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Evidence on the Temporal Stability of the Demand for Money Relationship in the United States

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ECONOMISTS and policymakers are extremely interested in the temporal stability of the money demand relationship. Most economists use macroeconomic models which assume that money demand is consistently related to a number of predetermined variables. As such, evidence of instability in the relationship casts doubt on the validity of such models.

Evidence of temporal instability is likewise disconcerting to monetary policymakers. When the relationship between money demand and the variables that determine it breaks down, policymakers by definition are unsure of future money demand. Thus, projecting the linkage between the money stock and economic variables such as output, prices, and interest rates becomes even more difficult and tenuous than before.

With regard to narrowly defined money (M1), the evidence on the stability of the demand relationship has recently taken a drastic turn. Prior to the mid-1970s, the evidence supporting a stable money demand relationship in the United States was *"overwhelming,"* to borrow Laidler's description.[1] Along the same line, Laumas and Mehra provided statistical evidence that the relationship was stable under a broad range of alternative specifications.[2]

In 1976, however, two separate studies found evidence which suggests that the money demand relationship had broken down around 1973. Both Enzler, Johnson, and Paulus (EJP), and Goldfeld found that the traditional transaction money demand relationship significantly overpredicted post-1972 real money balances.[3] Being unsuccessful in attempting to explain the decline statistically, both studies concluded that there had indeed been a downward shift in the relationship over this period.

This conclusion recently has come under attack in a number of studies which resurrect concern about the appropriate money demand specification. These studies argue that other specifications of the money demand relationship do *not* indicate any recent breakdown. This article provides a critical review of the existing evidence on the issue of the temporal stability of the money demand relationship. Various money demand specifications are examined in terms of their dynamic out-of-sample predictive ability over the post-1972 period and more formally through the use of the Brown-Durbin-Evans (BDE) cusum-squares tests.[4] The forecasting ability of these alternatives is compared using a common sample period, data base, and means of generating post-sample predictions.

[1]David E. W. Laidler, "The Influence of Money on Economic Activity: A Survey of Some Current Problems," in G. Clayton, J. C. Gilbert, and R. Sedgwick, eds., *Monetary Theory and Policy in the 1970's,* (London: Oxford University Press, 1971).

[2]G. S. Laumas and Y. P. Mehra, "The Stability of the Demand for Money Function: The Evidence from Quarterly Data," *The Review of Economics and Statistics* (November 1976), pp. 463-68.

[3]Jared Enzler, Lewis Johnson, and John Paulus, "Some Problems of Money Demand," *Brookings Papers on Economic Activity* (1: 1976) pp. 261-79; Stephen M. Goldfeld, "The Case of the Missing Money," *Brookings Papers on Economic Activity* (3: 1976), pp. 683-730.

[4]R. L. Brown, J. Durbin, and J. M. Evans, "Techniques for Testing the Constancy of Regression Relationships Over Time," *Journal of the Royal Statistical Society,* Ser. B, Vol. 37, (No. 2, 1975), pp. 149-92.

RECENT EVIDENCE ON THE STABILITY OF THE MONEY DEMAND RELATIONSHIP

The basic Goldfeld equation, which posits a real adjustment lag, provides the standard of comparison for alternative money demand specifications.[5] The real adjustment version of the Goldfeld specification is

$$(1) \quad \ln\left(\frac{M_t}{P_t}\right) = \alpha_0 + \alpha_1 \ln y_t + \alpha_2 \ln CPR_t + \alpha_3 \ln RTD_t + \alpha_4 \ln\left(\frac{M_{t-1}}{P_{t-1}}\right) + v_t,$$

where M = nominal M1 balances,
P = the general price level (the implicit GNP deflator),
y = real income (real GNP),
CPR = the commercial paper rate,
RTD = the rate on time deposits,
v = an error term.[6]

The first row of table 1 reports the coefficient estimates and summary statistics for this money demand specification. All estimates shown are for the sample period II/1955-IV/1972 and are based on the Cochrane-Orcutt (CORC) estimation technique. In addition, table 1 reports the root-mean-squared error (RMSE) of the dynamic post-sample simulations (I/1973-I/1977).[7]

Although the sample period is slightly different, the results for this equation are similar to Goldfeld's. The estimated coefficients all have the anticipated sign and are significantly different from zero. These estimates reveal that more than one-third of the desired change in the money stock is completed within one quarter and that the long-run income elasticity is 0.54. The resulting large RMSE for the dynamic simulation demonstrates a marked deterioration in the relationship after 1972. A comparable simulation over the period IV/1968-IV/1972 yielded an RMSE of only 2.33 — merely one-tenth of that found for the post-1972 period.

One of the earliest rebuttals to the instability claim came from Hamburger, who contended that EJP and Goldfeld were too restrictive in their choice of asset yields hypothesized to affect money demand.[8] He argued that the exclusion of long-term asset yields from the specification was both theoretically and empirically unjustified.

To support his argument, Hamburger incorporated long-term government bond yields and the common stock dividend-price ratio in estimating an altered version of the MPS (MIT-Pennsylvania-Social Science Research Council) money demand equation. The adapted specification used by Hamburger was

$$(2) \quad \ln\left(\frac{M_t}{P_t y_t}\right) = \beta_0 + \beta_1 \ln RTD_t + \beta_2 \ln DPR_t + \beta_3 \ln RGL_t + \beta_4 \ln\left(\frac{M_{t-1}}{P_t y_t}\right) + e_t,$$

where DPR is the dividend-price ratio on common stock, RGL is the yield on long-term government bonds, e is an error term, and other variables are as previously defined.

Estimation results for this equation are reported in the second row of table 1.[9] These results, similar to

[5]The equation hypothesizes that the real money stock only partially adjusts to the desired level in the current quarter (the desired level being determined by real income and the two contemporaneous interest rates). Another popular version of the partial adjustment process hypothesizes that the *nominal* money stock partially adjusts to the desired level within one quarter. This version is similar to equation 1 in all respects except that the lagged money stock variable is divided by the contemporaneous price level. It should be noted that Goldfeld found the nominal adjustment mechanism slightly preferable in terms of out-of-sample forecasting ability. We use his real version, however, since it has become the standard reference equation in most studies considered here.

[6]Since Goldfeld estimates equation 1 by the Cochrane-Orcutt (CORC) estimation procedure, he implicitly assumes $v_t = \rho v_{t-1} + \varepsilon_t$, where ρ is a constant and ε is an error term with classical properties. In theory, the coexistence of a lagged dependent variable and serially correlated error terms casts doubt about the consistency and efficiency of CORC estimates. However, the work of Laumas-Spencer suggests that the gains from more elaborate estimation procedures are small. See G. S. Laumas and David E. Spencer, "The Stability of the Demand for Money: Evidence from the Post-1973 Period," unpublished manuscript, 1979.

[7]Two important points about the post-sample simulations need to be noted. In the first place, the simulations are based on the transformed equation, in which the autocorrelation in the error terms is explicitly recognized. In other words, the forecasts are based on the equation

$$\ln\left(\frac{M_t}{P_t}\right) = \hat{\alpha}_0 (1-\hat{\rho}) + \hat{\alpha}_1 (\ln y_t - \hat{\rho} \ln y_{t-1}) + \hat{\alpha}_2 (\ln CPR_t - \hat{\rho} \ln CPR_{t-1}) + \hat{\alpha}_3 (\ln RTD_t - \hat{\rho} \ln RTD_{t-1}) + \hat{\alpha}_4\left[\ln\left(\frac{M_{t-1}}{P_{t-1}}\right) - \hat{\rho}\ln\left(\frac{M_{t-2}}{P_{t-2}}\right)\right] + \hat{\rho}\ln\left(\frac{M_{t-1}}{P_{t-1}}\right)$$

where $\hat{\rho}$ is the estimated serial correlation coefficient and $\hat{\alpha}_i$ $(i = 0, \ldots, 4)$ is the estimated regression coefficient. It is unclear from the cited studies whether such a procedure is commonly followed. Second, the RMSE for each equation is determined by comparing the actual money stock with the nominal level simulated by each equation. Many previous studies use the real money stock and projected real balances as the source of comparison.

The endpoint of our sample period (I/1977) was chosen to enhance the comparability between our findings and others considered here. Also, the series for net wealth used in this study was available only through I/1977.

[8]Michael J. Hamburger, "Behavior of the Money Stock: Is There a Puzzle?" *Journal of Monetary Economics*, (No. 3, 1977), pp. 265-288.

[9]This equation is based on the nominal adjustment mechanism discussed in footnote 5. We also estimated the equation assuming a real adjustment mechanism in which the lagged money stock is deflated by the term $(P_{t-1} y_t)$. Except for the coefficient on the commercial bank passbook rate, which was insignificantly different from zero, the coefficient estimates were similar to those reported in table 1. However, the RMSE increased dramatically to 14.59 when the real adjustment version was employed.

Table 1

Alternative Money Demand Equation
Regression Results: II/1955-IV/1972

	Coefficient[a]									Summary Statistics				
Equation	Constant	Income	Permanent Income	Net Wealth	Time Deposits	Commercial Paper	Government Bond Yield	Dividend Price Ratio	Money Lagged[b]	R2	D.W.	SEE	rho	RMSE[c]
(1) Goldfeld	−.861 (5.18)	.177 (5.04)			−.040 (3.51)	−.016 (4.57)			.665 (8.36)	.994	1.76	.0040	.440	21.88 (7.65)
(2) Hamburger	−.458 (3.25)				−.021 (2.24)		−0.020 (1.91)	−.024 (3.03)	.908 (34.77)	.999	1.70	.0040	.566	4.54 (1.59)
(3) B. Friedman	−.613 (3.49)	.100 (2.38)		.065 (2.63)	−.040 (3.71)	−.014 (4.05)			.728 (9.56)	.995	1.81	.0038	.372	21.72 (7.59)
(4) Laumas-Spencer	−.286 (5.60)		.056 (4.85)			−.017 (4.45)			.924 (21.88)	.993	1.88	.0044	.377	28.94 (10.12)
(5) Garcia-Pak	−.908 (5.22)	.174 (5.03)			−.038 (3.42)	−.021 (6.10)			.760 (12.24)	.993	2.02	.0055	.021	9.95 (3.48)

[a]All variables enter logarithmically and all equations are estimated using the Cochrane-Orcutt iterative technique. The numbers in parentheses are absolute values of t-ratios.

