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Monetary Targeting and Inflation: 1976-1984

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This article examines the relationship between the money supply and inflation during the period from 1976 to 1984 when monetary policy was generally framed in terms of target growth ranges for M1. Empirical evidence suggests that money supply disturbances were not an important source of inflation volatility, but that the Federal Reserve allowed such disturbances to exert a permanent effect on the level of money and prices.

Over the last 18 months, very rapid growth in M1 has been accompanied by relatively sluggish growth in nominal income. This anomaly has led many to conclude that the relationship among M1, inflation, and real income has broken down. In response to this apparent breakdown, the Federal Reserve has abandoned M1 targeting as a guide to setting monetary policy. This de-emphasis of M1 comes after a ten-year period during which monetary policy was predominantly framed in terms of growth ranges for M1.

The purpose of this article is to assess the impact of monetary policy on inflation during the period from 1976 to 1984. Monetary policy was criticized during this period both by those who opposed monetary targeting and by those proponents of targeting who opposed the Federal Reserve's tolerance of frequent, and frequently large, deviations of M1 from target. Some critics have argued that the Fed's procedure for dealing with those deviations contributed to both higher and more volatile inflation. These criticisms are empirically evaluated in this article.

The next section contains a discussion of both the Fed's procedure for setting monetary targets and the criticisms levied against that procedure. In Section II, we formulate a simple structural model linking output, prices, interest rates, and money, and discuss four hypotheses concerning the relationship between money and inflation that should be true if the criticisms were valid. The empirical methods used to evaluate these hypotheses are also presented. Section III consists of an evaluation of the empirical evidence, and Section IV provides a brief summary of the findings.

I. Monetary Targeting Since 1976

Target growth ranges for various monetary aggregates have been publicly announced by the Federal Open Market Committee (FOMC) of the Federal Reserve System since the passage of House Concurrent Resolution 133 in 1975. From the first quarter of 1976 until the passage of the Full Employment and Balanced Growth Act of 1978[1], the FOMC announced a target growth rate range for each monetary aggregate every quarter that would apply over a four-quarter period.

This target range was calculated from a base equal to the average level of the aggregate during the previous quarter. Thus, in February 1976, the FOMC set a target range of 4½ to 7 percent for M1 growth to apply to the period from 1975Q4 to 1976Q4; the range was calculated from a base equal to the average level of M1 in the fourth quarter of 1975. Three months later, the FOMC announced another four-quarter target range, in this case 4½

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percent to 7 percent again, to apply to the period 1976Q1 to 1977Q1. The base for this target range was the average level of M1 during 1976Q1.

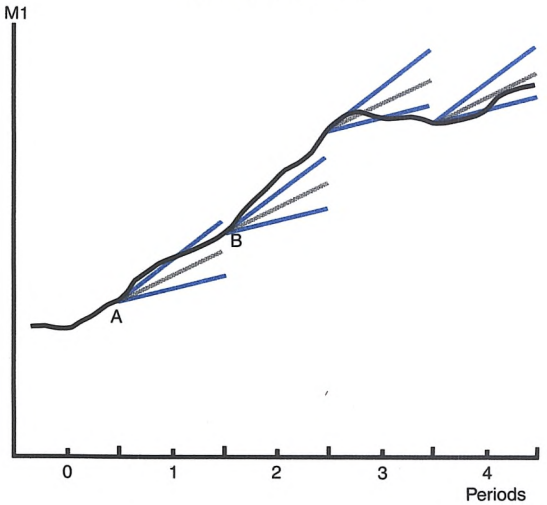
This method of setting the target growth paths for monetary aggregates leads to upward or downward shifts in those paths depending on how M1 deviates from the midpoint of its target range. A succession of hypothetical target ranges is illustrated in Figure 1. Assume that in period 1, a target range of 3 to 7 percent growth is set, with actual M1 in period 0 used as the base. This target range is represented by the cone emanating from the actual M1 value at the end of period 0 (point A in the figure). Suppose the actual path of M1 during period 1 is given by the solid line so that at the end of the period, actual M1 is given by point B. As drawn, actual M1 ended within the target cone, but above the midpoint of the cone represented by the dashed line.

In period 2, the FOMC would establish a new target growth rate range, say 3 to 7 percent again, and base the new cone on actual M1 at the end of period 1. The new target cone in the figure therefore has its apex at point B. If the solid line were to represent the actual path followed by M1, subsequent hypothetical target ranges for periods 3 and 4 would be as depicted.

Base Drift

The successive gray lines representing the midpoint of each target cone show that the procedure of using actual M1 as the base for each cone causes the base to drift upward or downward according to M1's deviation from the midpoint of any target growth cone. Such base drift has characterized the method of calculating growth targets for M1 and the broader monetary aggregates: at the beginning of each target period, the base for the new growth range has shifted to equal the actual level of money at the end of the previous target period. Base drift makes deviations of actual money from the midpoint path permanent at the end of each target period.

Figure 1
Base Drift Illustrated



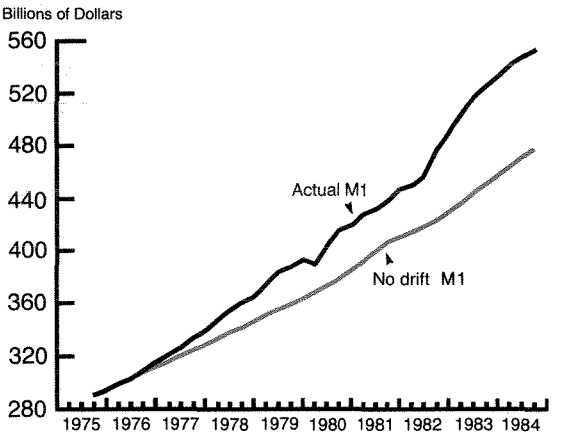
To eliminate the automatic occurrence of base drift each quarter, the Humphrey-Hawkins Act of 1978 required the FOMC to establish, in February of each year, target growth ranges for the entire calendar year. This new procedure in effect replaced automatic quarterly base drift with automatic annual base drift. That is, each February, the FOMC would establish target ranges for the fourth quarter of the previous year to the fourth quarter of the current year, calculated from a base equal to the average value of the aggregate in the fourth quarter of the previous year. Thus, in February 1979, the FOMC announced a target range of 1½ to 4½ percent growth for M1 starting from the actual value of M1 in 1978Q4.

