *both* money and high employment expenditures over 5 quarters affected spending significantly at the .05 level except in France, Germany and the United Kingdom. Perhaps it is no surprise that only money mattered in Germany; and only government spending, in the United Kingdom. Money multipliers ranged from less than 2 in the United Kingdom, and Italy, to 2½ and up in Canada, France, Germany, and the United States. Government spending multipliers ranged from less than 1 in France, Germany, and Italy to between 1½ and 2 in Canada, the United States, and the United Kingdom. We introduced dummy variables for the 1968 student strike in France and its aftermath.

R^2 is not the best country to country comparison because there can be very different cyclical and secular trends in the data. A better measure is the standard error divided by the mean level of spending which is recorded in the last row of Table 2. It shows that the unaltered St. Louis spending equation generated estimation errors of less than 1 percent for Canada and the United States to 2½ percent for the United Kingdom.

The results tend to confirm the eclectic view that both monetary and fiscal policy matter, contradicting the original St. Louis finding that only money mattered for the United States. By size and significance of the total impacts estimated, money tends to matter more than government spending in the United States, as was the original S. Louis finding, but government spending matters significantly, too. The finding was very much the same for Canada: a money multiplier of about 5 and a government spending multiplier of about 1½. For France and Italy the multipliers were much lower. As noted, only money mattered in Germany and only government spending mattered in the United Kingdom.

Table 2: **Spending Equation — Original St. Louis Specification (Billions of Currency Units)**

$$\Delta Y = \text{Constant} + \sum_{i=0}^{4} m_i \Delta M_{t-i} + \sum_{i=0}^{4} e_i \Delta E_{t-i}$$

Polynomial Degrees: 4 Ends of Lag Distributions Constrained to Zero

	Canada 1957 II - 1976 III	France 1960 IV - 1976 IV	Germany 1962 II - 1976 IV	Italy 1962 II - 1976 III	United Kingdom 1960 I - 1975 IV	United States 1956 I - 1976 III
Constant	.153 (1.18)	3.521 (1.22)	6.623 (2.77)	-286.21 (-1.20)	.144 (.78)	.372 (.24)
Strike		-43.021 (-3.35)				
After Strike		58.246 (4.57)				
m_0	-.044 (-.10)	.263 (.77)	1.448 (1.97)	.254 (1.20)	-.392 (-.75)	2.185 (3.77)
m_1	1.499 (5.06)	.702 (3.13)	.688 (1.48)	.613 (4.79)	-.292 (-.57)	1.622 (4.18)
m_2	2.312 (6.01)	.847 (3.03)	.019 (.03)	.653 (4.21)	.048 (.13)	.544 (1.08)
m_3	1.600 (5.50)	.573 (2.84)	.304 (.74)	.308 (2.37)	.377 (.84)	.081 (.22)
m_4	.084 (.18)	.102 (.30)	.968 (1.37)	-.127 (-.59)	.445 (.95)	.259 (.43)
Σm_i	5.451 (6.03)	2.488 (4.45)	3.425 (2.85)	1.701 (6.56)	.186 (.13)	4.690 (5.68)
e_0	.916 (5.69)	.048 (.65)	-.062 (-.26)	.122 (2.05)	.501 (3.48)	.335 (1.59)
e_1	.443 (3.58)	.107 (1.03)	-.132 (-.49)	.098 (1.60)	.627 (4.88)	.130 (.85)
e_2	-.067 (-.45)	.153 (1.30)	-.083 (-.28)	.124 (1.77)	.509 (4.59)	.092 (.51)
e_3	-.042 (-.33)	.163 (1.50)	.074 (.27)	.232 (2.87)	.278 (1.53)	.392 (2.52)
e_4	.309 (1.66)	.118 (1.38)	.196 (.81)	.290 (3.51)	.064 (.35)	.663 (3.02)
Σe_i	1.559 (6.01)	.589 (1.44)	-.008 (-.01)	.866 (3.44)	1.980 (4.58)	1.612 (4.39)
R^2	.852	.610	.240	.794	.603	.673
F	67.997	10.934	2.734	32.688	22.403	26.069
SE	.764	12.279	9.596	1018.61	1.073	7.877
DW	1.994	1.723	1.867	1.361	2.406	1.785
Mean	1.972	19.554	13.871	2051.6	1.226	15.657
SD	1.906	18.385	10.421	2120.96	1.648	13.261
SE/Mean Level	.0099	.0174	.0141	.0165	.0252	.0094