[b]The Goldfeld, Friedman, and Laumus-Spencer equations contain a lagged money variable of the form (M_{t-1}/P_{t-1}). The Hamburger specification includes a lagged money variable of the form $(M_{t-1}/P_t y_t)$. The lagged money term in the Garcia-Pak equation is of the form (M_{t-1}/P_{t-1}), where $M = M1 + IAF$.

[c]The RMSE is the root-mean-squared error for dynamic extrapolation over the I/1973-I/1977 period. The error is in billions of current dollars, and the percentage error — the RMSE relative to the mean level of M1 balances over the post-sample period — is listed in parentheses.

Hamburger's, indicate that "long-term" yields have a significant effect on money demand. Furthermore, the equation performs quite well relative to Goldfeld's equation in post-sample simulations.

Important differences between the Goldfeld and Hamburger estimation results should be noted, however. First, Hamburger's specification implies that less than 10 percent of the change in the desired money stock occurs within one quarter, much slower than the 34 percent adjustment suggested by Goldfeld.[10] In addition, Hamburger's specification, by excluding real income as a separate independent variable, has constrained the long-run income elasticity to be unity.[11] This, again, is quite different from the 0.54 estimate yielded by Goldfeld's equation. Finally, while Goldfeld was criticized for excluding long-term yields from the relationship, Hamburger equally can be criticized for excluding short-term rates other than the passbook rate. This exclusion creates problems when Regulation Q prevents the commercial passbook rate from moving in step with other short-term yields. Thus, Hamburger has no good proxy in the equation to pick up movements in freely fluctuating short-term yields.

Friedman has criticized Hamburger's conclusion that long-term asset yields provide the key to understanding the recent money demand problem.[12] Friedman's analysis considered aggregate wealth as a separate determinant of money demand. Arguing that Hamburger's dividend-price ratio variable is simply a proxy for aggregate wealth, Friedman replaced the equity yield in Hamburger's specification with aggregate household financial asset holdings and obtained a net improvement in post-sample predictive ability. Based

[10]It is interesting to note that the relatively slow speed of adjustment found for this specification is not wholly attributable to the use of a nominal adjustment specification as has been found in other cases. When Hamburger's equation is reestimated using a real adjustment mechanism, the estimated speed of adjustment declines to 7 percent per quarter.

[11]This may be shown formally by considering the nominal adjustment mechanism used by Hamburger:

$$\frac{M_t}{M_{t-1}} = \left[\frac{M_t^*}{M_{t-1}}\right]^{\lambda}$$

or

$$\frac{\frac{M_t}{P_t y_t}}{\frac{M_{t-1}}{P_t y_t}} = \left[\frac{\frac{M_t^*}{P_t y_t}}{\frac{M_{t-1}}{P_t y_t}}\right]^{\lambda}$$

which, after taking the logarithm and rearranging, yields

$$\ln\left(\frac{M_t}{P_t y_t}\right) = \lambda \ln\left(\frac{M_t^*}{P_t y_t}\right) + (1-\lambda)\ln\left(\frac{M_{t-1}}{P_t y_t}\right).$$

Returning to equation 2 in the text, we see that Hamburger's specification implies,

$$\lambda \ln\frac{M_t^*}{P_t y_t} = \beta_0 + \beta_1 \ln RTD_t + \beta_2 \ln DPR_t + \beta_3 \ln RGL_t + e_t$$

and $\beta_4 = 1 - \lambda$. From this it is clear that $\frac{\partial \ln M_t^*}{\partial \ln y_t} = 1$, so that Hamburger's equation constrains the long-run income elasticity to be unity. Hamburger's specification can be criticized further on the grounds that he includes a real rate of return when a nominal rate is appropriate.

[12]Benjamin Friedman, "Crowding Out or Crowding In: Economic Consequences of Financing Government Deficits," *Brookings Papers on Economic Activity* (3: 1978), pp. 593-641.

on this finding, he conjectured that ". . . Hamburger's proposed solution for the mystery of the missing money is simply a disguised story about the role of wealth in the money-demand function, and that the solution works better without the disguise."[13]

Were this true, however, one would also expect the inclusion of a wealth measure in a conventional equation (such as Goldfeld's) to yield more reliable post-sample forecasts. The estimated results for such a specification are reported in the third row of table 1. Although the wealth variable (measured here by household net worth) does have a significant effect on money demand, it does little to improve post-sample predictions.

These results do not support Friedman's interpretation of Hamburger's finding.[14] According to this interpretation, the inclusion of a wealth variable in any specification should improve the equation's predictive ability. When incorporated in Goldfeld's equation, it did not. This suggests that the inclusion of a proxy for real wealth is *not* the crucial feature of Hamburger's specification.

Laumas and Spencer examined the applicability of permanent income — measured as an exponentially weighted average of past values of real GNP — as the scale variable in the money demand relationship.[15] The relevance of such a variable is explored in the fourth row of table 1.[16] The estimation results of this equation are similar to Laumas and Spencer's. They imply a slow speed of adjustment (8 percent per quarter), similar to that of Hamburger's specification. On the other hand, the coefficient estimates yield a long-run permanent income elasticity that is less than unity (0.74). This specification, however, performs worse than the original Goldfeld equation over the post-sample period which suggests that permanent income, at least measured adaptively, is not a solution to the puzzle. Our findings (not detailed here) further indicate that this conclusion is insensitive to the measurement of interest rates.

Finally, Garcia and Pak have suggested that the recent problem stems from the use of an improperly measured money stock.[17] They argue that the recent widespread use of repurchase agreements has led to an important underestimation of "true" M1 balances.

The final equation of table 1 investigates this argument by including immediately available funds (IAF) data in the measurement of the money stock.[18] In all other respects, this equation is analogous to Goldfeld's. The coefficient estimates are similar to the estimates obtained for Goldfeld's specification. The standard error of the equation, however, is larger, which suggests a poorer sample period fit. While this equation predicts post-1972 M1 balances better than the Goldfeld equation, it is unclear whether this alone justifies the conclusion that the relationship is stable.

An examination of the forecasting ability of these alternative money demand equations indicates that the inclusion of neither permanent income nor wealth in the conventional equation significantly improves post-sample forecasts. Also, while the addition of repurchase agreements to M1 improves the post-sample predictions, the significance of the improvement remains unclear. Although Hamburger's specification does a superior job in forecasting money balances, the source of the improvement is puzzling.

A CLOSER LOOK AT HAMBURGER'S FINDINGS

As noted in the previous section, Hamburger's specification performs quite well in predicting post-1972 money balances. His specification, however, differs from the conventional equation not only in its incorporation of long-term asset yields, but also in its treatment of the long-run income elasticity and its exclusion of short-term interest rates.

Consider, first, the issue of the long-run income elasticity. Hamburger's specification constrains the long-run income elasticity to be unity while the others suggest that the long-run income elasticity is signifi-

[13]Ibid., p. 629.

[14]Interestingly enough, Friedman also finds that the inclusion of a wealth variable in Goldfeld's specification yields an unstable relationship, at least based on a "Chow test." This finding should have cautioned him against viewing Hamburger's solution as based on finding a proxy for wealth, since wealth itself does not appear to make the relationship stable.

[15]Laumas-Spencer, "The Stability of the Demand for Money."

[16]We used the same real permanent income series as Laumas and Spencer. It was kindly provided to us by David Spencer.

[17]Gillian Garcia and Simon Pak, "Some Clues in the Case of the Missing Money," *American Economic Review, Papers and Proceedings* (May 1979), pp. 330-34.

[18]The IAF data used in the present study is taken from Gillian Garcia and Simon Pak, "The Ratio of Currency to Demand Deposits in the United States," *The Journal of Finance* (June 1979), pp. 703-15. It has been argued that the Garcia-Pak equation is misspecified because of the exclusion of the appropriate own interest rate on the repurchase agreements. Using federal funds rate as a proxy for such a rate, Porter, Simpson, and Mauskopf report that out-of-sample forecast errors (III/1974-I/1979) are higher than those based on the equation examined in the text. See Richard D. Porter, Thomas D. Simpson, and Eileen Mauskopf, "Financial Innovation and the Monetary Aggregates," *Brookings Papers on Economic Activity* (1: 1979), pp. 213-29.

Table 2

Variations on Hamburger's Specification
II/1955-IV/1972

	Coefficient[a]							Summary Statistics				
Equation	Constant	Income	Time Deposits	Dividend Price Ratio	Government Bond Yield	Commercial Paper	Money Lagged[b]	R2	D.W.	SEE	rho	RMSE[c]
(1) Hamburger	−.458 (3.25)		−.021 (2.24)	−.024 (3.03)	−.020 (1.91)		.908 (34.77)	.999	1.70	.0040	.566	4.54 (1.59)
(2) Unconstrained Hamburger	−.774 (4.25)	−.158 (2.80)	−.037 (3.19)	−.025 (3.02)	−.018 (1.57)		.673 (7.82)	.999	1.63	.0039	.660	12.55 (4.39)
(3) Hamburger + CPR	−.525 (4.32)		−.026 (3.24)	−.015 (2.07)	.003 (0.32)	−.016 (3.81)	.899 (40.10)	.999	1.81	.0037	.509	11.29 (3.95)
(4) Unconstrained Hamburger + CPR	−.738 (4.38)	−.094 (1.82)	−.038 (3.61)	−.016 (2.10)	.002 (0.18)	−.014 (3.22)	.755 (9.26)	.999	1.74	.0036	.561	25.73 (9.00)

[a]All variables enter logarithmically and all equations are estimated using the Cochrane-Orcutt iterative technique. The numbers in parentheses are absolute values of t-ratios.

[b]The lagged term in all equations is given by $M_{t-1}/P_t y_t$.

[c]The RMSE is the root-mean-squared error for dynamic extrapolation over the I/1973-I/1977 period. The error is in billions of current dollars, and the percentage error — the RMSE relative to the mean level of M1 balances over the post-sample period — is listed in parentheses.

cantly less than one. Hamburger's constraint can be tested easily by adding the natural log of real income as a separate independent variable to his original specification. This allows the long-run income elasticity to be freely estimated.[19]

These estimation results are reported in the second row of table 2. The estimated coefficient on real income is negative and significantly different from zero, which suggests that the long-run income elasticity is less than unity. In fact, the estimation results indicate that this parameter is 0.52 — not much different from Goldfeld's equation. Incorporation of real income into the specification yields a larger estimate of both the speed of adjustment and the short-run interest elasticity on the time deposit variable. Also, the standard error of the equation is reduced slightly upon the relaxation of the income elasticity constraint. Thus, on empirical grounds, there is no apparent justification for Hamburger's restriction that the income elasticity be unity.