According to the new procedure, the FOMC also reviews its target ranges at mid-year and can adjust either the base or the target growth rate ranges. For example, in July of both 1983 and 1985, the FOMC responded to rapid M1 growth during the first six months of the year by using second quarter M1 (instead of fourth quarter M1 from the previous year) as its new base for calculating growth paths and by adjusting the growth rate ranges.[2]

Chart 1 provides an estimate of the cumulative effect of base drift during the period 1976Q1 to 1985Q4 by plotting both actual M1 and a hypothetical target path that incorporates changes in the target range midpoint while maintaining actual M1 in 1975Q4 as the base. The latter series, labeled "No drift M1", shows what the path of M1 might have been if M1 growth had always been at the midpoint of the FOMC's target ranges and no base drift had been allowed. By the end of 1984, according to the No drift M1 series, actual M1 was roughly 15 percent higher than it would have been if it had always grown at the midpoint of the successive target growth rate ranges.

Chart 1

Base Drift Raises the Level of M1



There is, however, an important reason for thinking that Chart 1 may not give an accurate picture of how M1 would have behaved if the FOMC had followed a policy of preventing base drift. It has been claimed that under the federal funds operating procedure followed prior to October 1979, the Fed allowed the money stock to respond to movements in income, interest rates, and inflation. Under a different monetary policy, such as one that did not tolerate base drift, the actual behavior of these macroeconomic variables would most likely have been different. This means that the FOMC might have set different target ranges if it had eliminated base drift rather than followed its policy of allowing complete base drift.

Criticisms of Base Drift

The FOMC has frequently been criticized for allowing money growth volatility and base drift to occur. Automatic base drift implies that the growth of the money stock will have no tendency to return to a constant trend. Thus, a policy that allows automatic base drift would seem to be inconsistent with a goal of zero inflation. It has been claimed that base drift hinders the achievement of both stable money growth and stable prices over longer periods by making permanent any short-run deviations from target that occur at the end of each target period.

Broaddus and Goodfriend (1984) discuss three major objections to base drift. First, they argue that base drift reduces the public's confidence in the Fed's commitment to maintaining a stable, steady expansion of the money supply over the long-run. Second, by automatically "forgiving" any target misses, they claim base drift greatly reduces the incentives for the Fed to hit its targets. Missing a target in one year imposes no penalty on the Fed in subsequent years since each year automatically starts on target. Third, by incorporating temporary disturbances that cause money to deviate from target, they believe base drift gives those disturbances a permanent effect on the money stock and, therefore, the price level. This leads to increased uncertainty about the future price level and reduces one of the advantages of monetary targeting.[3]

At the heart of these criticisms is the belief that the policy followed by the FOMC contributed both to raising average inflation over the ten years of monetary targeting and to increasing the volatility of inflation.

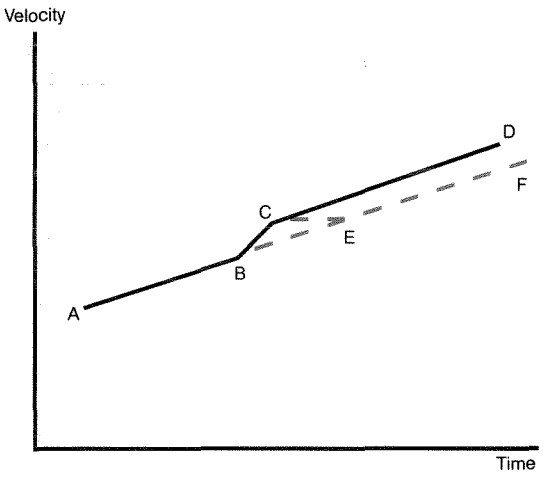
This criticism is not necessarily valid, however, since one can argue that some deviation from the midpoint target path and subsequent base drift is just what one should expect to observe if the FOMC is concerned about stabilizing inflation. For example, suppose velocity grows faster than expected during a year. If the Fed wishes to prevent such a rise from leading to higher inflation, it must reduce money growth. Consequently, the actual level of the money supply at the end of the year would be below the level implied by the midpoint target path set at the start of the year.

How should the target growth path for the next year be set? The answer to this question turns out to depend on the perceived persistence of the velocity disturbance. Suppose the unexpectedly rapid growth in velocity were temporary, with velocity growth returning to its trend value in subsequent years. The result of a one-year surge in velocity growth is to leave the *level* of velocity permanently higher, as illustrated in Figure 2 by the line ABCD. For a given path of money, such an upward shift in velocity will lead to a similar upward shift in the price level, thus generating higher inflation during the transition to a higher price level.

Higher inflation could be avoided if the path of the money supply were permanently lowered. In such a case, the FOMC should not use the midpoint of its prior year target range as the base for the next

Figure 2

A Surge in Velocity Growth Can Leave the Level of Velocity Higher



year's range because this will not produce the required lowering of the path for money. Instead, the new base should be set at a lower level. Since actual money was assumed to come in below target, the actual level of the money supply may provide a new base that would be more consistent with the prevention of a temporary increase in inflation.

A possible alternative path for velocity after an initial surge in its growth is labeled ABCEF in Figure 2. On that path, faster velocity growth is followed by an offsetting period of slower growth that returns the level of velocity to its original path (AF in the figure). In this case, no permanent adjustment in the level of the money supply is needed to prevent inflation. If the actual level of the money supply were used as the new target base, the target growth rates would have to be temporarily increased for the money supply to return to its original path. Such situations would result in a negative correlation between deviations from target midpoints and the target growth rates set for the following year as deviations of the money supply below the target path are followed by higher target growth rates designed to return the money supply to the level of the original path.[4]

Evaluation

This discussion suggests that the impact of M1 deviations from the target midpoint growth path on inflation will depend on the reasons for the deviation. On the one hand, such deviations might arise because the Fed allows the money stock to respond to income, interest rate, or inflation movements caused by disturbances to the economy. As was pointed out in the discussion of a velocity disturbance, the appropriate monetary policy response depends crucially on the nature of the initiating disturbance. Shocks likely to persist call for a different policy response than do more transitory disturbances.

On the other hand, some M1 target misses may represent the effects of money stock control errors or policy actions unrelated to income, inflation, or interest rates. Such money supply disturbances will change output and inflation; they represent an independent source of inflation volatility that can be attributed to monetary policy.