As shown in Table 2 the estimated lag distributions differed considerably even between Canada and the United States where total effects appeared much the same. For example, the latter experienced a large initial money impact whereas in Canada the maximum impact was delayed two quarters. This experience was similar to the estimated timing of response in France and Italy. Government spending effects typically were stretched out somewath more than monetary policy effects — the opposite of the original St. Louis finding for the United States. The exception was Canada where three fifths of the total effect of government spending on GNP was estimated to occur in the initial quarter.

We also calculated the regressions without constraining the ends of the lag distribution. Imposing such a constraint in the original St. Louis specification was criticized. Yet our results with or without constraints were not very different. One reason is that the original St. Louis specification partly compensated for constraining the head and tail of the lag distribution by using a comparatively high order polynomial. Money multipliers were slightly smaller and explanatory power, save for Germany, was slightly higher in the unconstrained case. Overall, these unconstrained results also tended to confirm the eclectic view that both monetary and fiscal policy matter within the St. Louis spending equation specification. We don't care to belabor the point, but as one JMCB author put it in 1977, "Even the St. Louis Model Now Believes in Fiscal Policy."[3]

II. A Modified St. Louis Spending Equation

In the present study not only money and high employment government spending but also exports were considered as autonomous variables in explaining total spending.

One reason the original St. Louis specification was criticized was because of the possibility of bias in the estimated effect of money on total spending that could result from important autonomous influences on spending being left out of the equation. For example, Robert J. *Gordon* found that the estimated money impact in the United States was reduced by adding a composite autonomous impulse defined to in-

[3] Benjamin M. *Friedman*. "Even the St. Louis Model Now Believes in Fiscal Policy", Journal of Money, Credit and Banking, IX, 2 (May 1977), 365 - 67.

clude exports less imports, consumer expenditures on new autos and net residential investment.[4]

In our respecified St. Louis spending equation, we have included only exports out of this melange since each of the other variables would be expected to be determined simultaneously with demand. Imports, for example, are very closely related to total income in each of the countries in our study. Furthermore, if variables such as imports or residential investment are considered autonomous, why not variables such as taxes or business net investment?

In any event, we found a uniformly significant effect of exports on total spending in the 6 countries studied and as *Gordon* warned, a reduction in the estimated total effect of money on total spending in those cases where money multipliers had been the largest as estimated within the original St. Louis specification.

There are a lot of other "autonomous" impulses that might have been included; but an associated risk that interrelationships between somewhat arbitrarily selected autonomous variables would bias the results. Bias might result for estimated effects of variables such as imports and taxes that are dependent on income. It was this kind of relationship that led to the concept of "high employment" taxes. Adjustments are made to remove the influence of income on taxes or other variables by calculating what their levels would be expected to be if the economy were operating at some "high employment" or "potential" level of output. The objective is to remove the effects of cyclical variations in income on taxes or imports and thus leave only the autonomous influences.

We estimated import and tax functions and calculated high employment imports for each of the countries and high employment taxes for each except the United States for which we used the Federal Reserve Bank of St. Louis high employment tax figures. Though we removed cyclical effects of income on taxes and imports, we left out high employment taxes and high employment imports variables from our common spending equation. The reason was to avoid bias that can result from another interrelationship. There would be a tendency for the government budget and international payments to balance, at least in some long run equilibrium sense. There also is a short run rela-

[4] Robert J. *Gordon,* loc. cit.

tionship between the issue of money and both the government budget and international payments balances. Such interdependencies could bias the estimates if money, government spending, taxes, exports and imports were all included as variables affecting total spending. In fact, regressions of total spending on these five independent variables yielded significant coefficients for the United States, but the result could not be replicated for the six countries generally. Accordingly, we have included only money, government spending and exports and not high employment taxes and high employment imports in our simple common specification of the spending equation.