Finally, note that the forecasting accuracy of this general specification (in terms of the RMSE) declines markedly relative to Hamburger's original specification. This suggests that an important characteristic of Hamburger's specification — as far as predictive ability is concerned — is the imposed income elasticity constraint.[20]

Unlike most other specifications, which ignore long-term asset yields, Hamburger's equation excludes both short-term interest rates and (since nominal rates should incorporate expected inflation) short-term inflationary expectations as well. Row three of table 2 enumerates the results of adding the commercial paper rate to Hamburger's specification. As far as sample period estimation is concerned, this short-term rate has a significant negative impact on money demand. However, the estimated coefficient on the *long-term government bond yield* now becomes insignificantly different from zero.

As observed when the real income variable was added, the inclusion of the commercial paper rate

[19]If real income is included in the specification as a separate variable, we have, following footnote 11,

$$\lambda \ln\left(\frac{M_t^*}{P_t y_t}\right) = \beta_0 + \beta_1 \ln RTD_t + \beta_2 \ln DPR_t + \beta_3 \ln RGL_t + \beta_5 \ln y_t,$$

(where β_4 $(= 1 - \lambda)$ is the coefficient on the lagged variable) or,

$$\ln\left(\frac{M_t^*}{P_t}\right) = (\beta_0/\lambda) + (\beta_1/\lambda) \ln RTD_t + (\beta_2/\lambda) \ln DPR_t + (\beta_3/\lambda) \ln RGL_t + (\beta_5/\lambda + 1) \ln y_t.$$

This implies that the long-run income elasticity,

$$\left(\frac{\partial \ln (M_t^*/P_t)}{\partial \ln y_t}\right), \text{ is } (\beta_5/\lambda) + 1, \text{ where}$$

β_5 is the coefficient on the real income variable and λ is the speed of adjustment. (Note again that Hamburger's specification constrains β_5 to be zero, implying a long-run income elasticity of unity).

[20]As far as static predictive ability is concerned, Hamburger's specification can be further improved by constraining the income elasticity to values in excess of unity. See Scott E. Hein, "Empirical Evidence on the Macroeconomic Demand for Money Relationship in the United States," (Ph.D. dissertation, Purdue University, 1979). Hein argues that these forecasts are accurate because the specification is essentially an autoregressive process.

improves the sample period fit, but only at the expense of post-sample predictive ability. Exclusion of short-term interest rates from the specification, although empirically unjustified, is partially responsible for Hamburger's superior forecasting results.

The addition of both real income and the commercial paper rate to the basic Hamburger specification has a significant impact on both sample period and post-sample period findings, as shown in row four of table 2. The coefficients on both variables have the anticipated signs and are statistically significant. The estimated coefficient on the lagged money term is smaller than that of the original specification, which suggests a quicker speed of adjustment. Also consistent with the Goldfeld equation results, the long-run income elasticity is estimated to be 0.62. Once again, the addition of these variables produces both a decline in the sample-period standard error of the equation and a deterioration in the equation's post-sample predictive ability. In this specification, though, the deterioration is so marked that the RMSE is *larger* than that of the original Goldfeld equation.

The preceding results suggest that crucial to Hamburger's forecasting accuracy are (1) his treatment of the long-run income elasticity and (2) his exclusion of short-term interest rates, not the incorporation of long-term asset yields as he argues.[21] This also explains why the substitution of a wealth variable in Hamburger's specification yields accurate post-sample predictions, while its inclusion in the Goldfeld equation does not.

AN ALTERNATIVE TEST OF TEMPORAL STABILITY

In the course of reviewing evidence on the temporal stability of the money demand relationship, this discussion like most recent literature has emphasized the relative post-1972 forecasting ability of alternative money demand specifications. This basis of comparison, however, assumes that the equation which performs best in terms of yielding the smallest post-sample RMSE is the most stable relationship.

The inappropriateness of such an assumption should be obvious. If one is concerned with the temporal stability of a given relationship, one should be concerned with the predictive ability of *that* specification at different points in time, *not* its predictive ability relative to other specifications. Evidence that a given equation's predictions over a certain time interval are inferior to its predictions at earlier time periods (especially when such predictions are consistently to one side of the actual values) is highly suggestive of a breakdown in that relationship. A comparison of the predictive ability of any two equations over a given time period, however, will *not* allow one to deduce anything about the temporal stability of either equation.

In order to redirect attention to the basic issue of temporal stability, an alternative criterion to that of examining the relative forecasting ability of alternative specifications is now applied. This alternative test procedure will be used to examine the temporal stability of each specification discussed earlier.

The test used here is formulated and described in Brown, Durbin, and Evans.[22] To test the hypothesis of coefficient stability statistically, the BDE test requires the calculation of the one-period-ahead forecast error of each specification. This prediction error is based on a regression over the time period 1 to r, where $r = k + 1, \ldots, T$ (k is the number of regressors, including the constant, and T is the sample size). In other words, if k is equal to, say, five, then the first one-period-ahead prediction error would be based on a regression estimated over the sample 1 to 6. The second prediction error is based on the regression estimated over the sample 1 to 7 and so on until the end of the sample (T) is reached.

The BDE statistic used, called the cusum-squares statistic, may be written as

$$(3) \qquad S_r = \frac{\sum_{t=k+1}^{r} w_t^2}{\sum_{t=k+1}^{T} w_t^2} \qquad r = k + 1, \ldots, T$$

where w_t^2 represents the squared one-period-ahead prediction errors. The cusum-squares statistic is essentially the ratio of the squared one-period-ahead prediction errors based on the sample period k + 1 to r, to the squared one-period-ahead prediction errors based on a regression estimated over the sample pe-

[21]All versions of the original Hamburger specification considered in table 2 were also estimated assuming a real rather than a nominal adjustment mechanism. The results, available from the authors upon request, were similar in most respects to those reported above.

[22]Brown, Durbin and Evans, "Testing the Constancy of Regression Relationships." Recently, Heller and Khan have applied this technique to a short-run money demand specification which includes an approximation of the interest rate term structure. See H. Robert Heller and Mohsin S. Kahn, "The Demand for Money and the Term Structure of Interest Rates," *Journal of Political Economy* (February 1979), pp. 109-29.

Table 3

Alternative Money Demand Equation
Regression Results: II/1955-I/1977

	Coefficient[a]									Summary Statistics			
Equation	Constant	Income	Permanent Income	Net Wealth	Time Deposits	Commercial Paper	Government Bond Yield	Dividend Price Ratio	Money Lagged[b]	R2	D.W.	SEE	rho
Goldfeld	−.684 (3.29)	.154 (4.30)			−.050 (2.71)	−.013 (2.90)			.642 (7.55)	.992	2.04	.0050	.922
Hamburger	.347 (3.69)				−.014 (1.95)		−.015 (1.68)	−.020 (3.68)	.930 (51.06)	.999	1.82	.0042	.478
Unconstrained Hamburger	−.366 (3.70)	−.020 (.668)			−.016 (2.02)		−.014 (1.47)	−.022 (3.58)	.903 (22.45)	.999	1.84	.0042	.512
Hamburger + CPR	−.312 (3.27)				−.014 (1.86)	−.008 (2.27)	−.002 (0.12)	−.019 (3.42)	.938 (50.43)	.999	1.90	.0041	.493
Unconstrained Hamburger + CPR	−.255 (2.87)	.041 (1.32)			−.009 (1.34)	−.010 (2.59)	.002 (0.17)	−.015 (2.59)	.995 (23.14)	.999	1.89	.0041	.405
B. Friedman	.111 (1.17)	−.064 (2.42)		.100 (3.50)	−.003 (0.40)	−.015 (3.82)			1.02 (26.51)	.992	2.00	.0049	.370
Laumas-Spencer	−.137 (2.67)		.025 (2.36)			−.018 (4.05)			.992 (21.15)	.991	2.07	.0052	.563
Garcia-Pak	−.952 (5.15)	.182 (5.14)			−.044 (3.33)	−.014 (2.72)			.742 (12.50)	.993	2.28	.0042	.392

[a]All variables enter logarithmically and all equations are estimated using the Cochrane-Orcutt iterative technique. The numbers in parentheses are absolute values of t-ratios.

[b]The Goldfeld, Friedman, and Laumas-Spencer equations contain a lagged money variable of the form (M_{t-1}/P_{t-1}). Hamburger and its variations used a lagged money variable of the form $(M_{t-1}/P_t y_t)$. The lagged money term in the Garcia-Pak equation is of the form (M_{t-1}/P_{t-1}), where $M = M1 + IAF$.

riod k + 1 to T.[23] The S_r statistic is compared to a critical value and, if the estimated relationship is stable, the value of S_r will be less than the predetermined critical value.[24] This test may be illustrated graphically by plotting S_r against time, along with parallel sets of significance lines which provide the statistical "boundaries" used to indicate a break point at that given level of statistical significance.

Before applying the cusum-squares test, it was necessary to estimate each of the alternative specifications over the entire sample period (II/1955-I/1977). These regression results are presented in table 3. In comparing the whole period regression results with those of the II/1955-IV/1972 period shown in table 1, several changes are noticeable. In many cases, the full sample estimation results, in and of themselves, indicate a breakdown in the money demand relationship.

In general, short-run income elasticity declines significantly as the sample period is extended. For example, when the income elasticity is freely estimated using the Hamburger specification (inclusive or exclusive of the commercial paper rate), the estimated coefficient on the income term becomes statistically insignificant and, in the latter equation, even takes on the "wrong" sign.

Another common feature of the full sample period results is the increase in the magnitude of the coefficient on the lagged dependent variable. This phenomenon, which has been found in previous studies, indicates a slower speed of adjustment.[25] In the Friedman specification, which incorporates the wealth variable, the lagged term coefficient becomes greater than unity, defying any meaningful interpretation within the stock-adjustment framework.

In general, many of the interest rate coefficients appear to be unstable. Although the coefficient on the commercial paper rate variable maintains its magnitude, the estimated coefficient on the commercial bank

[23]For a critical evaluation of the power of these tests, see K. Garbade, "Two Methods for Examining the Stability of Regression Coefficients," *Journal of the American Statistical Association* (March 1977), pp. 54-63 and John U. Farley, Melvin Hinich, and Timothy W. McGuire, "Some Comparisons of Tests for a Shift in the Slopes of a Multivariate Linear Time Series Model," *Journal of Econometrics* (Vol. 3, No. 3, 1975) pp. 297-318.

