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Authors	Daniel L. Thornton
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"SHOULD CONSUMER EXPENDITURES BE THE SCALE VARIABLE IN EMPIRICAL MONEY DEMAND EQUATIONS?"

Daniel L. Thornton*

Federal Reserve Bank of St. Louis

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Traditionally, real GNP or permanent income or wealth have been the scale variable of choice in empirical money demand equations. Recently, Mankiw and Summers (1986) argue that consumer expenditures are an ideal proxy for permanent income in money demand, and they provide evidence that total consumption expenditures or consumption expenditures on nondurables and services are better scale variables in money demand than current GNP. This result is odd because consumer expenditures reflect only the desires of the households, and a significant proportion of money balances is held by firms. This paper shows the difficulties in using consumer expenditures as a proxy for permanent income, shows that, properly estimated and compared, consumer expenditures are no better as a scale variable than real GNP and provides evidence that permanent income is a better scale variable than either consumer expenditures or GNP.

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Traditionally, empirical money demand equations have relied on some measure of real output or permanent income or wealth as the relevant scale variable. This practice has been challenged by Mankiw and Summers (1986) who argue that consumer expenditures should be and is a better scale variable in empirical money demand equations. Their preference for consumer expenditures is based on two conjectures. First, they argue that consumption is an ideal proxy for permanent income, "since it is proportional to this unobservable variable."[1/] Second, they argue that consumption should be more closely related than income to transactions and that the demand for money is closely related to the level of transactions.

A priori, this claim seems extravagant. Certainly businesses as well as consumers demand real money balances. Indeed, about 45 percent of M1 in 1984 (the last year of their sample) was in demand deposits, much of which were held by businesses. Consequently, it is unlikely that consumer expenditures are more closely related to transactions than some measure of total output or wealth. Furthermore, using consumer expenditures as a proxy for permanent income involves much more than the simple substitution of consumption expenditures for permanent income in a money demand equation. For this reason, and others discussed below, Mankiw and Summers' estimates give a misleading impression of the superiority of consumer expenditures over real GNP and provide no evidence of the superiority of consumer expenditure over permanent income.

This paper fills this void by appropriately comparing estimated money demand equations based on consumer expenditures with those that use both real GNP and permanent income. The evidence suggests that, appropriately estimated and compared, there is no reason to prefer money demand equations that use consumer expenditures as the scale variable over those that use real GNP. Furthermore, a money demand equation that use permanent income out performs those which use either consumer expenditures or real GNP. The latter result is consistent with the bulk of empirical work; for example, see Laidler (1977), Goldfield (1973) and Thornton (1985b).

The outline of the paper is as follows. Section 2 shows how consistent estimates of the money demand equation can be obtained when consumer expenditures are used as a proxy for permanent income. Section 3 presents estimates of money demand using two measures of consumer expenditures, real GNP and permanent income. The conclusions are presented in section 4.

2. Consumer Expenditures as a Proxy for Permanent Income

To see how using consumer expenditures as a proxy for permanent income affects the estimation of the money demand, assume that both real consumption and the demand for real money balances are represented by the following simple log-linear functions of real permanent income:

(1) $C_t = \beta YP_t + X_t\mu + \varepsilon_t$

and

(2) $(M-P)^d_t = \alpha YP_t + Z_t\delta + v_t.$

Here, C, M, P and YP denote real consumption, nominal money, the price level and real permanent income, respectively; X_t and Z_t are row vectors of other variables that affect consumption and money demand and μ and δ are corresponding conformable column parameter vectors.[2/] β and α are scalar parameters reflecting the permanent-income elasticity of consumption and money demand, respectively. Note that the form of the permanent income consumption function is very general and allows for the possibility that the level of consumption is not simply proportional to the level permanent income. If the level of consumption is proportional to the level of permanent income, then $\beta = 1$.

When consumption is used as a proxy for permanent income, equation (1) is solved for YP to yield:

(1') $YP_t = (1/\beta)[C_t - X_t\mu - \varepsilon_t]$.

Equation (1') is then substituted into (2) to obtain

(2') $(M-P)_t^d = \alpha' C_t + Z_t\delta + u_t$,

where $u_t = v_t - \alpha'\varepsilon_t - \alpha' X_t\mu$ and $\alpha' = \alpha/\beta$.

While Mankiw and Summers estimate Equation (2') with ordinary least squares (OLS), there are several problems with OLS estimates of this equation. First, the estimates will be inconsistent because $E(C_t u_t) \neq 0$. Furthermore, they will be biased if $X_t \neq 0$ because X_t is correlated with C_t and may be correlated with Z_t.[3/] Third, α' will overstate the true permanent income elasticity of the demand for money if the level of consumption is not strictly proportional to permanent income i.e., $\beta \neq 1$.[4/] Finally, if $E(\varepsilon_t v_t) = \sigma^2_{v\varepsilon} \neq 0$, then the estimated standard error from Equation (2') could be smaller than that of Equation (2).[5/]

3. The Empirical Evidence

To investigate whether consumer expenditures, real GNP or permanent income is the appropriate scale variable, the equation

(3) $(M-P)_t = a_0 + a_1 TIME + \sum_{i=0}^{3} b_i SV_{t-1} + \sum_{i=0}^{3} c_i TBR_{t-i} + u_t$,

was estimated. Here, TIME, (M-P), SV and TBR denote a time trend (TIME=1 in 1960/I), per capita real M1, a measure of the real per capita scale variable and the three-month Treasury bill rate, respectively.[6/] All variables are in natural logarithms. The equation was estimated by imposing the condition that the third-order distributed lags fall on second-degree polynominals with the far end-point constrained.[7/] Four alternative scale variables are examined: total consumption (CON), consumer expenditures on nondurables and services (CNS), GNP and permanent income (YP).

