Klein's Price Variability Terms in the U.S. Demand for Money: *A Note*

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Article:

1. Introduction

One recent innovation in the empirical work on the demand for money has been the inclusion of a measure of the past or future variability of the inflation rate or the interest rate.[1] One particularly unique empirical and theoretical treatment is developed by Klein [12] who reports a positive and significant effect on the U.S. demand for money by a price uncertainty variable, $S(\dot{P}/P)$, which allegedly measures the quality of cash balances. These results substantiate his theoretical development that an increase in the uncertainty of the inflation rate lowers the quality of the services from a stock of money which thereby increases the demand for money. The $S(\dot{P}/P)$ term represents a measure of the past variability of the rate of change of prices and is analogous to an adaptive expectations term for the rate of inflation.[2]

An exchange between Ibrahim and Williams [9] and Klein [13] over the stochastic structure of the rate of inflation resulted in Klein's publication of a short-run, σ_s, and long-run, σ_L, series of the *price unpredictability* measures to replace the original Klein [11] series of σ_s and σ_L. The revised series are the standard deviation of a one-year and six-year ahead forecast error of the rate of inflation respectively. Though Klein presents this revised series of σ_s and σ_L, he does not provide any new empirical evidence to update his 1977 money demand study. Laidler [14] presents evidence that for a postwar annual demand for money function the revised σ_s measure is not positive and significant. The purpose of this note is to reexamine Klein's estimates of the demand for money and to test for the sign and significance of the three variables which measure the quality of cash balances. This reexamination is important because Klein raises the theoretical and empirical question of whether the qualitative nature of the flow of services from a stock of money would affect the stock demand for money.[3,4]

2. Klein's Long-Run Money Demand Equation

Klein's [12] money demand function which assumes complete adjustment between desired and actual cash balance is

$$\log M = a_0 + a_1 \log y_p + a_2 r_s + a_3 r_L + a_4 r_M + a_5 \log S(\dot{P}/P) + u_t, \qquad (1)$$

where M is real per capita money balances, y_P is real permanent per capita income, r_s is the four-six month commercial paper rate, r_L is the yield on corporate bonds, r_M is the return on either M1 or M2 balances developed in Klein [10], and $S(\dot{P}/P)$ is Klein's price uncertainty term.[5]

Klein's ordinary least squares (OLS) estimates of both definitions of money are presented as equations (1.1) and (1.5) in Table 1. Klein does not correct for autocorrelation via the Cochrane-Orcutt iterative technique or other estimation procedure except that he reports the first difference results which assumes that $\rho = 1$. These results are reported as equations (1.2) and (1.6). The measure of quality, the log of the moving standard deviation, is

significant in both the OLS and the first difference equations. The results of correcting for autocorrelation by the Beach-MacKinnon [2] maximum-likelihood technique are reported as equations (1.3) and (1.7) and reveal a significant coefficient for the measure of quality in both the MI and M2 equations. Recently Carlson and Frew [5] have shown that Klein's r_M variable is an endogenous variable which results in biased coefficient estimates. Therefore, equation (1) is reestimated with r_M omitted for both definitions of money. The results are reported as equations (1.4) and (1.8) in Table I. The S($\dot{P}$/P) coefficient is insignificant for both the M1 and M2 equations for a two-tailed test at the 5 percent level of significance. Equation (1) with r_M omitted was also estimated with σ_s and σ_L substituted for $S(\dot{P}/P)$. The results are not reported because the σ_s and σ_L coefficients were insignificant in each case.[6] Therefore, the elimination of the endogenous r_M variable from the money demand function results in the insignificant coefficients on Klein's price uncertainty and unpredictability variables. This evidence which employs Klein's data overturns the empirical evidence that the quality of cash balances is an argument in a long-run demand-for-money function.