To evaluate the impact of monetary policy on inflation, then, it is necessary to answer two questions. First, have money supply disturbances been an important source of inflation volatility? Second, has the induced policy response of the money supply to economic disturbances contributed to the inflationary impact of such disturbances? If the answer to these questions is "yes", and the behavior of the money supply during the period of monetary targeting has contributed to inflation uncertainty and volatility, the following four stylized "facts" should characterize the data:

1. Money supply disturbances should account for a significant fraction of the volatility of inflation;
2. Changes in money growth should lead to subsequent movements in the rate of inflation;
3. Knowledge of money growth should help to forecast future inflation;
4. Temporary spending or money demand disturbances should lead to persistent, or permanent, responses of the money supply.

The data should have the first three of these four characteristics if independent money supply disturbances arising from policy shifts or from the failure to control the money supply were important contributors to inflation volatility. The fourth characteristic would be true if the Fed has responded to economic disturbances in a manner that has contributed to

raising the average rate of inflation.

To determine whether these stylized facts hold for the U.S. during the period of monetary targeting, it is necessary to translate each into a statistical hypothesis that can be tested. This translation will be done within the context of a simple structural model linking money with other macroeconomic variables. This model is discussed in the next section.

II. Empirical Framework

This section discusses an empirical framework that can shed light on the criticisms levied at the FOMC's conduct of monetary policy. The model to be examined consists of four variables: real GNP in 1982 prices, the GNP price deflator, the three-month Treasury bill rate, and M1. (All observations are quarterly.) Because most macro variables are nonstationary, the analysis is carried out in terms of first differences. Let Y_t, P_t, and M_t denote the first differences of the log of real GNP, the price deflator, and M1, respectively. Thus, Y, P, and M are approximately equal to the quarterly growth rates of output, prices, and money respectively. Let R_t denote the first difference of the level of the bill rate. All variables are expressed at seasonally adjusted annual rates.

A simple four-equation model was used to capture the structural relationships assumed to hold among the equilibrium values of these macro variables. The first equation is a simple IS, or aggregate spending, relationship that assumes real aggregate spending depends on the anticipated real rate of interest. This is represented by equation 1:

$$Y_t = \alpha_1(R_t + P_t - E_tP_{t+1}) + W_{1t-1} + u_{1t} \qquad (1)$$

where E_tP_{t+1} is the expectation of P_{t+1}, so that $R_t + P_t - E_tP_{t+1}$ is the expected real rate of interest, and W_{1t-1} is a composite term that incorporates all the dynamic effects of past values of income, prices, interest rates and money on Y_t. Since an increase in the expected real rate of interest should reduce aggregate spending, α_1 should be negative. The disturbance term u_{1t} will be referred to as an aggregate demand shock; it captures all contemporaneous effects on Y_t other than those operating through the real interest rate.

The second structural equation is a simple Phillips curve or aggregate supply relationship;

$$P_t = \alpha_2 Y_t + W_{2t-1} + u_{2t} \qquad (2)$$

Again, W_{2t-1} captures the effects of all lagged values and so would also incorporate the impact on P_t of expectations of P_t formed in earlier periods. The coefficient α_2 should be positive, as, ceteris paribus, a rise in output should lead to a rise in the price level. The disturbance term u_{2t} represents an aggregate supply shock.

The third structural equation in the model specifies the demand for real money balances as dependent on income and the nominal interest rate as well as on lagged values of the variables in the model:

$$M_t - P_t = \alpha_3' Y_t + \alpha_4' R_t + W_{3t-1}' + u_{3t}'.$$

For the purpose of estimation, this equation is normalized on the interest rate and written as

$$R_t = \alpha_3 Y_t + \alpha_4(M_t - P_t) + W_{3t-1} + u_{3t}. \qquad (3)$$

Since a rise in output should increase the demand for real money balances whereas a rise in the nominal rate should reduce it, we expect α_3 to be positive and α_4 to be negative. The disturbance term u_{3t} represents a money demand shock.

The final equation of the structural model is a description of money supply determination:

$$M_t = \alpha_5(Y_t + P_t) + \alpha_6 R_t + W_{4t-1} + u_{4t}. \qquad (4)$$

Equation 4 relates the money supply to the contemporaneous value of nominal income and the nominal interest rate. As in the other equations, W_{4t-1} captures any lagged effects on money supply. If the Federal Reserve slows money growth when nominal income growth increases, α_5 would be negative. However, Fed critics have often charged that the Fed allows money growth to vary procyclically. This

would suggest that α_5 may be positive. Since it is also often claimed that the Fed "leans against the wind" by attempting to smooth interest rate movements, α_6 would be expected to be positive. The term u_{4t} represents a money supply shock; it incorporates all contemporaneous influences on the money supply except the influences of nominal income and interest rates.

This structural model allows money supply effects to operate through three channels. First, u_{4t} represents monetary disturbances that directly affect the money supply and, through the presence of M in equation 3, interest rates, output, and prices. Second, aggregate spending, aggregate supply, and money demand shocks will affect nominal income and the nominal rate of interest, and thereby cause the money supply to respond endogenously, as long as α_5 and α_6 in equation 4 are not both zero. Third, lagged values of the money supply will also have effects on current output and prices. Empirical estimates of these various channels can be used to shed light on the stylized facts listed in the previous section.

Statistical Hypotheses

Within the context of the model described, stylized facts numbers 1 and 2 can both be interpreted as statements about the effects of money supply disturbances on inflation. Evidence that money supply shocks account for a large fraction of the variance of inflation would support "Fact" 1. Likewise, "Fact" 2 would be supported by evidence that a nonzero realization of the money supply shock led to subsequent movements in inflation.

To cast light on stylized fact 3, the four structural equations can be solved to express Y_t, P_t, R_t and M_t as functions of the lagged values of these variables and the current values of the structural disturbances. "Fact" 3 can then be interpreted as a statement about the coefficients on past values of M. If the coefficients on lagged M in the equation for inflation are jointly zero, then knowledge of past money supply growth rates does not help in forecasting inflation once past inflation, output, and interest rates are taken into account. Hence, nonzero coefficients on past M would provide evidence in favor of "Fact" 3.

Evidence relevant for judging "Fact" 4 can be obtained by determining how the money supply responds to disturbances to the model. Since disturbances in the structural model are assumed to be serially uncorrelated, a finding that *temporary* shocks to, for example, money demand had *persistent* effects on the money supply and prices would indicate that the induced response of the money supply to economic conditions was leaving lasting effects on prices and contributing to inflation as the price level adjusts.