Permanent income measure is the same as that used by Darby (1972), Carr and Darby and Carr and Darby (1981) and Thornton (1985).[8/] Because permanent income incorporates past information, only contemporaneous observations of permanent income are included. Darby (1972) has argued that transitory income (YT) shocks may initially effect money demand and Carr and Darby (1981) and Carr, Darby and Thornton (1985) report a significant effect for transitory income. Consequently, YT it is also included. In all other respects, the equation based on permanent income is the same as those based on the alternative scale variables.[9/]

Instrumental variables (IV) estimates of the equations which use the consumption and real GNP measures for the period, 1960/I-1984/IV, are presented in Table 1.[10/] A comparison of the standard error of the estimates (SEEs) shows a considerable reduction in the SEE when either CON or CNS is used as the scale variable. This improvement, however, is due largely to the serial correlation correction. This is shown by the model-based standard errors (MSEEs), which are calculated using only the structural parameters and ignore the times-series part of the equation captured by the coefficient of autocorrelation, ρ.[11/] A comparison of the MSEEs for these equations shows that the GNP-based estimate is only 3 percent larger than that CON-based estimate and is 4 percent smaller than that based on CNS. Hence, the marked superiority of the consumption-based equations is due largely to a serial correlation correction, made solely to capture variation in (M-P), not explained by the model. Consequently, the results do not provide a compelling reason to prefer the consumption-based money demand model over one based on GNP.

Estimates of the permanent income equation are presented in Table 2. Both YP and YT have a significant effect on the demand for money and the interest rate enters with a significant negative coefficient. While the SEE for the YP equation is somewhat larger (about 7 percent) than that of both the CON and CNS equations, the MSEE is considerably smaller than any of the others (at least 43 percent smaller). Consequently, the structural equation based on permanent income performs better than those using alternative scale variables if essentially the same specification is used.

That the permanent income specification outperforms those which use consumption as a proxy for permanent income is not surprising. Business firms, too, hold money balances; and it is unlikely that current consumption expenditures reflect the desire to hold these balances. Additionally, current consumption expenditures are likely to be affected by factors other than permanent income, so they may fluctuate more quarter-to-quarter than permanent income. That is, the consumer expenditure variables may be subject to essentially the same problem that Friedman and Schwartz (1982) allude to with respect to current GNP--albeit, at least for CON, to a lesser degree.

4. Conclusions

The results presented here suggest four conclusions. First, because firms hold money balances, it is unlikely that money demand equations that use consumer expenditures alone will adequately reflect the demand for money in the economy.

Second, consumption can not simply be inserted in the money demand equations as a proxy for permanent income. OLS estimates of equations that employ consumer expenditures as a proxy for permanent income are inconsistent and potentially biased.

Third, appropriately estimated and interpreted, estimates of the demand for money which use consumer expenditures are, at best, modestly better than those based on real GNP. Finally, while the evidence does not support the use of consumer expenditures as a proxy for permanent income, it does support Friedman and Schwartz's conjecture that the demand for money is more closely related to permanent income.

FOOTNOTES

1/ Mankiw and Summers (1986), p. 416.

2/ Note that X_t could include a constant term. Indeed, it would in the case where the level of consumption is proportional to the level of permanent income.

3/ Furthermore, u_t is heteroscedastic because $E(u_t^2)$ is a function of time unless the consumption function is very simple, i.e., $C = \beta YP + \varepsilon_t$. In this case, X = 0.

4/ This bias could vary with the definition of consumption. For example, if the permanent income elasticity gets smaller the more narrowly consumption is defined, the overestimate of β will get larger.

5/ $E(u_t^2) = \sigma_v^2 + \alpha'^2\sigma_\varepsilon^2 - 2\alpha'\sigma_{v\varepsilon}^2$ which is $< \sigma_v^2$ if $\sigma_{v\varepsilon}^2 > \sigma_\varepsilon^2/2\ \alpha'$. If β is .95 for total consumption, this condition is satisfied if the covariance is about 53 percent of σ_ε^2.

6/ To make the results comparable to Mankiw and Summers', by the price index for the corresponding scale variable. They claim that the residuals from these equations are comparable, however, this is not strictly true. Because these indices are highly correlated, however, estimating the equation with different price deflators does not present a serious practical problem. Equation 3 was estimated with the same price deflator, the CPI, and the results were not qualitatively different from those reported here. For a discussion of the importance of using the same dependent variable in money demand when the difference is a problem, see Thornton (1985a) and Carr, Darby and Thornton (1985).