[24]John M. Evans, "User Guide to TIMVAR," Working Paper, Central Statistical Office (London, 1973).

[25]Garcia and Pak, "Some Clues in the Case of the Missing Money;" Heller and Kahn, "The Demand for Money and the Term Structure of Interest Rates;" and B. Friedman, "Crowding Out."

Table 4

Stability Tests for Alternative Money Demand Specifications: II/1955-I/1977

Equation	Cusum-squares	Critical Values[a] 1%	5%	10%
Goldfeld	.168	.233	.192	.172
Hamburger	.108	.233	.192	.172
Unconstrained Hamburger	.161	.235	.194	.173
Hamburger + CPR	.175	.235	.194	.173
Unconstrained Hamburger + CPR	.206	.236	.195	.174
B. Friedman	.317	.235	.194	.173
Garcia-Pak	.397	.233	.192	.172
Laumas-Spencer	.218	.232	.192	.171

[a]The critical values for the cusum-squares test are taken from John M. Evans, "User Guide to TIMVAR," Working Paper, Central Statistical Office (London, 1973).

passbook rate shows a marked decline in a majority of the estimations, sometimes being insignificantly different from zero. In addition, the coefficient on the long-term government bond yield in all variations of the basic Hamburger specification fails to attain statistical significance over the longer sample period.

In contrast to the other money demand specifications, the Garcia-Pak and Goldfeld coefficient estimates are similar over both sample periods. The magnitudes of Garcia-Pak's lagged term, income, and time deposit rate coefficients all appear to change little when the I/1973-I/1977 observations are included. The largest change occurs for the coefficient on the commercial paper rate which declines by 30 percent when comparing the II/1955-IV/1972 results with those for II/1955-I/1977. Given certain reservations about this specification (see footnote 18), however, these results should be interpreted cautiously.

The coefficient estimates for Goldfeld's specification appear to be as stable as Garcia-Pak's. For instance, the estimated speed of adjustment for the full sample period regression is .358 compared with .335 for the II/1955-IV/1972 period. Given the relative stability of the other estimated coefficients, it is clear that the long-run elasticities for the interest rate variables do not vary dramatically between the two sample periods. For the commercial paper rate, the long-run elasticities are .036 and .048 for the II/1955-I/1977 and II/1955-IV/1972 periods, respectively. The same measures for the time deposits variable are .140 and .119. The change in the estimate of the long-run income elasticity is slightly larger. For the early sample period this parameter was .528, compared with .430 over the full sample period. While this change may be significant, it is clearly smaller than that observed for the other specifications.

In order to carry out the cusum-squares test, it was assumed that the autocorrelation coefficient for each specification (given in table 3) was constant over the entire sample period. This assumption allows the transformation of the dependent and all independent variables to correct for serial correlation in the errors. This transformation was accomplished by subtracting the product of the estimated rho coefficient and the variable's previous value from the current value of the variable.[26] Specifically, this procedure is given by the relationship

$$(4) \qquad X_t = x_t - \hat{\rho}\, x_{t-1}$$

where X_t represents the transformation of the variable x_t and $\hat{\rho}$ is the estimated autocorrelation coefficient.

The statistical results for the cusum-squares tests are presented in table 4. These tests indicate that several specifications are unstable over the full sample period: Hamburger with CPR (at a significance level of 10 percent), Unconstrained Hamburger with CPR (5 percent), Friedman (1 percent), Garcia-Pak (1 percent), and Laumus-Spencer (5 percent). Perhaps the most interesting finding is that the Goldfeld specification demonstrates *no* structural instability using this test. Indeed, the null hypothesis of stability cannot be rejected even at the 10 percent level of significance.[27]

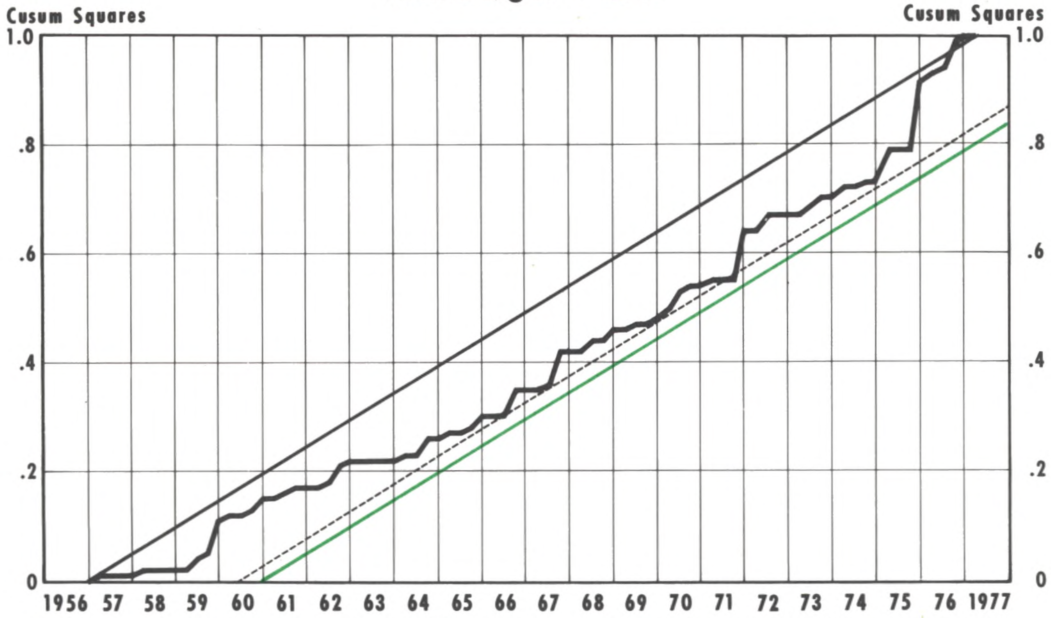
While the statistical tests reported in table 4 indicate which equations demonstrate structural instability in the regression relationships over the entire sample period, they do not locate the probable point of departure from constancy. Such information is provided by charts 1-5. In each chart, the sample cusum-squares statistic (S_r) is plotted against time for each specification in which the hypothesis of stability was rejected by the cusum-squares test. In addition to the

[26]Such a transformation was required since the BDE tests assume that the errors are serially independent. If the serial coefficient is constant throughout the period, this transformation yields serially independent error terms. This transformation, along with the presence of a lagged dependent variable, introduces nonstochastic independent variables, violating one assumption of the BDE test. However, we know of no other stability test that adequately deals with such problems.

It should be further noted that the BDE test is derived on the assumption that the variance of the errors are equal. In the case of money demand, the general increase in the standard error of the equation when the sample period is extended casts cursory doubt on this assumption.

[27]As regards the BDE tests for the Goldfeld equation, one should recall the above transformation required by the serially dependent error terms. In performing this transformation we took the rho value from table 3 (0.922). This serial coefficient was much larger than that found for the earlier sample period (0.440). When the latter estimate is used, the cusum-squares test rejects the null hypothesis at the 1 percent level.

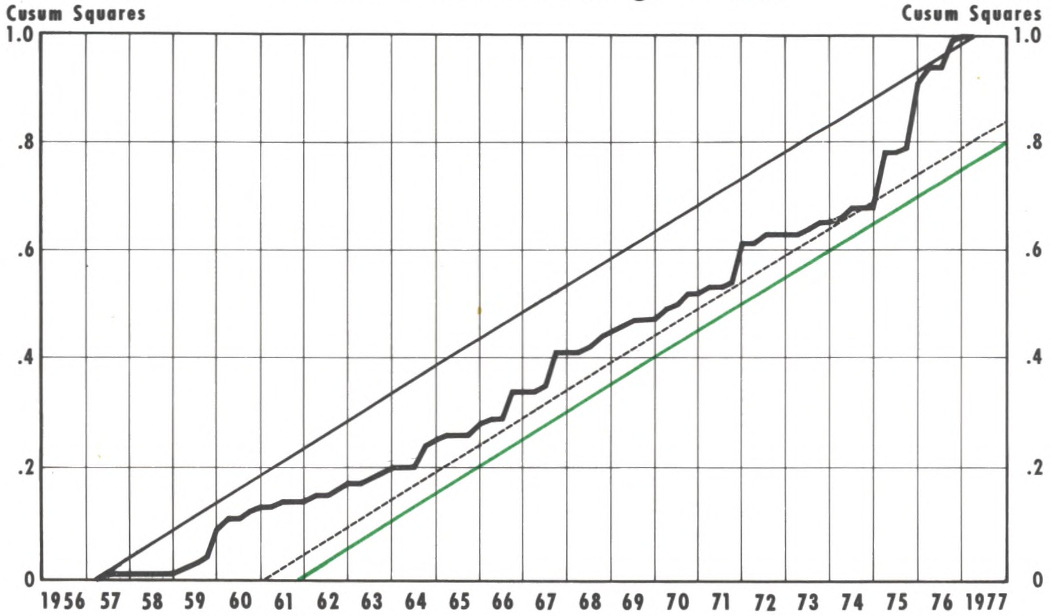
Chart 1
Brown-Durbin-Evans Test of Hamburger + CPR



The dashed line represents the 10 percent level of significance, the green line represents the 5 percent level.

Latest data plotted: 1st quarter

Chart 2
Brown-Durbin-Evans Test of Unconstrained Hamburger + CPR

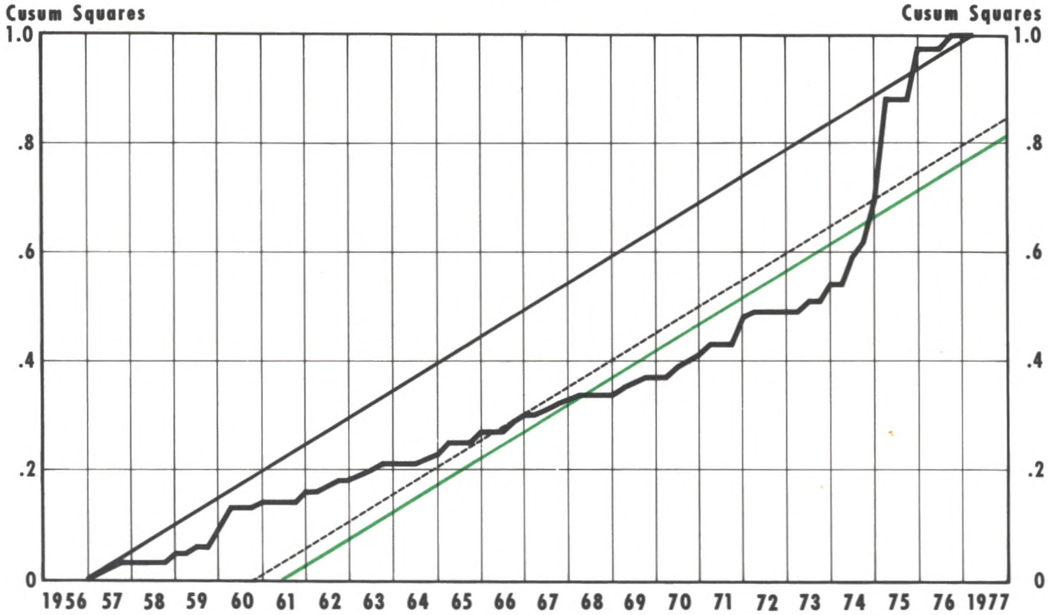


The dashed line represents the 5 percent level of significance, the green line represents the 1 percent level.