The nature of the interrelationship between money and the budget and international payments balances can be illustrated for the case of no international capital flows and no government bonds. At high employment output, it would be true that

$$\Delta M = A_0 + (E_0 - T) + (X_0 - I);\ E_0 - T = 0;\ \text{and}\ X_0 - I = 0\ .$$

Budget belance at high employment requires that taxes T adjust to equal autonomous government spending E_0. Trade balance at high employment requires that imports I adjust to equal autonomous exports X_0. Money change ΔM, therefore, is solely accountable at high employment to autonomous influences A_0. There are 6 variables and 3 equations so that there are only 3 independent variables, say, the autonomous change in money A_0 and the autonomous flows of spending E_0 and exports X_0. If the economy were operating at other than high employment output, changes in money would also be linked to the budget and payments balances in addition to any autonomous influences. There would be an induced increase in money whenever the economy operated at less than high employment output and an induced decrease in money whenever it operated at more than high employment output. In the research reported in this paper we have not explored the money supply process for the purpose of identifying an autonomous monetary impulse but rather have followed the St. Louis model in simply assuming that changes in money are autonomous because the policy authorities have controlled money[5].

[5] Using Australian data, *Dewald* and *Kennedy*, loc. cit., found that the estimated effect of fiscal policy was smaller, the broader and more endogenous the money supply definition. The fiscal policy effect was highly significant when money was defined as fiat money which includes mainly money supported by the central bank portfolio of securities.

To reiterate, our spending equation includes both the changes in money and government spending as explanatory variables as in the original St. Louis specification. But it makes three changes:

— It does not constrain the ends of the lag distribution to zero.

— It adds exports as a third independent variable.

— It searches for the best-fit lag lengths for effects of money, government spending, and exports on total spending in each country.

The results appear in Table 3. Money was significant except in the case of France. Even in the United Kingdom a significant money multiplier of 2 was estimated. This is less than the money multipliers of over 3 found for Canada, Germany, and the United States, but more than the less than unity multipliers found for France and Italy. Including exports resulted in reduced money multiplier estimates for Canada, Germany, Italy, and the United States, which lends credance to *Gordon*'s supposition about left out variables biasing the money multiplier estimates.

Estimated government spending multipliers were largest and significant for Canada, France and the United States at between 1.5 and 2.1, smaller at only .7 for the United Kingdom, and insignificant for Germany and Italy.

Export multipliers were largest for Italy, the United Kingdom and Canada at 2.2, 1.3 and 1.2 respectively but uniformly significant. It is interesting to note that where there were relatively small money multipliers, there was correspondingly either a relatively large government spending multiplier as in the case of France or a relatively large export multiplier as in the case of Italy. Perhaps the most notable aspect of the specification is the uniform significance of exports with little change in the qualitative findings with respect to money and government spending.

The standard errors of estimate were lower for our common spending specification than for the St. Louis equation by as little as 3 percent for the United States to as much as 32 percent for Italy. Errors relative to the level of GNP were about 1 percent for every country except the United Kingdom for which the error was over 2 percent as reported in Table 4.

As a contribution to the long and variable lag controversy, it is interesting that the estimated lag in the effect of money changes in no

Table 3: **Spending Equation — Modified Specification in Nonlogs (Billions of Currency Units)**

$$\Delta Y = \text{Constant} + \sum_{i=0}^{k1} m_i \Delta M_{t-i} + \sum_{i=0}^{k2} e_i \Delta E_{t-i} + \sum_{i=0}^{k3} x_i \Delta X_{t-i}$$

Polynomial Degrees: 3 or less if required Ends of Lag Distributions Unconstrained

