Money Demand and the Term Structure of Interest Rates: Some Consistent Estimates

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Article:

I. Introduction

Heller and Khan (1979, hereafter HK) employ a quadratic function of the term structure of interest rates to obtain quarterly coefficient estimates of its level, slope and curvature. These estimates are substituted for the interest rate variable in a short-run money demand function, HK conclude that their specification is stable during the turbulent 1972-1974 period. This note shows that HK's stability findings are dependent upon their use of the Cochrane—Orcutt iterative technique (hereafter CORC), not the inclusion of term structure variables. We show that money demand equations incorporating term structure information, specifically the specifications of HK, Bilson and Hale (1980, hereafter BH) and our own (which uses a cubic function of the term structure) are not stable when the Hatanaka (1974, hereafter HAT) procedure is employed to correct for serial correlation.

2. Empirical results

The form of our money demand equation to be estimated (hereafter AH) is

$$\ln m_t = a_0 + a_1 \ln y_t + a_2\alpha_{0t} + a_3\alpha_{1t} + a_4\alpha_{2t} + a_5\alpha_{3t} + a_6 \ln m_{t-1} + u_t, \quad (1)$$

where m represents real money balances, y is real income, α_i (i=0,1,2, 3) are the term structure parameters and u_t is an error term.[1] The HK and BH versions of eq. (1) omit the cubic term, α_{3t}, and have different time-series regressors for α_0, α_1 and α_2 based upon their individual term structure specifications.[2]

The regression results from estimating each money demand equation for the period 1960/H1-4979/IV using both the CORC and HAT estimation techniques are presented in table 1.[3] All the coefficients are statistically significant at the 5 percent level and are of comparable size for both estimation methods. The level, slope and curvature measures are statistically significant and consistent with the results of HK, and BH. The significance of the α_3 variable in the AH specification is evidence of the importance of specifying and incorporating a cubic term structure.

The empirical results, however, are plagued by the two problems associated with conventional money demand estimates that include the post-1973 period. These are the concomitant increase in the coefficient on the lagged dependent variable, which is not different from unity, and the dramatic decline in the estimated coefficient on real income. This deterioration relative to pre-1973 values suggests instability in the underlying structure. Thus, we use likelihood ratio tests to investigate the temporal stability of the alternative specifications.[4,5]

The 1973/IV break point is selected because it is essentially the point at which Quandt's log-likelihood ratio reached a minimum value in HK's study.

Table 1

Estimates of short-run money demand function incorporating the term structure of interest rates 1960/III–1979/IV.

Specification	Estimation technique	Estimated coefficients[a]							Summary statistics[b]		
		Constant	$\ln y_t$	α_0	α_1	α_2	α_3	$\ln m_{t-1}$	$\bar{R}^2/SEE(\times 10^{-3})$	$D.W./h$	$\hat{\rho}$
HK	CORC	−0.341	0.063	−0.042	−12.067	−3479.58		0.970	0.979	1.92	0.24
		(4.68)	(4.67)	(5.19)	(4.54)	(4.55)		(36.31)	5.02	0.36	
BH	CORC	−0.363	0.068	−0.048	−0.206	−1.238		0.968	0.969	1.91	0.37
		(4.08)	(4.13)	(4.80)	(3.59)	(3.57)		(30.58)	5.11	0.41	
AH	CORC	−0.377	0.070	−0.046	−0.225	−1.359	−8.390	0.962	0.977	1.90	0.27
		(4.78)	(4.81)	(5.17)	(4.35)	(4.34)	(4.44)	(34.16)	5.01	0.46	
HK	HAT	−0.275	0.049	−0.037	−10.345	−2985.53		0.995	0.925	2.21	0.30
		(2.28)	(2.27)	(2.98)	(2.59)	(2.70)		(22.08)	5.55	−1.01	
BH	HAT	−0.356	0.051	−0.051	−0.224	−1.401		0.988	0.921	2.13	0.33
		(2.78)	(2.82)	(3.66)	(2.80)	(2.95)		(21.33)	5.49	−0.63	
AH	HAT	−0.349	0.063	−0.049	−0.222	−1.391	−8.609	0.992	0.931	2.13	0.28
		(2.84)	(2.85)	(3.69)	(2.84)	(2.98)	(3.12)	(32.81)	5.43	−0.62	

[a]The number in parentheses are absolute values of *t*-statistics.