Latest data plotted: 1st quarter

Chart 3

Brown-Durbin-Evans Test of B. Friedman

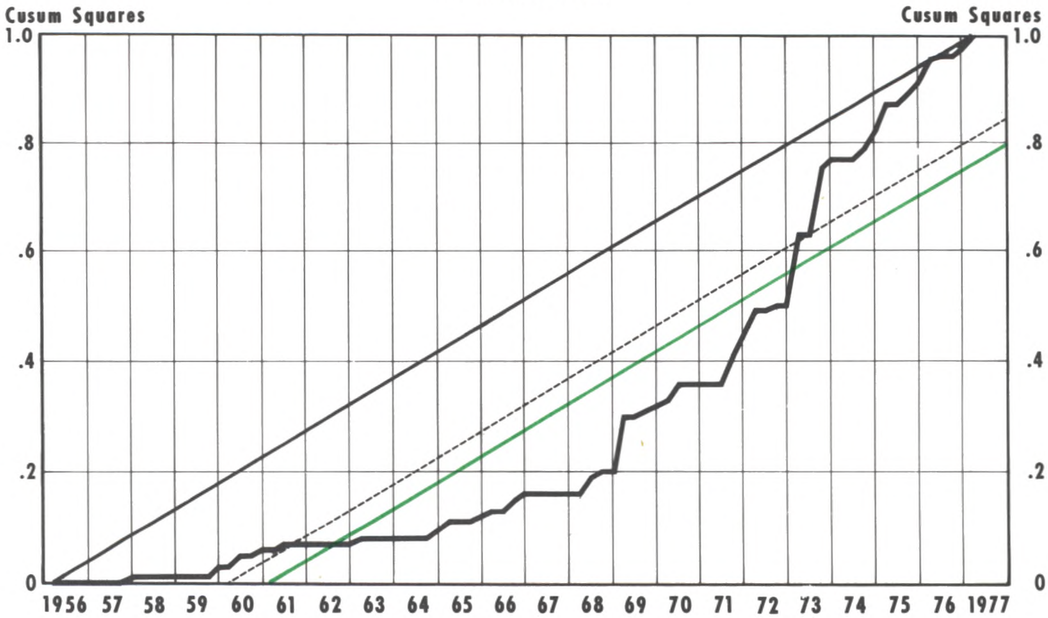


The dashed line represents the 5 percent level of significance, the green line represents the 1 percent level.

Latest data plotted: 1st quarter

Chart 4

Brown-Durbin-Evans Test of Garcia-Pak

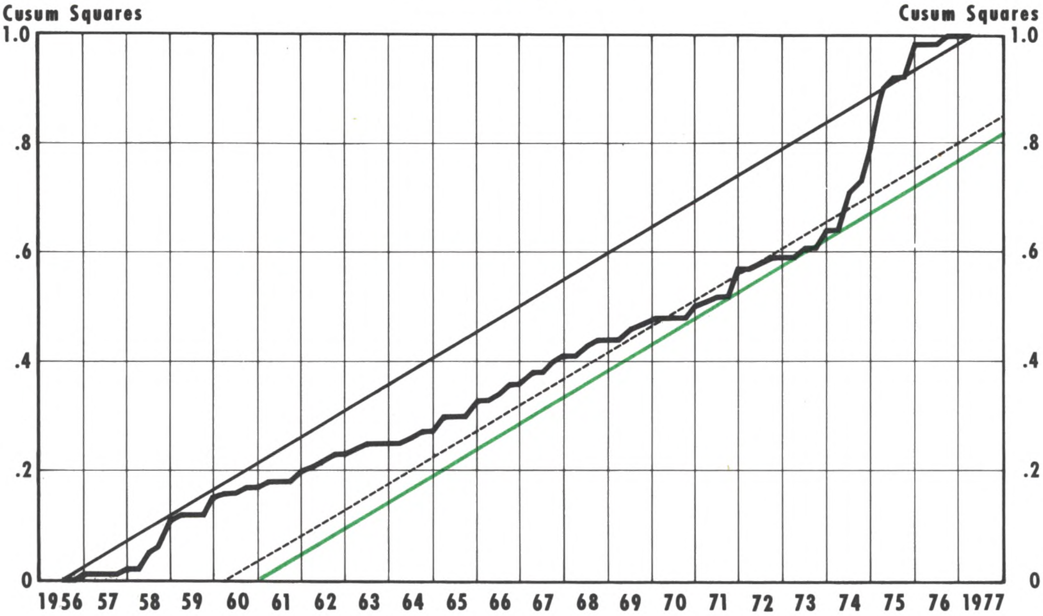


The dashed line represents the 5 percent level of significance, the green line represents the 1 percent level.

Latest data plotted: 1st quarter

Chart 5

Brown-Durbin-Evans Test of Laumas-Spencer



The dashed line represents the 5 percent level of significance, the green line represents the 1 percent level.

Latest data plotted: 1st quarter

plot of S_r, each chart plots the mean value of S_r [i.e., $E(S_r) = (r - k)/(T - k)$] and two confidence lines which, for given levels of significance, are drawn parallel to the mean value line. When the plot of S_r crosses one of these boundaries, the hypothesis of stability can be rejected at the appropriate significance level.

The charts reveal a varied picture of the timing of the possible structural shift. Chart 1 — representing the S_r plot for the Hamburger with CPR specification — shows that at the 10 percent level the sample plot first intersects the statistical boundary in II/1966. At the 5 percent level the S_r plot stays within the boundary, though nearly touching the 5 percent line in III/1971.

The S_r plot for the Unconstrained Hamburger with CPR (chart 2) crosses the 5 percent boundary in III/1974. Over the period 1966-74, however, the path of S_r remains close to the 5 percent confidence band. Chart 3, the S_r plot drawn for the Friedman specification, indicates a structural shift (at the 5 percent level) in I/1966. Similar to chart 3, the S_r plot for the Garcia-Pak specification (chart 4) indicates that at the 1 percent level a shift in the underlying structural relationship occurred as early as IV/1962. Finally, the path of S_r derived from the Laumus-Spencer equation (chart 5) crosses the 5 percent confidence line in I/1970, and intersects the 1 percent line in IV/1973.

An interesting feature of these results is that the equations which indicated structural instability shifted much earlier than might have been expected. The finding of break points during the mid-1960s is at odds with much of the recent literature which suggests structural shifts later in the sample period.[28] The results presented here do, however, tend to agree with those of Slovin and Sushka who, using a money demand equation in which demand deposits were used as the definition of money, found evidence of structural instability during the early 1960s.[29] Their work suggests that this shift was due to changes in Regulation Q limits during this period.

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[28]Applying the Quandt log-likelihood ratio test to these equations suggests the following possible points to structural shift in the regression relationships: Hamburger with CPR, I/1975; Unconstrained Hamburger with CPR, III/1974; B. Friedman, I/1974; Garcia-Pak, IV/1967; and Laumus-Spencer, IV/1973. While these results are in general agreement with those found by others (e.g., Enzler, Johnson, and Paulus, Goldfeld, Hamburger), the findings suggest that the structural instability of these models may have occurred at *various* times over the sample period.

[29]Myron B. Slovin and Marie Elizabeth Sushka, "The Structural Shift in the Demand for Money," *The Journal of Finance* (June 1975), pp. 721-31.

In summary, these results indicate that many of the money demand specifications which have been offered as possible explanations of the missing money puzzle have actually been subject to significant structural changes over the II/1955-I/1977 sample period. A most interesting finding is that the regression coefficients on the Goldfeld specification do *not* change markedly when the sample period is extended to include the post-1973 period. In addition, when the autocorrelation coefficient was constrained to be 0.92, the equation did not indicate instability according to the cusum-squares test.

SUMMARY AND CONCLUSIONS

This article has examined the temporal stability of several alternative money demand relationships. Recent literature on money demand has drifted away from this concern and has focused too narrowly on the issue of predicting post-1972 real money balances. The formal test results presented in this article suggest that such a shift in emphasis has been misleading.

The findings in this paper indicate that, while several of the respecifications of the traditional transaction money demand relationship have yielded accurate post-1972 forecasts relative to those found for the real adjustment version of the Goldfeld specification, none of the modifications which stood up under critical review was temporally stable over the entire II/1955-I/1977 sample period. The modifications considered here included changing the measurement of the scale variable, broadening the asset range to include long-term yields, and redefining money to incorporate repurchase agreements.

The test employed in this paper (the BDE cusum-squares test) did not allow us to reject the hypothesis that the underlying relationship between the predetermined variables and real money balances, given by the conventional Goldfeld specification, was stable. In fact, the regression coefficients for the sample period including the turbulent period I/1973-I/1977 were markedly similar to those found when the sample period was ended in IV/1972. This finding indicates that the purported breakdown in this specification was overemphasized as a result of the reliance on the short-term predictive ability of the equation. In terms of policy implications, this finding suggests that long-term monetary policy prescriptions based on the assumption of a stable money demand relationship will be more reliable than previous analysis has implied.

Appendix: Data Definitions and Sources

Commercial paper rate (CPR) — 4-6 month prime commercial paper rate. Prior to III/1974 average of most representative daily offering. After III/1974 average of midpoint of range of daily dealer closing rates.

Source: Federal Reserve Bank of New York

Long-term U.S. government bond yields (RGL)

Source: Federal Reserve Bulletin

Money stock (M1) — narrowly defined money balances (in billions of dollars), seasonally adjusted, quarterly average of monthly figures.

Source: Federal Reserve Board

Income (y) — gross national product in billions of 1972 dollars at seasonally adjusted annual rates.