	Canada 1957 II - 1976 III	France 1960 IV - 1976 IV	Germany 1962 II - 1976 IV	Italy 1962 II - 1976 III	United Kingdom 1960 I - 1975 IV	United States 1956 I - 1976 III
Constant	.0324 (.26)	4.022 (2.04)	4.273 (2.14)	100.361 (.59)	.000483 (.003)	1.056 (.70)
Strike		− 33.705 (− 3.57)				
After Strike		45.643 (4.63)				
m_0	.417 (.91)	− .519 (− 1.85)	2.276 (2.88)	.912 (7.26)	− .138 (− .21)	2.894 (3.93)
m_1	.829 (1.66)	.884 (3.08)	− 2.030 (− 1.96)	.435 (3.29)	1.580 (2.47)	.313 (.50)
m_2	2.040 (4.27)	.338 (1.18)	3.362 (2.97)	.241 (1.54)	.570 (.90)	.541 (1.23)
m_3	.080 (.14)		− .523 (− .58)	− .793 (− 3.57)		.933 (1.43)
m_4						− 1.162 (− 1.43)
Σm_i	3.366 (3.78)	.703 (1.56)	3.084 (4.05)	.796 (3.77)	2.012 (1.73)	3.518 (3.75)
e_0	.360 (1.64)	.160 (2.02)	.184 (.88)	.180 (3.02)	.365 (2.02)	.145 (.65)
e_1	− .081 (− .48)	.116 (1.33)	− .108 (− .49)	− .094 (− 1.47)	.342 (1.87)	.159 (.89)
e_2	− .107 (− .71)	.158 (1.72)	− .182 (− .93)	− .200 (− 3.62)	.257 (1.74)	.389 (2.37)
e_3	.103 (.88)	.246 (3.02)		.066 (1.24)	.062 (.33)	.585 (3.41)
e_4	.371 (2.39)	.340 (4.13)			− .291 (− 1.41)	.498 (2.71)
e_5	.518 (3.18)	.401 (4.13)				− .123 (− .48)
e_6	.366 (1.54)	.390 (3.75)				
e_7		.266 (2.27)				
Σe_i	1.529 (5.76)	2.077 (5.21)	− .105 (− .22)	− .047 (− .32)	.735 (1.61)	1.653 (4.35)

x_0	.378 (3.03)	.425 (3.71)	.747 (5.16)	1.031 (7.36)	.847 (3.83)	.830 (2.73)
x_1	.324 (2.28)	.327 (2.42)	.172 (1.21)	.734 (4.92)	.733 (3.68)	
x_2	.153 (1.10)	− .088 (− .68)	− .196 (− 1.43)	− .159 (− .83)	− .277 (− 1.30)	
x_3	.377 (2.73)		− .069 (− .48)	.574 (2.57)		
Σx_i	1.231 (4.47)	.633 (3.04)	.653 (3.07)	2.180 (7.02)	1.303 (3.50)	.810 (2.73)
R^2	.906	.819	.570	.915	.749	.707
F	51.911	19.591	5.651	40.379	15.845	19.589
SE	.638	8.680	7.596	695.86	.900	7.605
DW	2.197	1.900	1.824	1.499	2.157	1.846
Mean	1.972	19.554	13.871	2051.6	1.226	15.657
SD	1.906	18.385	10.421	2120.8	1.648	13.261

country was longer than the five quarters estimated in the original St. Louis model. That is quite short by the conventional monetarist wisdom. Lags in the effects of government spending change were typically longer than effects of money changes but in no case longer than two years. Mean lags of export changes were very short, often with large first quarter effects. Thus, the overall timing of impacts was estimated to be short, which tends to confirm one of the controversial findings of the original St. Louis spending equation.

Monetary effects in the revised common specification were generally smaller than in the original St. Louis equation. But monetary effects were more consistently estimated to be significant in affecting spending than were government spending effects. If the parameters of the models are stable, the results suggest that there would be opportunity in every country for monetary policy and/or fiscal policy to lean against the winds of the business cycle during expansions which average roughly three to four years. Though more difficult, it would be possible for policy makers to speed up monetary and fiscal impulses rapidly but briefly during contractions which last on the average only about a year.

Table 4

Estimated Changes in Spending Based on a Common Equation in Logarithmic and Nonlogarithmic Specification

(Billions of Currency Units)

Country (Sample Period)	R^2		*SE*		Mean (*SD*)	*SE* Divided by Mean Level of Spending	
	Log[a]	Non log	Log[a]	Non log		Log	Non log
Canada 1957 II - 1976 III	.886	.904	.699	.643	2.00 (1.91)	.0091	.0084
France 1960 IV - 1976 IV	.848	.819	8.04	8.68	19.6 (18.4)	.0114	.0123
Germany 1962 II - 1976 IV	.521	.570	7.84	7.60	13.9 (10.4)	.0115	.0111
Italy 1962 II - 1976 III	.856	.915	903.	696.	2052. (2121.)	.0146	.0113
United Kingdom 1960 I - 1976 III	.710	.749	.985	.900	1.23 (1.65)	.0232	.0211
United States 1956 I - 1976 III	.685	.707	7.83	7.61	15.7 (13.3)	.0093	.0091

a) Log specification: $\Delta \hat{Y} = \Delta$ Antilog $Ln\hat{Y}$.