Although it will be argued below that "Fact" 3 is the least interesting of the three stylized facts, it is the easiest to test since an estimate of the effects of lagged M on P can be obtained by directly regressing P on lagged values of M, Y, P, and R. However, to assess "Facts" 1, 2 and 4, it is necessary to recover information on the true structural disturbances, and this requires first estimating the α_is that characterize the contemporaneous relationships among Y, R, P and M.[5]

III. Empirical Results

The empirical results reported here are all based on the sample period 1977Q1 - 1984Q4. This period encompasses several changes in Federal Reserve operating procedures, the most important of which was the move, in October 1979, from a federal funds operating procedure to a nonborrowed reserves procedure. The Fed's commitment to monetary targeting also seems to have varied over this period. Unfortunately, the shortness of the sample period precludes dealing adequately with these potential structural shifts. Nevertheless, estimates derived from the whole sample may still provide useful information about the average impact of monetary shocks.[6]

Estimated values of the parameters giving the contemporaneous relationships between Y, R, P, and M in the structural model are listed in Table 1. All parameter signs agree with prior expectations, and, with the exception of the real interest elasticity of aggregate spending (α_1), all the parameters are

TABLE 1

Parameter Estimate for Structural Model

Parameter	Estimated Values	Standard Error*
α_1	−0.48	0.85
α_2	0.19	0.07
α_3	0.24	0.03
α_4	−0.56	0.04
α_5	−0.11	0.06
α_6	3.39	0.09
Variance of u_1	.00072	.00028
Variance of u_2	.00007	.000004
Variance of u_3	.00013	.00001
Variance of u_4	.00034	.00001

*These are asymptotic standard errors; see Hansen and Singleton [1982] for the appropriate formula.

statistically different from zero at conventional significance levels. Of particular interest is the estimated equation for the money supply — equation 6. The negative estimated value of α_5 — the coefficient on nominal income — indicates some endogenous policy response within the quarter to offset contemporaneous movements in nominal income. However, the very large coefficient estimate for α_6 is evidence of a tendency to attempt to offset nominal interest rate movements.

The estimated variances of the structural disturbance terms allow some conclusions to be drawn about their relative importance in generating economic fluctuations. In decreasing order of size are the variances of aggregate spending shocks, which are estimated to be more than twice as large as any of the other variances, money supply shocks, money demand shocks, and aggregate supply shocks. This ordering is somewhat at variance with the traditional Federal Reserve view that emphasizes the importance of money demand shocks. However, u_3 was the disturbance for a money demand equation normalized on the interest rate. When converted back to the standard form of a money demand equation, the estimated variance is .00052. This results in a ranking that seems consistent with the Federal Reserve view.

The estimated coefficients of the structural model, together with the results of the vector autoregression (VAR) estimation technique used to estimate the effects of lagged variables on Y, R, P and M, can be used to study the impact of money on the macroeconomy during the period of monetary targeting. In particular, it is possible to examine the stylized facts about monetary policy that were discussed in Section II.

If independent monetary volatility has contributed to the volatility of inflation, then one should expect to find that money supply disturbances, as identified in the structural model, account for a large fraction of the variance of errors made in forecasting future inflation. Table 2 presents the decomposition of the forecast error variance for inflation. Each column reports the fraction of the total variance of the inflation forecast error that is attributed by the structural and VAR estimates to a particular structural disturbance.[7] Results for various forecast horizons ranging from one quarter to 24 quarters are reported.

The clear conclusion from Table 2 is that money supply disturbances contribute very little to inflation uncertainty as measured by the variance of forecast errors. The evidence from this variance

TABLE 2

Variance Decomposition of Inflation

Quarter	Aggregate Spending	Aggregate Supply	Money Demand	Money Supply
1	24.15	75.78	0.03	0.04
4	18.64	73.42	6.35	1.59
8	22.66	65.19	9.16	2.99
12	22.41	64.96	9.34	3.29
24	22.18	64.36	10.04	3.43

decomposition suggests that the first of the four stylized facts discussed in Section II is not an accurate description of the money supply-inflation relationship during the period of monetary targeting.

To gauge whether shocks to the supply of money lead to subsequent movements in the rate of inflation — stylized fact 2 — the VAR and structural model estimates can be used to calculate the impact of a money supply disturbance both directly on each of the model's variables and indirectly through the induced effects of changes in one variable on the others. Table 3 presents the responses of all four variables in the model to a money supply disturbance.

The immediate impact of a positive shock to the growth rate of the money supply is a decline in market interest rates, a rise in real output growth, and an increase in the rate of inflation. However, the impact on the rate of inflation is very small, peaking 6 quarters after the shock to money growth, and then declining. This evidence, which is consistent with the variance decompositions reported in Table 2, suggests that money supply disturbances do not have large effects on subsequent inflation. As the last column of Table 3 shows, the small impact is in large part due to the temporary nature of the effect of money supply shocks on the rate of growth of the money supply.

An alternative way to assess the impact of monetary changes on future inflation involves testing whether information about past money growth rates is helpful in predicting the rate of inflation once past inflation rates, output growth rates, and nominal interest rates are known.[8] In essence, such a test examines whether monetary changes precede changes in inflation. The structural model is not needed to carry out such a test since, as explained in Section II, the test involves only the statistical significance of the coefficients on lagged money growth rates in the VAR equation for the rate of inflation. The relevant F-statistic for this test is 0.30 with a marginal significance level of 87 percent. Thus, the data are quite consistent with the hypothesis that money does not help to forecast inflation.

This test result, however, is not particularly useful for evaluating the contribution of money supply disturbances to the level and volatility of inflation. For example, the evidence that past money growth does not aid in forecasting inflation once past inflation, real output growth, and nominal interest rates are known is entirely consistent with the hypothesis that monetary shocks have a large contemporaneous impact on inflation. It is also consistent with the view that nonmonetary disturbances have been the cause of most inflation fluctuations over the period studied.

The results in Tables 2 and 3 indicate that money supply disturbances do not constitute an important source of independent variation in inflation. Yet this result in still consistent with the criticism that the FOMC has let the money supply respond endogenously to interest rates and income in a manner that has led to more inflation than would have occurred under a policy that eliminated such induced movements of the money supply. To assess

TABLE 3

Responses to a One-Standard Deviation Money Supply Disturbance*

Quarter	Y Output Growth	P Inflation	R Changes in Interest Rate	M Money Growth
1	0.11	0.02	−0.34	0.66
4	−0.10	0.10	−0.06	−0.92
8	−0.22	0.01	0.09	−0.11
12	0.13	0.03	0.11	−0.14
24	−0.00	0.02	−0.02	−0.04

*All entries have been multiplied by 100.