7/ The equations were estimated to make these results comparable with those of Mankiw and Summers.

8/ This formulation is $YP_t = bY_t + (1-b)(1+c)YP_{t-1}$, where b = .025 and c = dlnYt/dt from $\ln Y_t = a_1 + a_2 t + a_3 t^2$, and where $YP_0 = \exp(a_1)$. Also, because YP_t should be independent of Y_t, YP_t was defined as YP_{t-1} for the estimation equations of Table 2.

9/ Two fewer parameters are estimated for the permanent income equations; however, the reported SEEs and MSEEs are calculated using N, not N-k, as the divisor.

10/ The same set of instruments were used for all three scale variables (but they were deflated by the appropriate specific deflator). The instruments are contemporaneous and one lag of the passbook savings rate, the monetary base, the real per capita federal deficit and the per capita federal debt and real wages plus all of the exogenous and predetermined variables of each equation.

11/ The MSEE = $(1/T)(\hat{u}'\hat{u})$, where $\hat{u}$ is the vector of residuals obtained from $Y - X\hat{\beta} = \hat{u}$, and where $\hat{\beta}$

is the estimate of the vector of structural parameters obtained from the equation adjusted for serial correlation.

REFERENCES

Blinder, Alan S. and Robert M. Solow. "Does Fiscal Policy Matter?" Journal of Public Economics 2 (November 1973), 319-37.

Carr, Jack and Michael R. Darby. "The Rule of Money Supply Shocks in the Short-Run Demand for Money," Journal of Monetary Economics (September 1981), pp. 183-199.

______. and Daniel L. Thornton. "Monetary Anticipations and the Demand for Money: Reply," Journal of Monetary Economics (September 1985), pp. 251-257.

Darby, Michael R. "The Allocation of Transitory Income among Consumers' Assets" American Economic Review 62 (December 1972), 928-41.

Friedman, Milton, and Anna J. Schwartz. Monetary Trends in the United States and The United Kingdom, 1867-1975. Chicago: University of Chicago Press, 1982.

Goldfield, Stephen M. "The Demand for Money," Brookings Papers on Economic Activity (3; 1973), pp. 577-646.

Holmes, James M. and David J. Smyth. "The Specification of the Demand for Money and the Tax Multiplier," Journal of Political Economy (January/February 1972), 179-85.

Laidler, David E. W. "The Demand for Money: Theories and Evidence," Second Edition, Dun-Donnelley, New York (1977).

Mankiw, N. Gregory and Lawrence H. Summers. "Money Demand and the Effects of Fiscal Policies." Journal of Money, Credit and Banking 18 (November 1986), 415-29.

Thornton, Daniel L. "Money Demand Dynamics: Some New Evidence," Federal Reserve Bank of St. Louis Review (March 1985a), pp. 14-23.

______. "The Appropriate Interest Rates and Scale Variable in Money Demand: Results from Non-Nested Tests," Applied Economics (August 1985b), pp. 735-44.

Table 1
IV Estimates of Equation 3

Variable	Scale Variable GNP	CON	CNS
TIME	-.004*	-.006*	-.007*
	(7.26)	(7.22)	(6.57)
Scale Var_0	.182	.317*	.479*
	(1.83)	(2.95)	(3.61)
Scale Var_{t-1}	.165*	.256*	.314*
	(4.47)	(6.20)	(5.38)
Scale Var_{t-2}	0.129	.182*	.179*
	(1.93)	(2.65)	(1.99)
Scale Var_{t-3}	.074	.097	.074
	(1.25)	(1.60)	(0.96)
Σ Scale Var.	.550*	.852*	1.046*
	(4.31)	(5.84)	(5.07)
TBR_0	-.016*	-.008*	-.006
	(2.20)	(1.39)	(1.14)
TBR_{t-1}	-.019*	-.017*	-.017*
	(4.29)	(4.72)	(4.88)
TBR_{t-2}	-.018*	-.018*	-.020*
	(3.31)	(4.25)	(4.80)
TBR_{t-3}	-.012*	-.013*	-.014*
	(2.70)	(3.71)	(4.33)
ΣTBR	-.065*	-.066*	-.057*
	(4.14)	(4.44)	(4.60)
ρ	.88*	.91*	.94*
	(18.53)	(21.95)	(27.55)
SEE	.0086	.0073	.0072
MSEE	.0294	.0286	.0306

Absolute value of t-statistics in parenthesis.

* Indicates statistical significance at the 5 percent level.

Table 2
Estimates of The Permanent Income Specification

Variables	
TIME	-.006*
	(10.05)
YP	.945*
	(7.85)
YT	.315*
	(3.86)
TBR	-.010
	(1.85)
TBR_{-1}	-.011*
	(3.15)
TBR_{-2}	-.009*
	(2.23)
TBR_{-3}	-.005
	(1.66)
ΣTBR	-.035*
	(3.15)
ρ	.88*
	(18.53)
SEE	.0077
MSEE	.0162

Absolute value of t-statistics in parenthesis.

* Indicates statistical significance at the 5 percent level.