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Secretary's Department

The Demand for M1 in the United States: A Comment on
Baba, Hendry, and Starr

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Abstract

A recent paper by Baba, Hendry, and Starr presents an error-correction model of the demand for M1 in the United States, which shows a dramatic improvement in both fit and stability over earlier models. This note estimates an alternative model with the same data set and draws two conclusions: that the improvements are due more to the use of complex dynamics than to the introduction of variables representing financial innovation, and that some of the economic properties are not robust with respect to minor changes in specification.

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* This paper is to be published in The Economic Journal, in tandem with a response by David Hendry. I would like to thank (without implicating) Neil Ericsson for providing the data and for helping me to interpret some of the tests.

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Summary

A 1992 paper by Yoshihisa Baba, David Hendry, and Ross Starr presents a model of the demand for narrowly defined money (M1) in the United States that shows a dramatic improvement in both fit and stability over earlier models. This note estimates an alternative model that is based on the same data set, uses a similar error-correction methodology, and has very similar statistical properties to the original. Both models show remarkable stability throughout the past three decades.

Two conclusions are that the improvements are due more to the use of complex dynamics than to the introduction of variables representing financial innovation (as alleged by Baba, Hendry, and Starr) and that some of the economic properties are not robust with respect to minor changes in specification. Notably, whereas in the original model, money demand has a low elasticity to real income, which suggests substantial economies of scale in money holdings, this alternative has a unitary elasticity, which suggests that money and income should grow proportionately in the long run.

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I. Introduction

Baba, Hendry, and Starr (1992), hereinafter BHS, estimate a demand function for real M1 balances in the United States that is stable over the 1970s and the 1980s. This success contrasts with the bulk of recent research on U.S. M1, which has led most analysts to conclude that financial innovations and other developments have rendered that aggregate so unstable as to be virtually useless for analytical or policy purposes. BHS attribute the superior performance of their model to two features: extended dynamics and the inclusion of innovations-related variables. This note will show that the improvement is attributable largely to the first feature rather than to their proxies for financial innovations, and that some of the main economic inferences drawn by BHS do not hold under a revised specification of the model.

II. Two Models of Money Demand

The BHS equation (18), estimated over 1960q3 through 1988q3, is as follows (with some minor changes in notation):

$$\begin{aligned} \Delta(m-p) = & 0.352 - 0.334\Delta_4(m-p)_{-1} - 0.249(m-p-0.5y)_{-2} - 1.409AS \\ & (0.02) \quad (0.10) \quad (0.02) \quad (0.10) \\ & - 0.973Ai - 0.255\Delta R_{ma} - 1.097\Delta_4 p_{-1} - 0.330\Delta \hat{p} + 0.395\Delta Ay \\ & (0.06) \quad (0.05) \quad (0.13) \quad (0.05) \quad (0.07) \\ & + 0.859V + 11.680\Delta SV_{-1} + 0.435R_{nsa} - 0.156\Delta^2(m-p)_{-4} + 0.013D \\ & (0.08) \quad (1.49) \quad (0.06) \quad (0.04) \quad (0.003) \end{aligned} \quad (1)$$

$R^2 = 0.894$, $\hat{\sigma} = 0.385\%$, $F(13,99) = 64.50$, $DW = 1.89$, $SC = -10.67$
 $\eta_1(5,94) = 0.40$, $\eta_2(11,88) = 0.33$, $\eta_2(16,83) = 1.20$, $\eta_3(26,72) = 0.47$,
 $\eta_4(25,74) = 0.74$, $\xi_5(2) = 0.45$, $\eta_6(4,91) = 0.44$, $\eta_7(1,98) = 0.13$,
 $\eta_8(y)(1,98) = 0.17$, $\eta_8(p)(1,98) = 0.48$, $\eta_8(R_{ma})(1,98) = 0.03$.