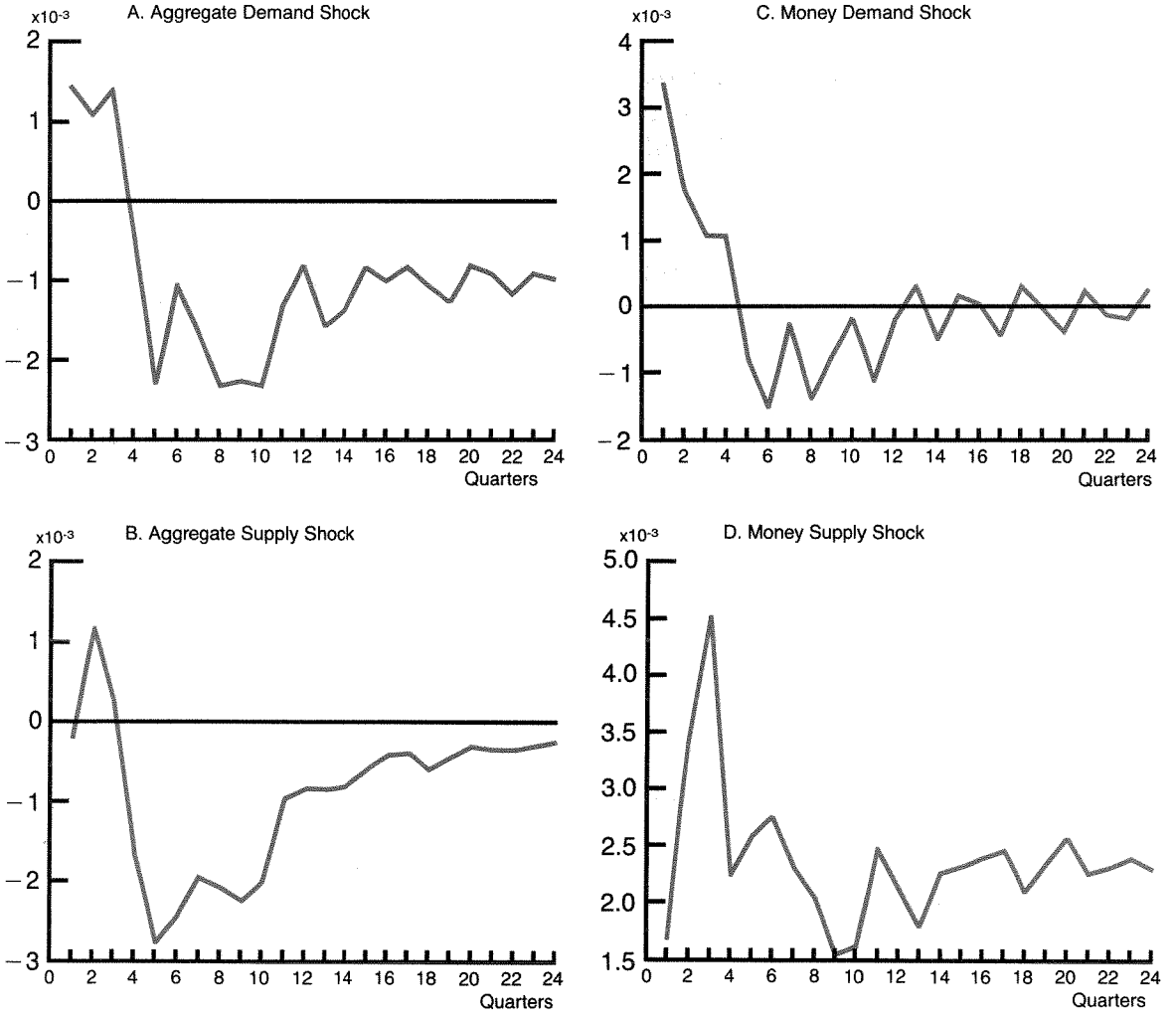
this criticism, it is necessary to examine the manner in which the money stock responds to the other disturbances in the model. The response of the *level* of M to each of the various structural disturbances is reported in Chart 2.

Several interesting conclusions are apparent from Chart 2. Panel A shows the response of the level of the money supply to an aggregate spending disturbance. Initially, the money supply responds positively to a spending increase, but this is reversed by the end of four quarters. The net effect of the aggregate spending shock is to leave the level of the money supply lower than it would have been in the absence of the positive spending shock. The pattern of response to an aggregate supply shock, shown in Panel B, is similar. The net effect of an aggregate supply shock on the level of the money supply, however, is more than offset within a year. Eventually, the path of the money supply appears to return to what it would have been in the absence of the shock.

In Panel C, the response of the money supply to a money demand shock is illustrated. A positive money demand disturbance induces an increase in money growth that appears to be fairly quickly reversed. At the end of five quarters, the level of the money supply is back to where it would have been had it remained on its initial path.

Chart 2

Response of Money to Various Shocks



In none of these first three panels is there evidence that aggregate spending, aggregate supply, or money demand shocks induce permanent effects on either the growth rate of the money supply, or even the level of the money supply, that would produce sustained inflation.[9]

Panel D paints a somewhat different picture. A positive shock to the money supply is not completely offset afterward. Instead, the shock leaves the nominal money supply permanently higher. This implies that money supply disturbances do seem to have the effect of permanently raising the price level, and, during the transition to a higher price level, producing an increased rate of inflation. This evidence is consistent with Table 3 which showed that money supply shocks led to a period of temporarily higher inflation. Because these shocks are never offset, the price level is left permanently higher.

One interpretation of these results is that the FOMC lets temporary errors in its control of the money supply result in permanent changes in the price level. This interpretation supports the criticism of automatic base drift — that base drift converts temporary deviations (due to control errors) from the target path into permanent deviations of the price level from the path consistent with a constant rate of inflation.

IV. Summary and Conclusions

This article has examined the relationship between the money supply and inflation during the period from 1976 to 1984 when monetary policy was generally framed in terms of target growth ranges for M1. The major criticisms of the Federal Reserve's loose control of the money supply focused on the implications of money growth for inflation.

To assess the empirical validity of these implications, evidence obtained from a vector autoregression and an estimated structural model was employed. The empirical sections of the paper examined the impact of money supply shocks on subsequent inflation, the fraction of inflation forecast error attributable to money supply shocks, the contribution of past money growth to the forecast of inflation, and the induced response of money to aggregate spending, aggregate supply, money demand, and money supply disturbances.