TABLE 1

DEMAND FOR MONEY FUNCTION: $\log M = a_0 + a_1 \log y_p + a_2 r_s + a_3 r_L + a_4 r_M + a_5 \log S(\dot{P}/P)$

	a_0	a_1	a_2	a_3	a_4	a_5	θ/ρ	R^2	D-W	SEE
M2 *1880–1972*										
1.1 (OLS)*	−14.01	1.38	−0.268	−0.071	0.302	0.050		0.991	0.98	0.0684
	(69.55)	(41.44)	(11.37)	(5.68)	(11.09)	(4.48)				
1.2 (FD)†	0.011	1.01	−0.050	−0.060	0.067	0.023	θ = −0.3901	0.671‖	1.98	0.0284
	(2.19)	(6.90)	(3.41)	(4.92)	(3.14)	(2.11)	(3.71)			
1.3 (ML)	−12.81	1.13	−0.062	−0.064	0.080	0.016	ρ = 0.991	0.895	1.59	0.0364
	(16.63)	(9.94)	(3.08)	(4.22)	(2.92)	(1.10)				
1.4 (ML)	−13.61	1.25	−0.005	−0.059		0.014	ρ = 0.989	0.899	1.61	0.0380
	(18.32)	(11.25)	(1.09)	(3.74)		(0.95)				
M1 *1919–72*										
1.5 (OLS)‡	−15.80	1.67	−0.135	−0.135	0.146	0.143		0.962	0.75	0.0806
	(42.29)	(26.65)	(1.85)	(7.21)	(1.63)	(7.40)				
1.6 (FD)§	0.004	0.87	−0.089	−0.026	0.118	0.011	θ = 0.6677	0.749‖	1.82	0.0316
	(NR)	(3.94)	(3.00)	(1.75)	(2.92)	(2.49)	(6.13)			
1.7 (ML)	−11.51	0.92	−0.122	−0.065	0.173	0.052	ρ = 0.968	0.951	1.23	0.0454
	(10.94)	(5.86)	(2.55)	(2.94)	(2.72)	(2.11)				
1.8 (ML)	−12.03	1.00	−0.006	−0.073		0.047	ρ = 0.957	0.955	1.23	0.0483
	(11.26)	(6.23)	(0.62)	(3.17)		(1.80)				

NOTES: ML = Beach-MacKinnon maximum likelihood estimates, FD = first difference equation, NR = not reported.
*Klein [12, p. 703, eq. (10)].
‡Klein [12, p. 703, eq. (14)].
†Klein [12, p. 709, eq. (25)]. $\Delta \log M2 = a_0 + a_1 \Delta \log y_p + a_2 \Delta r_S + a_3 \Delta r_L + a_4 \Delta r_M + a_5 \Delta \log S(P/P)_{t-1} + u_t + \theta u_{t-1}$ $Q = 8.06$
§Klein [12, p. 709, eq. (27)]. $\Delta \log M1 = a_0 + a_1 \Delta \log y_p + a_2 \Delta r_S + a_3 \Delta r_L + a_4 \Delta r_M + a_5 \Delta \log S(P/P)_{t-1} + u_t(1 - \theta B)$ $Q = 7.02$
‖$\bar{R}^2$

TABLE 2

DEMAND FOR MONEY: ALTERNATIVE PRICE UNCERTAINTY VARIABLES. LOG $M = a_0 + a_1 \log y_P + a_2 r_s + a_3 r_L + a_4 \log S(\dot{P}/P) + a_5 \log M_{t-1}$

	a_0	a_1	a_2	a_3	a_4	a_5	SEE	D-W	ρ
1883–1974 M2									
(2.1) $S(\dot{P}/P)$	−7.886	0.807	−0.013	−0.047	0.011	0.485	0.0335	1.87	0.862
	(6.89)	(6.84)	(2.74)	(3.67)	(0.89)	(6.60)			
(2.2) σ_s	−7.757	0.787	−0.011	−0.045	−0.084	0.492	0.0337	1.87	0.872
	(6.87)	(6.86)	(2.84)	(3.57)	(0.16)	(6.76)			
(2.3) σ_L	−7.760	0.786	−0.010	−0.044	−0.126	0.492	0.0333	1.86	0.882
	(6.86)	(6.84)	(2.80)	(3.44)	(1.37)	(6.73)			
1920–74 M2									
(2.4) $S(\dot{P}/P)$	−7.014	0.678	−0.006	−0.036	0.020	0.488	0.0335	1.81	0.761
	(4.90)	(4.76)	(1.12)	(2.58)	(1.39)	(4.71)			
(2.5) σ_s	−6.619	0.611	−0.005	−0.035	−0.424	0.487	0.0339	1.80	0.810
	(4.78)	(4.62)	(0.93)	(2.46)	(0.68)	(4.57)			
(2.6) σ_L	−6.331	0.603	−0.08	−0.027	0.480	0.548	0.0335	1.76	0.765
	(4.79)	(4.78)	(1.42)	(1.93)	(1.37)	(5.49)			
1920–74 M1									
(2.7) $S(\dot{P}/P)$	−4.403	0.429	−0.004	−0.052	0.026	0.678	0.0396	1.82	0.699
	(3.44)	(3.23)	(0.60)	(2.85)	(1.48)	(7.73)			
(2.8) σ_s	−3.877	0.345	−0.003	−0.047	−0.199	0.689	0.0402	1.76	0.767
	(3.19)	(2.87)	(0.39)	(2.59)	(0.17)	(7.54)			
(2.9) *σ_L	−4.366	0.408	−0.006	−0.041	0.728	0.691	0.0393	1.65	0.770
	(3.39)	(3.08)	(0.81)	(2.33)	(1.78)	(7.89)			