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Price level (P) — implicit gross national product price deflator (1972 = 100)

Source: U.S. Department of Commerce, Bureau of Economic Analysis

Time deposit rate (RTD)

Source: Stephen M. Goldfeld

Dividend price ratio on common stocks (DPR)

Source: Federal Reserve Bulletin

Permanent income — exponentially weighted average of past values of real gross national product.

Source: David E. Spencer

Household net worth (wealth)

Source: Federal Reserve Board

Immediately available funds (IAF)

Source: Garcia-Pak, "The Ratio of Currency."

Outlook for Food and Agriculture – 1980

CLIFTON B. LUTTRELL and NEIL A. STEVENS

The U.S. Department of Agriculture (USDA) annually appraises the outlook for food and agriculture for the year ahead. These appraisals for 1980, summarized below, have been made on the basis of a number of factors which influence the supply and demand for farm products and food. Such factors include the size of livestock and poultry inventories, the incentive for feeding, feedstocks, stocks of other crops available for food processing, and the prospects for other crops which have not been harvested. The outlook for food and farm product demand reflects both domestic and foreign demand. Domestic demand is based largely on prospects for national income, and foreign demand is based largely on crop supplies, crop conditions, and prospects for income abroad.[1]

The U.S. government's embargo of grain shipments to the Soviet Union occurred as this article was being completed for publication. This action obviously can have a large effect on the food and agricultural outlook for 1980 and beyond.

FOOD prices are projected by the USDA to increase by about 8 percent for 1980. This is well below both the 11 percent increase in 1979 and the overall rate of inflation projected by most analysts for 1980.

A larger supply of most food products is in prospect for 1980. Large crops in 1979 provide the base for expanded food processing and livestock feeding. The large feed crops point to increased production of livestock foods, especially pork, poultry, and dairy products. Egg production may also be slightly higher than in 1979. The supply of canned and frozen vegetables is up 6 to 7 percent. The larger oilseed crop points to increased supplies of fats and oils and feed by-products.

Food Prices Since the Mid-1960s

Food prices began to accelerate along with the rate of inflation in the mid-1960s and have increased at a relatively high rate throughout most of the 1970s. From an annual rate of increase of less than 1.5 percent per year during the decade 1955-65, food prices accelerated to a 4.0 percent annual rate of increase during the period 1965-70, and to an 8.8 percent rate during 1970-75 (table 1). They have continued to increase since 1975 at an average rate of 6.4 percent per year. Most of the increase in the price of food since the mid-1960s can be traced to rising demand. Since the consumer price index (CPI) has accelerated since 1965, it is apparent that the rate of increase in demand for all consumer goods and services has exceeded output growth.

Table 1

Change in Consumer Prices, Food Prices, and Percent of Farm Products Exported

	Rate of Change of Consumer Prices		
Years	All Items Less Food	Food	Percent of Farm Products Exported*
1950-55	2.3%	1.8%	10.6%
1955-60	2.2	1.5	13.2
1960-65	1.3	1.4	15.2
1965-70	4.3	4.0	14.5
1970-75	6.1	8.8	20.1
1975-78	6.8	6.4	24.8
1950-70	2.5	2.2	13.4
1970-78	6.4	7.9	21.8
1950-78	3.6	3.8	15.8

*Average of 1951-1955, 1956-1960, 1961-1965, etc.

SOURCE: *Economic Reports of the President* and *Economic Indicators.*

[1]Unless otherwise noted, all projections for food and farm products included in this article are based on reports and speeches given at the USDA Agricultural Outlook conference in Washington, D.C., November 5-8, 1979, and other recent USDA publications.

Table 2

Change in Farm Output, Industrial Production, and Relative Food Prices

	1950-1970	1970-1975	1975-1978
Farm Output (Rate of change)	1.57%	2.45%	2.29%
Industrial Production Index (Rate of change)	4.48	1.79	7.19
Food Prices minus Prices of All Items less Food (Rates of change)	–.32	2.08	–.20
Farm Product Prices minus Prices of All Industrial Commodities (Rates of change)	–1.63	.67	–2.44

SOURCE: *Economic Reports of the President.*

It is now generally conceded that excessive demand and inflation in all sectors occur largely as a result of excessive monetary growth. During the 1950s and early 1960s, the stock of money rose at an average rate of 1.5 percent per year. It accelerated to 3.8 percent per year from 1962 until late 1966 and to 5.8 percent per year from late 1966 to early 1970. Since then, monetary growth has averaged about 6.5 percent per year.

In the long run, monetary growth predominantly influences the average rate of inflation since all sectors make about the same fundamental adjustments in response to excessive demand. If resources are fully utilized and production techniques are unchanged, rising demand for goods and services caused by an increase in the stock of money will not lead to major changes in the relative prices of food and other consumer goods. Rather, prices of all goods and all resources will tend to be bid up equally over the long run.

In Most Years Food Prices Rose Less Than Nonfood Prices

Nonmonetary factors can affect the relative prices of food and other consumer goods. Such factors include changing consumer tastes and preferences, uneven rates of technological growth in the various sectors of the economy, population growth, changing weather conditions, and changing foreign demand. Relative prices have changed during most five-year periods since 1950. As indicated in table 1, food prices rose at a slower rate than the average price of other consumer items from 1950 to 1970 and from 1975 to 1978, but at a faster rate from 1970 to 1975.

The rise in food prices relative to other consumer prices in 1970-75, however, does not necessarily indicate the beginning of a high food-cost era in the United States. Despite a possible slowing, the rate of food production is still expected to exceed the rate of population growth. U.S. population in the 1980s is projected to grow at a modest .70-.75 percent rate, well below the 1.5 percent rate projected for food output. Hence, a rising quantity of food per capita is in prospect for U.S. consumers.

Table 3

Changes in Food Prices for 1979 and Forecasts for 1980

Component	Relative Importance	Percent Change 1978-1979	Percent Change 1979-1980
All food	100.0	11.0%	8.0%
Food away from home	30.4	11.3	9.7
Food at home	69.6	10.8	6.8
Cereals and bakery products	8.5	9.8	8.9
Beef and veal	9.3	27.9	8.2
Pork	5.6	1.5	–5.6
Other meats	3.0	14.6	4.5
Poultry	2.5	4.7	–0.6
Fish and seafood	2.3	9.8	9.2
Eggs	1.4	9.4	–1.3
Dairy products	9.3	11.1	9.2
Fresh fruits	2.4	14.1	7.3
Fresh vegetables	2.5	2.9	8.4
Processed fruits and vegetables	4.8	9.0	8.2
Sugar and sweets	2.4	8.1	8.0
Fats and oils	2.0	8.0	7.4
Nonalcoholic beverages	7.8	4.7	7.9
Other prepared foods	5.8	10.2	9.2

SOURCE: U.S. Department of Agriculture.

One factor contributing to the more rapid increase in food than nonfood prices during 1970-75 was the sharp increase in export demand for U.S. farm products. Export demand for farm products rose as a result of reductions in tariffs and other trade barriers. Also contributing to rising export demand was the decline in the foreign exchange value of the dollar in the early 1970s when the United States abandoned the gold exchange standard.

As shown in table 1, farm exports rose from an average of 14.5 percent of farm commodity sales during 1966-70 to 20.1 percent of sales during 1971-75, to 24.8 percent during 1976-78. In contrast, the ratio of farm exports to sales was relatively stable in the 1950s and 1960s, rising from 10.6 percent in the first

Table 4

Percent of Disposable Personal Income Spent on Selected Groups of Consumer Goods

	1950	1955	1960	1965	1970	1975	1978	1979*
Total durable goods	15.0%	14.1%	12.3%	13.3%	12.4%	12.2%	13.7%	13.3%
Motor vehicles & parts	6.7	6.5	5.6	6.3	5.1	4.9	6.2	5.9
Furniture & household equipment	6.7	5.9	5.1	5.2	5.3	5.3	5.3	5.2
Total nondurable goods	47.8	44.9	43.2	39.9	38.6	37.6	36.4	36.3
Food	26.2	24.6	23.2	20.9	19.9	19.3	18.6	18.6
Clothing & shoes	9.5	8.4	7.6	7.1	6.8	6.4	6.2	6.1
Gasoline & oil	2.7	3.1	3.4	3.1	3.2	3.6	3.5	3.7
Services	30.7	33.7	37.4	37.8	39.2	40.3	42.5	42.7

*Annual rate for first two quarters.
SOURCE: *Economic Reports of the President* and *Economic Indicators.*

half of the fifties to 14.5 percent in the last half of the sixties. It has stabilized again in the last three years, with exports totaling 25.2 percent of sales in 1975 and 24.6 percent in 1978.

The acceleration of foreign demand for U.S. food and farm products in the early 1970s resulted in sharply higher farm product prices which in turn led to an increase in farm output growth. Farm output growth rose from 1.6 percent per year during the two decades 1950-70 to 2.5 percent per year in 1970-75 (table 2). While farm output accelerated in response to rising foreign demand for U.S. farm products, industrial production decelerated in response to rising imports of nonfarm products and higher energy costs, declining from a 4.5 percent rate of increase in 1950-70 to a 1.8 percent rate in 1970-75.

The increase in farm exports and nonfood imports was associated with the faster growth in food than nonfood prices in the early 1970s. Rising farm exports led to relatively higher farm commodity prices, and rising imports to relatively lower prices on nonfarm goods. Food prices rose about 2 percentage points faster than nonfood products and service prices during 1970-75 (table 2). Since 1975, however, the growth in farm commodity exports has decelerated, and food prices have increased at a somewhat slower rate than nonfood prices.

Food Price Increases to Moderate in 1980

While food prices and the CPI rose at about the same rate from 1978 to 1979, food prices are expected to rise at a somewhat slower pace than other consumer items in 1980 and to average only about 8 percent higher than in 1979 (table 3). This is well below the 10 percent rate of inflation projected by the USDA outlook conference participants. The USDA projects moderate increases in food prices for the early months of the year reflecting larger prospective supplies of pork and poultry and a possible slackening in demand growth. More rapid increases, however, are projected for the last half of the year because of a potential decline in meat output and rising overall demand due to economic recovery.

Most of the increase in food prices projected for 1980 stems from the rising marketing costs of domestic farm products and from higher prices for fish and imported food products. Assuming no serious weather-related problems, the farm price of food is expected to average only about 1 percent higher in 1980 than in 1979. Rising marketing costs, reflecting the pace of inflation, are expected to continue throughout the year and to account for about 75 percent of all food price increases.