In general, little evidence was found to indicate that money supply disturbances have independently made a major contribution to the level of inflation or its unpredictability. However, it does appear that the FOMC has allowed random disturbances in the growth rate of the money supply to exert a permanent effect on the level of money and prices. Faster-than-expected money growth generates temporarily higher inflation that leaves prices permanently higher. Such a finding is not surprising given the FOMC's policy of automatic base drift, in which deviations of the money supply from target are allowed to affect the level of the money supply permanently. However, given the short sample period and the changes in Federal Reserve operating procedures that occurred in 1979 and 1982, these conclusions must be considered tentative.

FOOTNOTES

1. This Act is better known as the Humphrey-Hawkins Act.

2. Each year, the Federal Reserve Bank of St. Louis publishes in its *Review* an analysis of the FOMC deliberations on setting targets during the previous year.

3. The Shadow Open Market Committee (1985) has recommended the elimination of base drift. See also M. Friedman (1982, 1985) and McCallum (1984). In one of the earliest attacks on base drift, Poole (1976) suggested, as an alternative procedure, that the midpoint of the previous year's target range, and not actual M1, be used as the new base. This recommendation was also proposed in the 1985 *Economic Report of the President*.

4. In fact, this correlation is positive. For a more detailed analysis of base drift, see Walsh (1986).

5. Actual estimation proceeds in two steps. If Z_t is the column vector of Y_t, P_t, R_t, M_t, then the structural model can be written as $AZ_t = B(L)Z_{t-1} + u_t$. Hence, $Z_t = A^{-1}B(L)Z_{t-1} + A^{-1}u_t = D(L)Z_{t-1} + v_t$. The lag coefficients in D(L) can be obtained in the first step from estimating a vector autoregression (VAR) in Z_t. This also yields estimates of v_t. A lag length of four was used in the VAR and each equation also included a constant and a time trend. In the second step, an estimate of A was obtained by noting that the population covariance matrix of v is $A^{-1}\Sigma_u A^{-1\prime}$ where $\Sigma_u = E(u'u)$ and applying a Generalized Methods of Moments estimation procedure. For further discussion of this approach, see Bernanke [1986] or Sims [1986]. The Generalized Methods of Moments estimator is discussed in Hansen and Singleton (1982) and Chamberlain (1984). The structural disturbances can then be recovered as $\hat{A}\hat{v}_t$ where $\hat{A}$ is the estimate of A and $\hat{v}_t$ is the vector of VAR residuals. See also Walsh [1987].

6. In Walsh (1987), the model was expanded to include a measure of the Fed's M1 target and a dummy variable for the period 1979Q4 to 1982Q3, when the Fed used a nonborrowed reserves operating procedure. This slight change in the specification had a large impact on the estimated dynamics implied by the VAR system. Points where the results of this paper differ from those of Walsh (1987) are noted in footnote 9.

7. Unlike standard methods of orthogonalizing the VAR residuals to construct variance decompositions, the approach taken here, which combines a VAR with a structural model, yields results that are independent of the ordering of the variables. Thus, the fact that money supply shocks are listed last in Table 2 has no significance.

8. This is just a test of the null hypothesis that money does not Granger cause inflation.

9. Somewhat different results were obtained from an extended model that included a dummy variable for 1979Q4 to 1982Q3. In this model, aggregate supply shocks appear to produce a permanent increase in the rate of money growth. This indicates that the endogenous Federal Reserve policy response contributed to the inflationary impact of aggregate supply disturbances. See Walsh, (1987).

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Inflation, Age, and Wealth

Randall J. Pozdena*

A comparison of data from two special surveys of household assets and liabilities conducted by the Federal Reserve System in 1977 and 1983, respectively, reveals a significant redistribution of household wealth toward older Americans. This change in the age-distribution of wealth is consistent with the notion that the unexpectedly high rates of inflation during the period between the surveys resulted in increases in home values, social security income, and other sources of wealth from which older households benefited disproportionately.

A stable price level is considered a desirable objective of economic policy for well-known reasons of equity and efficiency.[1] Among the equity issues is the effect of inflation on the distribution of wealth within a society.[2] In particular, unanticipated changes in the rate of inflation and uncertainty about the inflation rate can change the value of various assets and liabilities held in household and business portfolios.

The purpose of this article is to examine selected, recent changes in the age-distribution of household assets and liabilities. In particular, we examine empirically the changes in the age-distribution of net worth that occurred during the period of the late 1970s and early 1980s. The reason for this particular focus is twofold. First, the sharp increases in inflation that occurred during this period are likely to have had important age-specific effects due both to differences in the composition of portfolios of households of various ages and to the existence of inflation-indexed programs designed to assist older Americans.

Second, to the extent that there has been a significant change in the age-distribution of wealth, it may be desirable to revise federal budget policy. A significant proportion of federal expenditures consists of programs that emphasize support for older Americans. Social Security retirement programs and Medicare, for example, together represent nearly 40 percent of total federal expenditures. As the Administration and Congress attempt to deal with the large federal budget deficit, information on the age-distribution of household net worth should be helpful in the debate over program priorities.

The study in this article employs data from two special surveys of consumer finances conducted by the Federal Reserve System. The two surveys provide very detailed information on the composition and value of household portfolios, and afford us the opportunity to obtain a rough "before-and-after" glimpse of the age-distribution of net worth during the high-inflation period spanned by the surveys. Data from the surveys reveal a significant change in the relative wealth status of various age groups that generally favors older Americans, and enable us to determine which components of household portfolios have contributed most to this change.

The remainder of this paper is structured as follows. We review in the first section the changes in economic and policy conditions that occurred during the period of the late 1970s and early 1980s. In the second section, we discuss why these changes may lead to age-specific changes in household

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wealth. The third section of the paper summarizes our analysis of survey data. In a fourth section, we briefly review other evidence about the changing economic status of the elderly. The paper concludes with a discussion of qualifications to the study's findings and some policy implications of those findings.

I. A Changing Economic Environment

By the mid-1970s, the economy of the United States was experiencing seriously stagnating growth and a rising — and increasingly volatile — inflation rate. The annual rate of change in the consumer price index (CPI) was 5.8 in 1976, but had risen to over 13.5 percent in 1980 (see Chart 1). As important as the actual changes in the rate of inflation were the apparent upward revisions in inflation *expectations* that also occurred during this period. Although it is difficult to measure long-term inflation expectations directly, they are, in theory, a component of nominal interest rates, and contributed to the observed rapid increase in long-term rates that began in the mid-1970s and peaked in the early 1980s.