One should not make too much of the economic policy prospects based on these results. Just as the exclusion of exports would appear to bias estimated monetary effects on spending, there may be other left out autonomous variables. Another concern, especially for the effect of the fiscal policy variable is its sensitivity to choice of the sample period. This is apparent in the marked increase in the fiscal policy influence in the original St. Louis equation specification as reestimated for a sample period through 1976 III compared with the original sample period ending 1969 IV.

Another problem is the definition of government spending. Only federal but not local and state government spending is included in the case of the United States. Where possible a comparable definition was used for the other countries. In the case of Germany, economists at the Bundesbank questioned our excluding the expenditures of Länder which are perceived as an integral part of the stabilization process. Yet for the period 1965 II - 1976 III for which government spending was defined both to include and exclude expenditures of the Länder, we could identify no significant fiscal policy effect using either definition. The overall fit was much the same when the broader government spending definition was used. Hence we used the narrow definition for Germany as for the other countries, reported in Table 3.

Questions were also raised about the appropriate definition of the monetary policy impulse. For Germany it was suggested that money issued by the central bank would be better. We tried it and found the same qualitative results as in our regressions that used M_1. But the overall fit was not nearly as good. For Italy, economists at the Banca D'Italia suggested that M_2 would better represent the monetary policy impulse than M_1. We tried M_2 and found a marginally improved fit but qualitatively much the same results as with M_1. It did appear that the estimated fiscal policy effect in Italy was especially sensitive not only to the choice of sample period, but also to the definition of the monetary impulse. With M_1, a significantly positive fiscal impulse was estimated for the sample period 1963 III - 1976 III rather than that reported for 1962 II - 1976 III but the money multiplier remained at about .8. Generally for each of the countries this tendency for the estimated fiscal impulse to be sensitive to the sample period was observed, and also to a lesser degree for the estimated monetary effect.

Despite our somewhat arbitrary definition of monetary and fiscal variables, the overriding consideration was to use as close to the same

Table 5: **Spending Equation — Modified Specification in Logs (Log Billions of Currency Units)**

$$\Delta LnY = \text{Constant} + \sum_{i=0}^{k1} m_i \Delta LnM_{t-i} + \sum_{i=0}^{k2} e_i \Delta LnE_{t-i} + \sum_{i=0}^{k3} x_i \Delta LnX_{t-i}$$

Polynominal Degress: 3 or less Ends of Lag Distributions Unconstrained

	Canada 1957 II - 1976 III		France 1960 IV - 1976 IV		Germany 1962 II - 1976 IV		Italy 1962 II - 1976 III		United Kingdom 1960 I - 1975 IV		United States 1956 I - 1976 III	
Constant	.00312	(.93)	.0132	(2.36)	.00296	(.49)	− 0.00535	(− .59)	.00172	(.33)	.00556	(2.31)
Strike			− .0714	(− 5.12)								
After Strike			.0904	(6.21)								
m_0	.085	(1.17)	− .065	(− .66)	.370	(2.22)	.220	(1.67)	.003	(.03)	.547	(3.10)
m_1	.020	(.26)	.186	(1.82)	− .345	(− 1.77)	.102	(.78)	.254	(2.00)	.071	(.45)
m_2	.300	(3.87)	.169	(1.66)	.612	(3.04)	.138	(1.20)	.065	(.59)	.243	(2.46)
m_3	− .037	(− .49)	− .222	(− 2.20)	− .140	(− .81)	.032	(.24)	− .058	(− .48)	.342	(2.12)
m_4											− .353	(− 1.93)
Σm_i	.369	(3.44)	.067	(.50)	.497	(2.40)	.491	(2.45)	.264	(1.22)	.849	(4.43)
e_0	.035	(.61)	.024	(1.53)	.050	(1.87)	.031	(.142)	.044	(.93)	.018	(.36)
e_1	− .039	(− .97)	.025	(1.17)			.013	(.50)	.070	(1.50)	.112	(2.24)
e_2	− .027	(− .64)	.031	(1.20)			.029	(1.04)	.054	(1.19)	− .004	(− .07)
e_3	.030	(.86)	.038	(1.63)			.053	(1.88)	.028	(.65)		
e_4	.093	(2.90)	.043	(2.12)			.061	(2.26)	.022	(.49)		
e_5	.121	(3.28)	.046	(2.00)			.026	(1.21)	.068	(1.42)		
e_6	.073	(2.18)	.042	(1.65)								
e_7	− .090	(− 1.64)	.029	(1.37)								
e_8			.006	(.37)								
Σe_i	.195	(1.41)	.284	(2.22)	.050	(1.87)	.214	(1.90)	.285	(1.57)	.127	(1.54)