where m , p , and y are the logarithms of M1, the GNP deflator, and real GNP, respectively; Ai , AS , and Ay are two-period averages [$Ax=0.5(x+x_{-1})$], where $x = i$ (the short-term interest rate), S (the term structure, $r-i$), or y]; R_{ma} is a learning-adjusted maximum yield on assets in M2 (but not in M1); R_{nsa} is a learning-adjusted yield on "other checkable" deposits included in M1; $\Delta p = \Delta p + \Delta^2 p$; V is a measure of volatility in bond yields; $SV = \max(0, S)V$; and D is a dummy variable for the temporary imposition of credit controls in 1980. 1/ The η 's are F-statistics against various aspects of the null

1/ The differencing notation is $\Delta^2 x = \Delta x - \Delta x_{-1}$, and $\Delta_1 x = (x - x_{-1})/1$.

hypothesis that this model is well specified, and ξ_5 is a χ^2 test for the normality of the residuals. 1/

The BHS model was derived by specifying an initial less-restricted model and then deriving a more parsimonious form by sequentially imposing restrictions and testing to ensure their validity. Both the initial specification and the criteria for narrowing it are necessarily somewhat arbitrary, and it is of interest to determine whether alternative choices would lead to a significantly different outcome. BHS began (their Table 1) by including 6 lags on m , p , and y ; 2 lags on SV and the raw components of R_{nsa} ; 1 lag on V and the other interest rates; and the dummy variable, D . As an alternative, suppose that one starts from 6 lags on m , y , p , i , r , and R_{nsa} , ignoring all other variables found in (1); that is, one postulates a conventional money demand relationship, ignoring financial innovation except for the inclusion of yields on "other checkable" deposits as a measure of the own yield on $M1$, but incorporating much richer dynamics than in the old partial-adjustment models (and even richer than in BHS). The parsimonious form derived from that general model (same data set and estimation period) is as follows:

$$\begin{aligned} \Delta(m-p) = & 0.035 - 0.029(m_{-4} - p_{-4} - y_{-1}) + 0.200(i_{-1} - r_{-1} - 2\Delta R_{nsa-2}) \\ & (0.003) \quad (0.003) \quad (0.045) \\ & + 0.221\Delta y - 0.728\Delta p - 0.245\Delta^2 p_{-2} + 0.253\Delta^2 m_{-1} - 0.260\Delta i_{-1} \\ & (0.048) \quad (0.099) \quad (0.115) \quad (0.057) \quad (0.064) \\ & + 0.154(\Delta i_{-2} + \Delta i_{-4}) - 0.400(\Delta r_{-3} + 4\Delta r) + 0.024D \\ & (0.048) \quad (0.036) \quad (0.003) \end{aligned} \quad (2)$$

$$R^2 = 0.866, \quad \hat{\sigma} = 0.427\%, \quad F(10,102) = 65.92, \quad DW = 1.93, \quad SC = -10.55$$

$$\eta_1(5,97) = 0.46, \quad \eta_2(11,91) = 1.33, \quad \eta_2(16,86) = 1.70, \quad \eta_3(20,81) = 0.66,$$

$$\eta_4(28,74) = 0.46, \quad \xi_5(2) = 4.26, \quad \eta_6(4,94) = 0.76, \quad \eta_7(1,101) = 0.56,$$

$$\eta_8(y)(1,101) = 0.03, \quad \eta_8(p)(1,101) = 2.21, \quad \eta_8(R_{nsa})(1,101) = 1.43.$$

The two equations are statistically similar but--as discussed below--are economically distinct. Equation (1) fits slightly better than (2)--its standard error is 10% smaller, and the Schwartz criterion (SC) is slightly larger--but its statistical properties are not significantly better. Both models pass all of the diagnostic tests selected by BHS; the only noticeable difference is that the residuals in (2) are more skewed than those in (1),

1/ η_1 tests for serial correlation, η_2 for parameter constancy, η_3 for heteroscedasticity, η_4 for the validity of the restrictions in (1) against a less restricted model, η_6 for ARCH, η_7 for the validity of the functional form (Ramsey's RESET test), and η_8 for the exclusion of the current value of the indicated variable.

but ξ_5 still is below the 90% level for the $\chi^2(2)$ distribution. Furthermore, neither equation encompasses the other. Using the Davidson-MacKinnon test, the predictions from each model are a significant additional argument in the other model. 1/ The t-ratios on the error-correction term are also similar.