Major price increases for individual food products, such as the 28 percent increase for beef and veal in 1979, are not anticipated. Commercial beef production is expected to total about the same in 1980 as in 1979. Pork production, however, may be 10 percent greater, thus holding down the increases in overall red meat prices. The greatest price increases are projected for food consumed in restaurants and other eating establishments. The price of such food, which accounts for about 30 percent of the average urban family's food budget, will probably increase by about 10 percent largely reflecting higher service costs. Dairy product prices are expected to rise about 9 percent as a result of higher government support prices for milk. Other prices projected to rise rapidly are those with relatively large processing and marketing costs such as cereals, bakery products, and other prepared foods. Lower prices are expected for pork, poultry, and eggs.

Food Expenditures and Consumption

Expenditures on food as a percent of disposable personal income have trended down for most of the century and, on the basis of current income and food price projections, are likely to continue down through 1980. As shown in table 4, food expenditures declined from 26.2 percent of disposable personal income in 1950 to 18.6 percent in 1978. The outlook for an increase in food production and a moderation in food price increases means that a further decline will likely occur in 1980.

Total food consumption per capita has been relatively stable for more than a decade. In 1979, per capita food consumption was estimated at 104.8 percent of the 1967 level, about the same as in the two previous years but slightly less than in 1976 (table 5). Per capita consumption of poultry and vegetable oils has trended up while consumption of red meat, dairy products, cereal, and bakery products has remained about the same, and eggs and animal fats has declined. With somewhat larger supplies of food and relatively moderate food price increases in prospect for the year, per capita consumption of all foods may rise slightly from the 1979 level.

OUTLOOK FOR AGRICULTURE

Following two generally prosperous years for most farmers, the outlook by USDA analysts for farm income in 1980 is not optimistic. Net income of farm operators may decline from about $32 billion in 1979 to about $25 billion in 1980.

Table 5

Change in Per Capita Food Consumption[1]
(1967 = 100)

	1976	1977	1978	1979[2]
All food	105.8	104.7	104.6	104.8
Animal products	103.5	103.1	102.1	102.1
Meat	107.9	107.0	103.0	100.5
Poultry	116.0	119.4	125.9	136.7
Eggs	85.5	84.8	86.5	87.7
Dairy	101.6	101.0	101.5	102.0
Crop products	108.4	106.4	107.4	107.8
Fruits	107.1	105.9	106.1	107.1
Vegetables	107.2	107.0	108.6	109.2
Cereal and bakery	104.0	100.8	101.4	101.4
Vegetable oils	146.4	140.2	147.9	142.1

[1]Individual items combined, using 1967-69 prices.
[2]Preliminary.
SOURCE: U.S. Department of Agriculture.

USDA analysts did not anticipate the gain in net farm income of about $4 billion in 1979 at last year's outlook conference. Although they expected some increase in net income due to rising livestock receipts, the large increase in crop receipts came as a surprise. This increase resulted primarily from a rise in export demand, in part due to a crop shortfall in the Soviet Union. When the final tally is made, 1979 crop receipts will be about $63 billion, up $11 billion from 1978, while livestock receipts will be about $67 billion, up $8 billion. These cash receipt estimates total $130 billion, 17 percent above the 1978 amount. Gross farm income (which includes cash receipts, inventory value changes, government payments, and nonmoney income) is expected to total $146 billion, up from $126 billion in 1978 (table 6).

Production expenses also rose sharply in 1979 totaling about $114 billion, up about 16 percent from 1978. Most of this increase was due to higher prices for feed, livestock, and fuel, and to higher interest payments. Fuel expenditures, for example, increased about 40 percent over the 1978 level and accounted for about 6 percent of total farm production costs.

Assuming normal weather and crop yields, total farm cash receipts in 1980 are expected to rise only 2 or 3 percent. Most of the increase will be from crop sales where prices are expected to average somewhat higher. Cash receipts will likely be up for most crops except oilseeds. Livestock cash receipts may total about the same as last year. Receipts from dairy products and cattle may rise, but it is likely that this will be offset by declines in hog and poultry sales.

Production expenses in 1980 are expected to rise faster than gross income, resulting in a lower net income. Most of this increase reflects higher prices resulting from inflation. Among those inputs that are expected to show rapid price increases are fuel and fertilizer. Fuel prices may increase 33 percent or more. Feed, pesticides, and other farm chemicals may also rise, but less rapidly than the rate of inflation.

The outlook for farm income in 1980 is subject to considerable uncertainty, particularly in the second half of the year. Crop receipts will depend substantially on domestic and foreign weather developments. Unfavorable weather conditions and lower crop yields would result in a greater increase in cash receipts than currently anticipated. On the other hand, unusually favorable weather could result in no gain or even a small decline in crop receipts. Because of government price support and reserve programs, however, cash receipts will not decline drastically. Returns to livestock producers will depend not only on 1980 crop

Table 6

Farm Income
(Billions of Dollars)

	1975	1976	1977	1978	1979
Gross Income	$100.3	$101.8	$108.5	$126.0	$146.0
Marketing Receipts	88.2	94.8	95.6	111.1	130.0
Other Income[1]	12.1	7.0	12.9	14.9	16.0
Production Expenses	75.9	83.1	88.8	98.1	114.0
Net Farm Income (current dollars)	24.5	18.7	19.8	27.9	32.0
Net Farm Income (1967 dollars)	15.2	11.0	10.9	14.3	14.7

[1]Includes inventory value changes, direct government payments, and nonmoney and other income items.
SOURCE: U.S. Department of Agriculture.

production and prices, but also on how quickly producers of pork and poultry respond to current market signals to moderate production increases. For example, if hog producers cut back plans for farrowing this winter so that pork supplies rise more slowly in the second half of next year, livestock and poultry prices and cash receipts will be higher than now anticipated.

In addition to these supply factors, overall demand for farm products is quite uncertain for 1980. Global demand for food is expected to rise, but at a reduced pace from the past two years. Recent OPEC oil price increases plus more restrictive monetary policies in a number of countries suggest that overall economic growth is likely to slow further in 1980. It is assumed, however, that a recession will not be as severe as in 1974-75. Should a severe recession develop, however, food demand will slow more than currently anticipated, and farm prices and farm income will be lower than currently forecast.

While measures of farm income are useful in judging the general financial position of farmers, they can also be misleading. The concept of farm income measures only the annual income flows to the farm sector from farming operations. This measure does not take into account capital gains or losses, which affect the wealth of farmers.

In the past decade the nominal value of all productive assets used in agriculture has tripled; in 1979 the value of farm assets is estimated to have increased 16 percent over 1978. Real estate holdings comprise about three-fourths of farm assets and have been the leading source of capital gains in farming. Farmland values in 1979 rose about 16 percent. Such capital gains are a source of increased wealth to farmers not measured in the cash flow from farming operations.

Aggregate farm income measures also fail to reflect the sizable differences in income among individual farmers and types of farming operations. The returns on resources from various farming operations over the long run must tend toward equality since resources will be switched from lower return to higher return uses. In the short run, however, aggregate income measures may not reflect the financial status of individual farmers whose income depends on such factors as the particular commodity produced, farm size, and local weather patterns. In 1980, for example, returns to pork and poultry producers are likely to remain relatively low whereas returns to grain and feeder cattle producers may be relatively high.

Crop Outlook

Major factors that contributed to the rise in crop prices and the income of producers in 1979 were the favorable growing and harvesting conditions in the United States and the shortfall in Soviet Union harvests. The Soviets experienced a 20 percent decline in coarse grain and a 29 percent decline in wheat production. Wheat production was also down in several major exporting nations, including Canada, Australia, and Argentina. This decline increased foreign demand for U.S. food and feed grains, thus placing upward pressure on grain prices. With relatively high yields and record grain crops, U.S. producers benefited from these rising prices (table 7).

Table 7

Yields of Major U.S. Crops
(per harvested acre)

	1976	1977	1978	1979
Wheat (bu)	30.3	30.6	31.6	34.0
Rice (lbs)	4,663	4,412	4,493	4,568
Feed Grain (metric tons)	—	1.88	2.08	2.24
Corn (bu)	87.9	90.7	101.2	106.4
Sorghum (bu)	48.9	56.3	55.1	63.7
Oats (bu)	45.7	55.8	52.2	53.1
Barley (bu)	44.9	43.9	48.4	48.9
Soybeans (bu)	26.1	30.6	29.5	31.5
Cotton (lbs)	465	520	421	528

SOURCE: U.S. Department of Agriculture.

The upward price pressure from the reduced crops abroad, however, was moderated by the generally large grain inventories carried over from previous years. For example, world grain stocks at the beginning of the current marketing year totaled 227 million tons, about 16 percent of annual use.[2] Despite reduced production, world grain consumption in the 1979-80 marketing year is expected to rise slightly. This contrasts with some other years when declines in output had more severe consequences. For example, production in 1974-75 declined less than 4 percent, but due to smaller grain inventories, world consumption declined 2½ percent.

World grain stocks will be reduced during the current marketing year so that carryover inventories are projected at 195 million tons, or 13.7 percent of use. This ratio of stocks to use is below the 15 percent and 14 percent levels held at the end of 1976-77 and 1977-78, respectively, but larger than the 11 percent at the end of 1975-76. Grain stocks in the United States have been replenished in recent years after being drawn down earlier in the 1970s.

Food Grains — Wheat and Rice

U.S. wheat and rice production increased substantially in 1979, while foreign production of these crops declined sharply. U.S. wheat production totaled 57.5 million tons, up 17 percent from 1978. There was an 8 percent increase in acres planted and a favorable growing season, which resulted in higher yields per harvested acre and a larger percent of the acres planted being harvested.

Export demand for wheat has been very strong largely because of the 29 percent reduction in the Soviet Union's wheat crop. Exports for the 1979-80 season are projected at 1.4 billion bushels, up 17 percent from last year. Total usage of U.S.-produced wheat is forecast at about 2.2 billion bushels, up 7 percent from last year and slightly above the 2.1 billion bushels produced. Stocks at the end of the 1979-80 marketing year are estimated to decline about 8 percent to around 850 million bushels.

Strong export demand has led to higher wheat prices over the past several months despite the large U.S. crop. Prices in the 1979-80 marketing year are expected to average about $3.75 per bushel, up from $2.94 last year. With higher prices in prospect for 1980 and no set-aside acreage restrictions (for producers to be eligible for target-price protection, loans, and the farmer-owned reserve), wheat acreage is expected to increase about 10 percent. Production, however, is not likely to rise by 10 percent as yields will likely decline from the unusually high yields of 1978-79.