*Hildreth-Lu iterative technique employed

3. A Short-Run Money Demand Equation

A short-run money demand function which includes a lagged dependent variable to allow for only partial adjustment of actual money balances to the desired level is also estimated. The results, which are reported in Table 2 for the 1883-1974 period for M2 and the 1920-74 period for both M2 and M1 confirms that Klein's price uncertainty and price unpredictability measures are insignificant and should not enter the money-demand function. Furthermore, the evidence shows that Klein's long-run money demand function which assumes complete adjustment between actual and desired levels of money balances is misspecified because the lagged dependent variable coefficient is always positive and significant.

Klein's price uncertainty measures as defined in [11] were originally employed to consider the nature of the monetary regime and to indicate possible shifts in the regime. On the basis of the movement of σ_s, Klein divides his data into three separate monetary regimes which include "the gold standard from 1880-1915, the transitional period from 1916-1955 and the 'new standard' from 1956-1973" (p. 466). The short-run money demand function was reestimated for the 1883-1915, 1916-55, and 1956-74 periods for M2 and for the 1920-55 and 1956-74 periods for M1.[7] The evidence shows that $S(\dot{P}/P)$, σ_s, and σ_L are insignificant in eight of the nine M2 estimates and four of the six M1 estimates.[8] The three exceptions for the fifteen equations which were estimated do not overturn the previous conclusions.

4. Conclusions

The evidence presented in this study strongly suggests that Klein's measures of price uncertainty and unpredictability do not significantly enter the demand for money function. There is, however, a theoretical and empirical question which remains to be answered. If a change in the monetary regime does result in a structural shift in the demand for money, then a variable, which indicates the probability and/or magnitude of a regime shift, should enter the money demand function.[9] Such a question is outside the scope of this note.

Notes:

[1] Eden [6], Klein [12], Frenkel [8], Blejer [3], and Pautler [16] consider the variability of the rate of inflation while Brunner and Meltzer [4] and Amihud [1] consider the variability of interest rates.

[2] Klein's $S(\dot{P}/P)$ variable [12, p. 701] is the five-term moving standard deviation from the 10-term moving mean of the annual rate of change of prices."

[3] Klein suggests that his empirical results [12, p. 691] have important implications for the theory of inflation, the optimum quantity of money, and the potential government tax revenue from money creation."

[4] An important, yet unresolved, issue involves the expected sign of these price uncertainty or unpredictability measures. Studies by Matthews [15], Frenkel, and Blejer have noted that increased uncertainty of the rate of inflation will have an ambiguous effect on the demand for money.

[5] Klein argues that according to modem portfolio theory interest rates should not enter the equation in logarithmic form [10, p. 939] because "the commonly used logarithmic functional form implies a proportionately greater effect for every percentage point change in interest the lower the rate of interest and an undefined demand for money at a zero rate of interest."

[6] The results are not altered by the elimination of the war years of 1940-47.

[7] Minor adjustments are made in the estimated time periods because Klein's Ml data begin in 1919 and his σ_s, and σ_L data begin in 1883.

[8] The exceptions are the M2 equation for σ_s over 1956-74 and the MI equation for σ_s and σ_L for 1920-55 when these coefficients are positive and significant for a two-tailed test at the 5 percent level of significance.

[9] Flood and Garber [7] consider this question for the German hyperinflation.

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