To test for stability, equation (2) was re-estimated with money balances adjusted for the effects of the 1980 credit controls; rather than using the actual data with a dummy variable for the temporarily depressing effect of the controls, the data were revised by adding 2% to the money stock in 1980q2. This adjustment permits the use of recursive least squares to determine if there were any significant breaks throughout the sample period. At no point does the N-step Chow test (i.e. the test for whether the remaining observations are consistent with the equation estimated over a truncated sample) reject stability at the 5% significance level. The closest it comes is after 1984q4, when the F-statistic is just below the threshold.

As for economic properties, there are a number of interesting comparisons between the two equations, aside from the obvious one that the volatility and r_{ma} variables are omitted from equation (2). Ignoring the constant term, the cointegrating relationship derived by BHS (their equation 19) from equation (1) is

$$m - p = 0.5y - 3.90i - 5.65S + 3.45V + 1.74R_{nsa} - 1.43\pi \quad (1a)$$

where π = inflation ($\Delta_4 Lp$). The comparable but much simpler solution to equation (2), in which the innovations-related variable R_{nsa} does not appear, is

$$m - p = y - 6.99S - 2.14\pi. \quad (2a)$$

One major difference in these two solutions is in the long-run elasticity to real income. The BHS equation conforms to the Baumol-Tobin model in that the steady-state real income elasticity is 0.5. (The unconstrained estimate was 0.576 with standard error 0.06, but the authors chose to impose 0.5 for consistency with the model.) In contrast, equation (2) has a unitary steady-state elasticity (0.96 unconstrained). Since any number of plausible elasticities could be drawn from theory, this lack of consensus in equations drawn from essentially the same data set is unsettling.

A second major difference in the equilibrium expressions concerns the interest elasticities. If all interest rates are equal in the steady state ($i=r=R_{nsa}$), the BHS equation will have a negative semi-elasticity of 2.2, whereas the interest rate effect will vanish in the alternative (2a). Another way of viewing this difference is to consider the case where all

1/ Testing (1) against (2) gives $\eta_8(1,98) = 10.71$; testing (2) against (1) gives $\eta_8(1,101) = 45.84$. Both tests reject the null at the 99% confidence level.

short-term yields are equal ($R_{nsa}=i$), in which case the BHS interest-rate effect reduces to $-5.65r+3.49i$, compared with the alternative $-6.99(r-i)$. Either BHS's formulation understates the positive effect of short-term yields as a proxy for the own rate of interest, 1/ or the effect is exaggerated in the alternative. In any event, it is likely that neither is fully capturing the underlying relationships; the data are not rich enough to reveal structural information on interest-rate effects.

In addition to these differences in equilibrium properties, the dynamic responses are quite different. The basic speed of adjustment is relatively fast in the BHS equation; the coefficient on the error-correction term is 0.25 in equation (1) and only 0.03 in equation (2). This difference does not imply, however, that real balances will adjust more rapidly to any particular disturbance, because there is a range of dynamic effects in each equation. For instance, the BHS equation has a significant negative impact effect from changes in the short-term interest rate (i), whereas equation (2) does not; on the other hand, the impact effect from a rise in real income is approximately 0.2 in both equations.

III. Conclusions

While the BHS estimate of U.S. money demand is a major improvement over earlier studies in terms of both goodness and fit and intertemporal stability, it would be premature to view its economic properties as conclusive. The importance of financial innovations appears to be overstated, in that the fit and stability of the equation have much more to do with the introduction of rich dynamics than with the innovations-related variables. With this dynamic complexity, it is relatively easy to generate alternative estimates that nearly match the statistical performance but that have quite different implications.

1/ R_{nsa} is a weak proxy for the own rate, since it takes on non-zero values beginning only in 1981.

Reference

Baba, Yoshihisa, David F. Hendry, and Ross M. Starr, "The Demand for M1 in the U.S.A., 1960-1988," *Review of Economic Studies*, vol. 59 (January 1992), pp. 25-61.