x_0	.118 (3.14)	.071 (2.35)	.254 (5.41)	.135 (3.89)	.186 (3.56)	.0319 (1.50)
x_1	.065 (2.04)	.042 (1.40)	.043 (.92)	.047 (1.49)	.100 (1.81)	
x_2	.087 (3.32)	.032 (1.08)	− .026 (− .56)	.026 (.93)	.001 (.01)	
x_3	.081 (2.51)	− .013 (− .50)	− .049 (− 1.08)	.019 (.55)	.058 (1.14)	
x_4	− .060 (− 1.78)			− .026 (− .70)		
Σx_i	.291 (3.49)	.132 (1.99)	.221 (2.22)	.202 (2.08)	.344 (2.92)	.0319 (1.50)
R^2	.577	.785	.470	.527	.443	.408
F	7.387	13.05	4.836	4.175	3.380	6.367
SE	.00965	.0113	.0121	.0141	.0189	.00861
DW	2.030	2.223	2.016	1.535	2.435	1.894
Mean	.0222	.0266	.0204	.0297	.0236	.0172
SD	.0136	.0215	.0153	.0182	.0228	.0106

definitions as we could in each of the six countries so that we could attempt to replicate estimates based on a common specification of the spending equation across countries. Though the results were not uniform, they tend to confirm the primary importance of money as related to spending and the subsidiary importance of government spending and other autonomous influences. This amounts to a watered down result compared with the original *Andersen-Jordan* and *Andersen-Carlson* findings — but qualitatively it is the same.

1. Spending Equation in Logarithms

Table 4 compares R^2 *s* and standard errors of log and nonlog specifications of the spending equation. The log results were transformed into nonlogs for the comparison. The errors were much the same though the nonlog specification generally fit slightly better. The detailed results reported in Table 5 were qualitatively similar to the nonlog results with a few exceptions. Most notable: The effect of government spending in the case of Germany and Italy was estimated to be insignificant under the nonlog specification but significant under the log specification. Under the log specification, 12 of the 18 coefficients of money, government spending, and export variables for the six countries were estimated to affect spending significantly (*T*-values greater than 1.64). All the signs were positive as expected theoretically. For the nonlog specification 14 of the 18 coefficients were significant. The only estimated coefficients with *T*-values less than one were for money in France under the log specification and for government spending in Germany and Italy under the nonlog specification.

III. Conclusions

Our research was built on a small "monetarist" model of the U. S. economy. The research design was to fit a common specification of spending determination to data for Canada, France, Germany, Italy, the United Kingdom, and the United States.

Our estimation of a St. Louis type model has tended to confirm that the quantity of money (M_1) is the most important factor affecting spending in the U. S. economy. It was demonstrated to be very important in each of the other countries too, particularly Canada and Germany. As in the original St. Louis model, the length of the lag in the effect of money on spending was estimated to be quite short and

stable in contrast to the long and variable lag distribution that was once the conventional monetarist view. Unlike the original St. Louis model we have estimated that fiscal policy measured by government spending also significantly affects spending. In fact, even the St. Louis model specified exactly as originally now identifies a significant U. S. fiscal policy effect. Government spending effects, though generally significant and also quite rapid, were found to be very sensitive to the sample period, definition of money, and whether or not the data were expressed in logarithms. Exports were nearly uniformly significant in affecting spending, given money and government spending, regardless of specification.

Looking at the historical record for the period and the countries we have studied, it is clear that both money and government spending were generally accountable for major movements in spending over quite short periods of a year to a year and a half. That presents both a policy opportunity and responsibility, an opportunity to exert an accelerating or decelerating effect on spending growth when it is needed, and a responsibility not to take actions that perversely add to what natural instabilities exist in the economies.