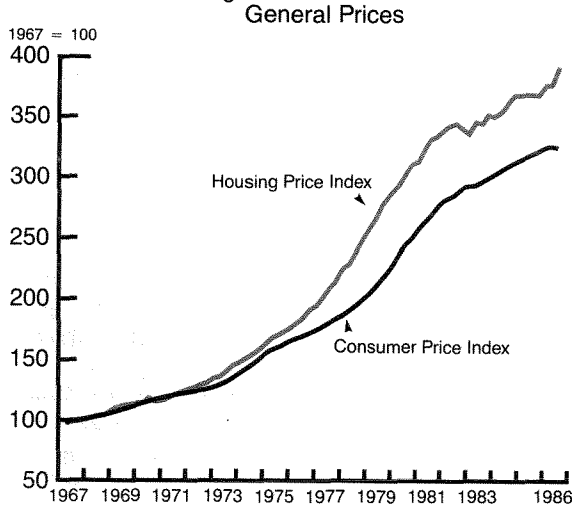
Policy Conditions

These abrupt changes in the inflation rate, inflation expectations, and nominal interest rates took place in a policy environment that was not configured with high rates of inflation in mind. In particular, the federal income tax system incorporated a progressive rate structure, with the rate brackets defined on the basis of nominal taxable income. As their nominal incomes rose, taxpayers found themselves facing higher average and marginal tax rates even if their real (inflation-adjusted) incomes had not risen. Thus, the effective marginal tax rate facing households — an important variable in portfolio decisions — also changed abruptly during this period.

Labor markets too were caught unawares by the rapid acceleration in inflation. Because few labor market participants enjoyed wage adjustments as rapid as inflation, the real hourly wage of the average worker fell by one percent between 1975 and 1980.[3] The practice of indexing wages to the cost of living (so-called cost-of-living allowance or COLA) was not a common feature in the private sector, although a number of government programs, including many income transfer programs, employed such indexing.

Notable among the indexing procedures employed by government programs was the process used to determine Social Security benefit levels. In particular, in 1972, Congress introduced automatic indexing into Social Security pensions. Social Security payments were determined using a formula applied to a nominal, base income standard. As wage inflation occurred, of course, this base automatically was adjusted upward. In addition, as a result of the 1972 amendments, benefit levels derived from this formula also were inflation-indexed. The combined effect was a form of "double-indexing" of Social Security benefits to inflation that resulted in a rise in the average level of monthly Social Security benefits of over 270 percent between 1970 and 1983 — a real increase of 120 percent.[4] Since it is unlikely that then-current and prospective Social Security beneficiaries anticipated the inflation of this period and its impact on benefits, inflation may have conferred a windfall gain on Social Security recipients. (Double-indexing was eliminated in later amendments to the Social Security Act.)

Chart 1
Housing Prices Rose Faster than General Prices



Source: U.S. Department of Commerce; C27 Construction Series and U.S. Department of Labor; Bureau of Labor Statistics

II. Theoretical Implications for the Household Portfolio

To provide a framework for reviewing the effects of this economic and policy environment on the age distribution of net worth, it is helpful first to discuss the simple theory of household asset accumulation.

The Life-Cycle Saving Hypothesis

Economists long have had an interest in the accumulation and disposition of assets over the course of an individual's lifetime.[5] The process is a complicated one as it is likely to depend upon such diverse factors as the earnings profiles of individuals over their "life-cycle", individuals' preferred pattern of consumption over time, how accurately the death of the individual can be forecast, and the strength of bequest motives. The interaction of these and other factors on saving and the distribution of wealth typically is studied in the context of the so-called "life-cycle theory of saving."

The development of the life-cycle theory of saving is credited most frequently to the economist Franco Modigliani, although work by Irving Fisher, Milton Friedman and others also was critical to its development.[6] Because detailed descriptions of the many variants of the theory are easily available in the literature and because its implications for the pattern of wealth accumulation over the life-cycle are not always unambiguous, we will review only the essence of the model and its relationship to our study.

The life-cycle theory of saving begins with the notion that individuals wish to maximize lifetime "utility" — the economist's nomenclature for what colloquially might be called well-being. Lifetime utility has two components. The first consists of the utility derived from consuming goods, services, and leisure time throughout the individual's lifetime. Within this component, the utility of consumption in the future contributes differently to lifetime utility than utility derived from present consumption. Specifically, the utility of future consumption is discounted by the individual's so-called "rate of time preference": the greater the rate of time preference, the less important is future consumption in the perception of lifetime utility.[7] The second component of lifetime utility is the utility derived from bequesting assets at the end of one's life. The weight that this utility receives in lifetime utility is a measure of the strength of the bequest motive.

Maximization of lifetime utility is constrained, of course, by the resources available to the individual during his lifetime. The availability of resources, in turn, depends on the individual's initial endowment, if any, of assets, and income that flows to the individual from market earnings. In concept, the pattern of earnings over the life-cycle (the "earnings profile") is itself endogenous to the lifetime wealth maximization process because of decisions to enhance human capital through education and decisions about how much labor to supply at each point in time.

Out of their income flows, individuals make consumption (and hence savings) allocations, borrowing and lending in the capital markets to obtain the desired pattern of consumption. The interest rate encountered in borrowing and lending — and its relation to the rate of time preference — influences the way in which individuals will arrange their consumption and savings patterns over their life-cycle.[8]

This process of maximizing lifetime utility subject to resource constraints results in life-cycle patterns of consumption, saving and, hence, financial wealth positions. Depending upon the assumed degree of uncertainty about the length of life and earnings, the relationship between market interest rates and the rate of time preference, the strength of the bequest motive, and other characterizations of the model, various configurations of life-cycle behavior can be derived. If one can assume that most individuals expect the last phase of their "life-cycle" to consist of a period of detachment from the labor force (a period we might call "retirement"), then a general profile of financial wealth over the course of the individual's life emerges. In particular, the distribution of wealth over an individual's life-cycle will be "humped" — rising initially and then falling as the end of life approaches.[9]

The preceding describes the pattern of financial wealth held by individuals at various dates in their own life cycle. The comparative wealth positions of individuals of *different ages measured at the same point in time* (the "age-distribution of wealth") will

only be the same as the life-cycle distribution if life-cycle income prospects were the same for all generations. Historically, however, incomes have grown from one generation to the next. This growth should (everything else being equal) skew the observed age-distribution of wealth toward younger generations. Conversely, a secular decline in the income prospects of newer generations would skew the observed age-distribution of wealth per individual toward older generations.