[b]$\bar{R}^2$ is the coefficient of determination corrected for degrees of freedom, *SEE* is the regression standard error, *D.W.* is the Durbin–Watson test statistic, *h* is the Durbin *h*-statistic and $\hat{\rho}$ is the estimated autocorrelation coefficient.

The null hypothesis that the estimated coefficients are stable across the 19641/III-1979/IV period is uniformly rejected at the 5 percent level for the HAT regression results. The respective χ^2-statistics for the alternative term structure money demand equations are (critical values in parentheses): HK, 23.4 (16.9); BH, 26.3 (16.9); and AH, 23.3 (18.3). The null hypothesis cannot be rejected at the 5 percent level, however, for the HK and AH specifications estimated using the suspect CORC procedure: The calculated χ^2-statistics (and critical values) are 14.7 (15.5) and 15.5 (16.9) for the HK and AH equations, respectively. As with the HAT stability results, the null hypothesis is rejected for the BH equation using CORC: $\chi^2 = 18.7$ (15.5).

3. Conclusion

Our stability results are contrary to those reported by HK. We find that substituting an approximation of the term structure of interest rates for some vector of rates in a conventional short-run money demand equation does *not* eliminate the problem of unstable coefficient estimates when appropriate econometric techniques are employed.

Notes:

[1] The data used to generate the variables used to estimate eq. (1) are nominal *M 1B,* the implicit *GNP* deflator (1972=100) and real *GNP* ($1972).

[2] The term structure parameters used for the HK specification are derived from the equation $\ln R_? = \alpha_{0t}, + \alpha_{1t}T_i + \alpha_{2t}T_i^2 + \varepsilon_t$, where the dependent variable is the logarithm at time t of the i^{th} nominal interest rate of monthly maturity *T (T=3,* 6, 12, 36, 70, 120, 240 months), α_i *(i*= 0, 1,2) are the level, slope and curvature Parameters to be estimated and ε_t is an error term. The BH specification is a double-logarithmic version of the above equation. Eq. (1) is based on the findings of Allen, Hatfield and Williams (1981) that a cubic function is a better approximation of the term structure. Thus, the term structure parameters of eq. (1) are obtained from a double-logarithmic cubic specification. For further detail on these specifications, see Allen and Hafer (1981).

[3] It is well known that the use of the Cochrane—Orcutt procedure yields inconsistent and inefficient parameter estimates in the presence of a lagged dependent variable. See Theil (1971). Hatanaka (1974) has shown that under fairly general assumptions, his residual-adjusted Aitken estimator yields consistent and asymptotically efficient estimates. See Laumas and Spencer (1980) and Lieberman (1980) for other money demand studies employing the Hatanaka procedure.

[4] FM employ the Brown—Durbin—Evans (1975) cusum, cusum squared and time-trend regressions test of stability. Their results do not reject the null hypothesis of structural stability. These stability tests, however, are based on estimates that are neither consistent nor efficient and upon data transformed by an inconsistent rho value. Moreover, Brown—Durbin—Evans developed their teats for situations in which no autocorrelation

exists, a fact ignored by HK. For critical evaluations of the cusum and cusum squared tests, see Farley, Hinich and McGuire (1975) and Garbade (1977) Moreover, BH do not address the question of stability in their paper.
[5] Standard chow tests were also performed. These results lead to the same conclusions reached
More appropriate likelihood ratio test. See Allen and Hafer (1981).

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