Sources of Data

Banca d'Italia, Servizio Studio, Ufficio Richerche (Private communication).

Federal Reserve Bank of St. Louis and Federal Reserve Statistical Release H. 6, "Money Stock Measures", March 4, 1976 and March 3, 1977.

Federal Reserve Bank of St. Louis, Rates of Change in Economic Data for Ten Industrial Countries (quarterly).

Federal Reserve Bank of St. Louis, "St. Louis Model Results", December, 1976.

Federal Reserve Bank of St. Louis, "Technical Notes for Estimates of the High-Employment Budget", December, 1976.

International Monetary Fund, International Financial Statistics (monthly).

Guy Laroque, Bernard LeCalvez and Philippe Nasse, Comptes Trimestriels, Methodes Statistiques et Series Retrospectives, Series C (trimestrial).

Organization for Economic Cooperation and Development, Main Economic Indicators (monthly).

Organization for Economic Cooperation and Development (memorandum), Paris, June 1, 1976.

Statistics Canada, Current Economic Analysis Division, Canadian Statistical Review (monthly).

U.S. Department of Commerce, Bureau of Economic Analysis, Business Conditions Digest (monthly).

U.S. Department of Commerce, Survey of Current Business (monthly).

Zusammenfassung

Eine modifizierte Ausgabengleichung der Federal Reserve Bank von St. Louis für Canada, Frankreich Deutschland, Italien, Großbritannien und die USA

Dieser Beitrag gibt die Ausgabengleichung der Federal Reserve Bank of St. Louis wieder und modifiziert sie. Die Originalschätzungen basieren auf vierteljährlichen US-Daten bis 1969. Die Ergebnisse scheinen die monetaristische Hypothese zu bestätigen, daß Geld (Bargeld und Sichteinlagen) das Bruttoinlandsprodukt signifikant über einen Zeitraum von 5 Quartalen beeinflußt, aber die Staatsausgaben nur einen transitorischen Einfluß haben.

Teil 1 enthält die genaue Gleichung der Federal Reserve Bank of St. Louis, weitet aber die Grundgesamtheit bis Mitte der 70er Jahre und auf Daten für Kanada, Frankreich, Deutschland, Italien, und Großbritannien aus. Die Ergebnisse scheinen zu bestätigen, daß Geld einen signifikanten Einfluß auf das Bruttoinlandsprodukt ausübt, allerdings nicht in Großbritannien. Im Gegensatz zu den Originalergebnissen konnte bei den Staatsausgaben ebenfalls ein signifikanter Einfluß auf das Bruttoinlandsprodukt geschätzt werden. Dies traf für die Vereinigten Staaten und andere Länder mit Ausnahme von Frankreich und Deutschland zu.

In Teil 2 wurde die Ausgabengleichung verändert, indem die Enden der Lagverteilung nicht beschränkt wurden. Die Exporte wurden als eine weitere autonome Variable eingeführt, wobei man nach der am besten passenden Laglänge suchte und die Variablen in prozentuale Veränderungen umformte. In dieser neuen allgemeinen Gleichung waren die monetären Wirkungen geringer, aber im allgemeinen signifikant, sogar in Großbritannien. Die Wirkungen von Staatsausgaben und Exporten waren ebenfalls im allgemeinen signifikant. Die Ergebnisse waren qualitativ die gleichen, wenn logarithmische oder nicht-logarithmische Gleichungen benutzt wurden; Ausnahmen gab es bei den Auswirkungen der Staatsausgaben in Deutschland und Italien, die nur bei Benutzung einer logarithmischen Gleichung signifikant waren. Die Schätzfehler hinsichtlich des Niveaus des Bruttoinlandsprodukts lagen bei etwa ein Prozent für jedes Land mit Ausnahme von Großbritannien, wo der Schätzfehler 2 Prozent betrug.

In keinem Land übertraf der geschätzte Wirkungslag der Geldmengenveränderung für das Bruttoinlandsprodukt mehr als fünf Quartale, wie schon in dem Orginal-St. Louis-Modell geschätzt wurde. Andere Lags waren ebenfalls kurz. Für den beobachteten Zeitraum und die beobachteten Länder scheinen die Ergebnisse zu bestätigen, daß die laufenden und verzögerten Effekte einer Geldmengen- und Staatsausgabenveränderung für größere Bewegungen beim Bruttoinlandsprodukt verantwortlich sind.