U.S. rice production was estimated at a record 139.6 million cwt., an increase of 4 percent over 1978. The combined domestic and export use of rice is expected to increase somewhat in 1979-80, though still remaining below production levels. Rice stocks at the end of the 1979-80 marketing year are likely to rise to around 42 million cwt., or a stock-to-use ratio of 32 percent. However, farm prices for rice are expected to average about $9.75 per cwt., up from $8 in 1978-79.

World rice production is forecast at 369 million tons in 1979-80 (rough basis), down 4 percent from 1978-79. World utilization of rice is expected to be near 1978-79 levels, and world stocks are expected to be reduced somewhat. The stock-to-use ratio is expected to remain at about 9.5 percent, well above the 5 percent for the 1972-74 period.

Feed Grains — Corn, Sorghum, Oats, Barley, and Rye

U.S. feed grain production increased about 5.5 percent in 1979. With the help of large beginning stocks, the total supply for the 1979-80 marketing year is up 6.4 percent. Corn production was up nearly 7.6 million bushels, or 7 percent, and sorghum production was up 10.3 percent. These increases more than offset the declines in barley, oats, and rye.

Domestic use of feed grains is expected to rise only slightly in 1979-80 since livestock feeding is not expected to increase substantially. Exports of feed grains, however, are expected to increase sharply (about 17 percent), again a reflection of the sharp drop in Soviet production. Under the five-year US/USSR bilateral grains agreement, the Soviet Union can purchase up to 25 million tons of United States wheat and corn in the October 1979 to September 1980 period without further consultation. Consequently, exports to the Soviet Union and elsewhere are expected to increase about 12 percent in 1979-80, and the United States share of world feed grain exports is expected to increase from 64 percent to 70 percent.[3]

With the increase in export demand and a slight increase in domestic demand, U.S. feed grain stocks will be up only slightly by the end of the 1979-80 marketing year despite the large crops last fall. Prices are expected to average higher than in 1978-79. For

[2]A marketing year begins with the beginning of the harvesting season for most crops. Thus, the marketing year varies for different crops.

[3]These export estimates represent the outlook prior to the embargo.

example, corn prices are expected to average about $2.40 a bushel, compared with $2.20 a bushel last season.

With the projected decline in world feed grain stocks, the USDA has not established a set-aside program for feed grains in 1980. All producers, however, will be eligible for target price protection, loans, and the farmer-owned reserve program. Current price relationships indicate that acreage planted to corn in 1980 will increase and acreage planted to soybeans will decline.

Oilseeds

In contrast to the expected decline in world food and feed grain crops, oilseed production in 1979-80 is forecast to be up about 13 percent. In the Southern Hemisphere, these crops won't be harvested until spring (their fall), but a sizable increase in this production is expected. U.S. oilseed production in 1979-80 was up 23 percent from a year earlier. Soybean production was up nearly 20 percent accounting for about three-fourths of this gain. Sunflower seed production doubled, and cottonseed production rose about 35 percent.

Growth in world demand for oilseed products in 1979-80 is expected to slow somewhat because of slower economic growth and smaller increases in livestock production. Consequently, an increase in world stocks of oilseeds is likely by the end of the marketing year. With world oilseed supplies at record levels, prices have been subject to downward pressure. Soybean prices are expected to average about $6.15 per bushel in the 1979-80 season, below last year's $6.75 per bushel. Demand for soybeans is expected to expand in 1979-80, but quantities available for consumption are about 66 million tons, up 19 percent from a year ago. Total soybean use is expected to expand about 8 percent, but carryover inventories next September will be up about 11 million tons, double that of September 1979. The prospect of lower soybean prices and relatively high prices of some competing crops will probably lead to a decline in acreage planted to soybeans this spring.

Cotton and Tobacco

World cotton fiber production in 1979-80 is estimated to be 7 percent above 1978-79, with most of the increase occurring in the United States. U.S. cotton production in 1979-80 was estimated to be 14.5 million bales, 34 percent above a year earlier and about the same as in 1977-78.

Demand for U.S. cotton is expected to increase this year largely because of increased foreign demand. Domestic mill use may fall slightly, but exports are likely to total 7.0 million bales, up from 6.2 million a year ago. Since production exceeded expected usage, stocks will rise to about 5.3 million bales at the end of the current marketing year, up from 4.0 million bales last year and about the same as the year before. Prices at the farm level may average below the government target price, making producers eligible for deficiency payments.

Tobacco production was down about 22 percent in 1979. This decline reflects both reduced acreage (down about 11 percent) and reduced yields. Because of a substantial carryover, however, total tobacco supplies are down only about 7 percent. Flue-cured tobacco prices increased only about 4 percent in 1979 whereas burley tobacco prices rose to an all-time high, exceeding the previous record of $1.31 per pound in 1978.

Production of tobacco is heavily influenced by government price support programs. Under current legislation, price supports for eligible tobaccos must rise about 9 percent in 1980. The national marketing quota for flue-cured tobacco, 1,095 million pounds in 1979, will increase somewhat in 1980. On the other hand, the burley tobacco quota is expected to remain at the 1979 level of about 614 million pounds.

Livestock Outlook

The livestock outlook continues to be influenced by the supply and demand fluctuations of the early 1970s. The sharp increase in export demand for feed grain in the early seventies as well as the U.S. crop failure in 1974 have contributed to a sharp increase in domestic feed prices, low returns to feedlot operations, and the prolonged liquidation of beef herds. Beef cattle production responds to changing supply and demand factors only after a considerable time lag. For example, when livestock feeding became generally profitable following the large grain harvests of 1977 and 1978, sharp increases in pork and poultry production soon occurred. Beef herds, however, were still being reduced, increasing the supply of beef and depressing prices. Since 1975 pork and broiler production have increased 31 and 38 percent, respectively. Meanwhile, beef production continued down, dropping 4 percent in 1978 and 12 percent in 1979 when beef herd liquidation ended. With more young female cattle being added to herds for reproduction, beef production will remain relatively low for another year or two.

Beef Cattle

Prospects in 1980 for cattle producers, especially cow-calf operators, are more favorable than for pork and poultry producers. Cattle herds have been reduced about 16 percent since 1975. In the initial phase of the reduction, beef supplies were increased and prices depressed by the increased slaughter of breeding herds and calves. As herds were reduced and the calf crop fell, beef output declined. As a result, cattle prices have been rising since the beginning of 1978. In 1979 cattle producers began to rebuild herds by holding back part of the calf crop for breeding purposes and reducing the number of animals for slaughter.

In 1980 cattle and calf slaughter is expected to be near the reduced 1979 level. Total meat supplies, however, will increase to record levels because of the expected increases in pork and poultry production in the first half of the year. Choice steer prices may average near $70 per hundred pounds during the first half of 1980. Prices, however, may increase in the second half of the year if pork and poultry producers slow production in response to unfavorable profit margins.

Hogs

Hog production in 1979 increased 15 percent over the previous year as producers responded to higher profit margins. These gains, however, were offset by a 13 percent decline in beef and veal so that total red meat production increased only a small amount.

The decline in pork prices and the sharp increase in feed costs in the second half of 1979 greatly reduced profitability for hog producers and will affect future production decisions. Production in the first half of 1980, however, will be heavily influenced by decisions already made. For example, hog slaughter in the first half of 1980 will come largely from the September pig inventory and the September-November pig crop. The number of pigs weighing less than 60 lbs. on September 1 was up 16 percent, and farrowing intentions for the September-November period were up 13 percent from a year earlier. Hence, pork production will be up about 17 percent during the first half of 1980.

Production will be increased even more if hog producers reduce their breeding herds. Large supplies are likely to keep hog prices relatively low (at least through mid-1980), with the price of barrows and gilts averaging in the mid $30s per hundredweight. Many hog producers may experience losses in the first half, but an improvement could occur by year-end if farrowings in the March-May period are near year-earlier levels. In this case, pork production at the end of 1980 would be only slightly above earlier levels, and hog prices could average in the upper $30s per hundredweight in the second half of the year.

Poultry

Poultry producers also face less favorable price and income prospects in 1980. Broiler production generally has been profitable over the past four years, but profit margins turned down last fall as a result of rising feed costs and falling broiler prices. Production costs are expected to continue to rise while broiler prices are expected to remain considerably below year-ago levels. Returns to most producers, therefore, may not cover all expenses (including fixed costs). These prospects have already begun to slow production, and a further slowing will occur if current conditions persist or worsen. Thus, output may be near year-ago levels by spring.

Broiler prices were generally favorable until mid-1979 when large increases in pork and broiler production led to depressed prices. Increased pork production early this year is expected to keep broiler prices well below year-ago levels during the first half of the year. Should pork production decline to the year-ago levels after mid-year, broiler prices may rise above the 1979 level, but with substantially higher costs in prospect, profit margins will be well below a year earlier.

Dairying

Producers of dairy products experienced a relatively profitable year in 1979 and the milk-feed price ratio is expected to remain at a generally profitable level this year. Milk prices rose an average of 14 percent in 1979. This increase largely reflected market forces as government purchases of milk under the price support program were relatively small. Beginning in June, milk production began to increase and for the year was about 1¼ percent higher than in 1978.

Farm prices for milk in 1980 are expected to rise about 10 percent with most of the gain occurring in the second half. A year-to-year increase in prices is expected because higher government support prices have already been announced and the adjustment of production support prices is due to occur again in April. Should milk production increase as expected and demand growth subside, government purchases of milk would be much higher in 1980 than the relatively small purchases of 1979. Nonetheless, higher prices for milk are likely to be offset by rising prices of inputs, particularly higher feed prices. The milk-feed price ratio, however, is expected to remain generally favorable for producers. Consequently, milk production in 1980 will probably be up about 1 percent.

SUMMARY

According to the USDA analysts, food prices are likely to increase only about 8 percent in 1980, less than the expected rate of inflation. Most of the increase will result from rising processing and marketing costs rather than prices at the farm level. Indeed, farm commodity prices are expected to average only about 1 percent higher than a year ago.

Net farm incomes are expected to decline in 1980 from the 1979 level. Cash farm receipts are expected to increase 2 or 3 percent, but production expenses will likely continue up at about the same rate as general inflation. Consequently, net farm income may be down to about $25 billion, $7 billion less than in 1979. Net incomes will be above average for producers of most crops except soybeans and for dairy and cow-calf operators. Net incomes for producers of poultry, eggs, hogs, and fat cattle, however, are likely to be down from year-earlier levels.

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