Summary

A Modified Federal Reserve of St. Louis Spending Equation for Canada France, Germany, Italy, the United Kingdom, and the United States

This paper replicates and modifies the Federal Reserve of St. Louis spending equation. The original estimates were based on quarterly U.S. data through 1969. The results tended to confirm the monetarist hypothesis that money (currency and demand deposits) affects GNP significantly over 5 quarters but government spending has only a transitory effect.

Part 1 maintains the exact St. Louis specification but extends the sample to the mid-1970s and to data for Canada, France, Germany, Italy, and the United Kingdom. The results tend to confirm that money is a significant factor affecting GNP except in the United Kingdom. Unlike the original results government spending was also estimated to affect GNP significantly in the United States and in the other countries except France and Germany.

Part 2 modifies the spending equation by not constraining ends of the lag distribution, including exports as another autonomous variable, searching for best-fit lag lengths, and transforming the variables into percent changes. Monetary effects were smaller in the revised common specification but generally significant even in the United Kingdom. Government spending and export effects were also generally significant. Results were qualitatively the same under either log or nonlog specifications with the exceptions that government spending in Germany and Italy was significant only under the log specification. Errors relative to the level of GNP were about 1 percent for every country except the United Kingdom for which the error was 2 percent.

In no country was the estimated lag in the effect of money on GNP longer than the 5 quarters estimated in the original St. Louis model. Other lags were also short. For the period and the countries studied the results tend to confirm that current and lagged effects of changes in money and government spending account for major movements in GNP.

Résumé

Une équation des dépenses modifiée de la Federal Reserve Bank de St. Louis pour le Canada, la France, l'Allemane, l'Italie la Grande-Bretagne et les Etats-Unis

Cette contribution présente l'équation des dépenses de la Federal Reserve Bank de St. Louis et la modifie. Les estimations originelles sont basées sur les données trimestrielles des Etats-Unis jusqu'à 1969. Les conclusions semblent confirmer l'hypothèse monétariste, selon laquelle l'argent (comptant et dépôts à vue) influence le produit national brut de manière significative sur une période de 5 trimestres, alors que les dépenses publiques n'exercent qu'une influence transitoire.

La 1e partie comporte l'équation précise de la Federal Reserve Bank de St. Louis, mais élargit l'ensemble de base jusqu'à la moitié des années '70 et à des données pour le Canada, la France, l'Allemagne, l'Italie et la Grande-Bretagne. Les conclusions semblent confirmer que l'argent joue un rôle significatif dans le produit national brut, sauf toutefois en Grande-Bretagne. Contrairement aux résultats originels une influence significative sur le produit national brut put également être constatée pour les dépenses publiques. Ceci vaut pour les Etats-Unis et les autres pays à l'exception de la France et de l'Allemagne.

Dans la 2e partie l'équation des dépenses a été modifiée, en ce sens que les fins de la division des "lags" ne furent pas limitées. Les exportations furent introduites en tant qu'autre variante autonome, cherchant les durées des "lags" les plus appropriées et transformant les variantes en variantes exprimées en pourcentages. Dans cette nouvelle équation générale, les influences monétaires étaient plus réduites, mais en général significatives, même en Grande-Bretagne. L'influence des dépenses publiques et des exportations était en général également significative. Les résultats étaient qualitativement similaires lorsque des équations logarithmiques ou non-logarithmiques étaient utilisées; des exceptions apparurent pour les répercussions des dépenses publiques en Allemagne et en Italie, qui ne furent significatives que lorsqu'une équation logarithmique était utilisée. Les erreurs d'estimation concernant le niveau du produit national brut s'élevaient à environ un pourcent pour chaque pays sauf pour la Grande-Bretagne, où elle atteignait 2 pourcent.

Dans aucun pays le "lag" estimé d'action de la modification de la masse monétaire pour le produit national brut ne dépassa plus de cinq trimestres, correspondant ainsi à l'estimation du modèle originel de St. Louis. D'autres "lags" étaient également courts. Pour la période observée et les pays étudiés les résultats semblement confirmer que les effets courants et retardés d'une modification de la masse monétaire et des dépenses publiques sont responsables de mouvements accrus du produit national brut.