III. A Life-Cycle View of the 1970s

In this section, we study empirically the effects of the various "shocks" that occurred in the 1970s on patterns of wealth accumulation. In doing so, it is useful to characterize the events of the 1970s in the language of the life-cycle saving theory. We necessarily are selective, both in the economic events we emphasize as well as the characterization of these events in terms of the life-cycle model.

Shocks to Real and Financial Asset Values

The abrupt increases in inflation, inflation expectations, and nominal interest rates that occurred in the late 1970s significantly influenced the relative prices of important financial and real assets. The price of housing, for example, rose sharply over this period, far outstripping the general rate of increases in prices (see Chart 1). Such behavior in housing prices follows directly from the effect of inflation expectations on the demand for durable goods coupled with the fact that the stock supply of housing is relatively price inelastic.[10] Individuals already owning homes, therefore, experienced sharp increases in the value of the housing component of their asset portfolios.

The value of fixed-coupon debt instruments, such as bonds or fixed rate mortgages, for example, fell as nominal interest rates increased. Holders (lenders) of such debt experienced decreases in the value of this component of their financial asset holdings. Borrowers (such as corporations and homeowners, for example) experienced increases in financial wealth.

From the viewpoint of the life-cycle theory of saving, unanticipated increases in asset values are analytically similar to larger initial asset endowments and should have similar effects on the pattern of asset accumulation over the life-cycle. Generally speaking, an increase in initial asset endowment results in a proportional increase in holdings of financial assets in all phases of the life-cycle.[11] The impact of changes in real and financial asset values on the distribution of wealth therefore will depend upon the distribution of these "windfall" gains among households.

About half of the nation's nonhuman wealth is in the form of residential real estate.[12] Since such real estate tends to be held mainly in the portfolios of older households, a change in its value is likely to change the age-distribution of household net worth. Moreover, because most mortgage debt in the mid-1970s was fixed coupon debt, homeowners enjoyed not only increases in the market value of their homes but also a decrease in the market value of their debt burden. Households on the brink of retirement could "capture" a significant proportion of this net worth because retirees no longer are tied to developed metropolitan areas (for example, by work), where housing supply is least elastic (and home price inflation most pronounced). Also, various court rulings often permitted the buyer to assume the low-coupon mortgage debt, something likely to be reflected in the home sales price.[13] This scenario suggests that there may have been a significant transfer of wealth to homeowning households near retirement age.

Social Security Programs

The implications of changes in Social Security programs for saving over the life cycle is difficult to model and, in fact, have been the subject of intense debate in the economics literature.[14] In essence, the Social Security program consists of a tax on the wages of current workers that funds benefits to individuals who have reached a prescribed retirement age and who have severed their attachment to the labor force. Even if the tax and benefit features of

the Social Security system were permanent and could be perfectly forecasted, the effects on private saving still would be ambiguous.

Some have argued that the combination of reduced after-tax income during the working years and the anticipation of benefits to be received in the retirement years will reduce private wealth accumulation.[15] Others have argued that the effect on the accumulation of private wealth depends upon the rationale and strength of bequest motives. In particular, they claim that the wealth implicitly "transferred" from the working generation to the retired generation by the Social Security system will be returned to the younger generation through heightened post-retirement saving and larger bequests.[16] If so, saving over the life-cycle could be largely unaffected by the Social Security system.

Social Security's effect on private saving efforts is further clouded by the possibility that Social Security taxes, benefits or both may be perceived as impermanent or uncertain. In fact, the tax and benefit features of Social Security have changed frequently and are difficult to interpret because of the complexity of tax and benefit formulae and the relationship of taxes and benefits to other economic circumstances.[17] The extent to which Social Security's features are viewed as impermanent or uncertain may affect private saving efforts.

The sharp increase in benefit levels (and concomitant increases in Social Security taxes) that occurred in the 1970s may therefore have had a wide range of possible effects on the private accumulation of wealth. For those at or near retirement age, the decision to add to or dispose of current assets may depend upon whether they view the benefit increase as permanent or temporary and likely to be offset by a future decrease in benefits. Their decision will also depend on whether they believe the increase in retirement benefits is a transfer of income from the younger generation that is offset when retirees adjust their saving for bequest purposes.

IV. The Age Distribution of Net Worth: 1977 vs. 1983

The ambiguity that pervades the theory of saving over the life-cycle limits what we can draw from life-cycle models in the way of useful inferences about likely changes in the age-distribution of wealth. Moreover, the life-cycle saving hypothesis formally deals with the way in which assets accumulate and are disposed of by individuals *over their life cycle,* whereas as a practical matter, policymakers are less concerned with how policy affects the pattern of accumulation of savings over the life cycle than they are with one of its consequences: the age-distribution of net worth at a given point in time. In the remainder of this paper, we look at two "snapshots" of the distribution by age of household financial wealth. Such an approach can shed light only indirectly on the processes that determine life-cycle savings behavior, but it can reveal changes in the financial wealth status of various age groups.

The findings that follow, therefore, are largely descriptions of changes rather than an attempt to verify a particular model of the life-cycle saving theory. Nevertheless, findings that support (at least anecdotally) some of the implications of the life-cycle saving model are highlighted below.

Studying Household Net Worth

There are a number of surveys that, in concept, should provide data useful to our exercise.[18] However, of these, only one publicly available database is designed specifically to survey the financial "balance sheets" of American households accurately. This survey is the Federal Reserve System's Survey of Consumer Finances. Because the survey in its present form was conducted in 1977 and again in 1983, it provides a convenient span for us to see the consequences of the turbulent economic conditions of that time.

Approximately 2,600 and 3,800 randomly selected households, respectively, were interviewed in each survey to obtain information on their various real and financial assets and liabilities.[19] The table presents the components of net worth from the coarse balance sheet categories in the surveys. The only major categories omitted were consumer durables and the present value of private pension assets. Data on consumer durables stocks were not collected in either survey, and data on pensions were not obtained in the 1977 survey, preventing comparison on these items. Theory and some empirical

work argue that institutionalized saving through pension funds will partly depress private wealth accumulation.[20] To the extent that pensions have become more generous and ubiquitous over time, their exclusion may lead to an understatement of the relative wealth of younger versus older households.

Household Net Worth

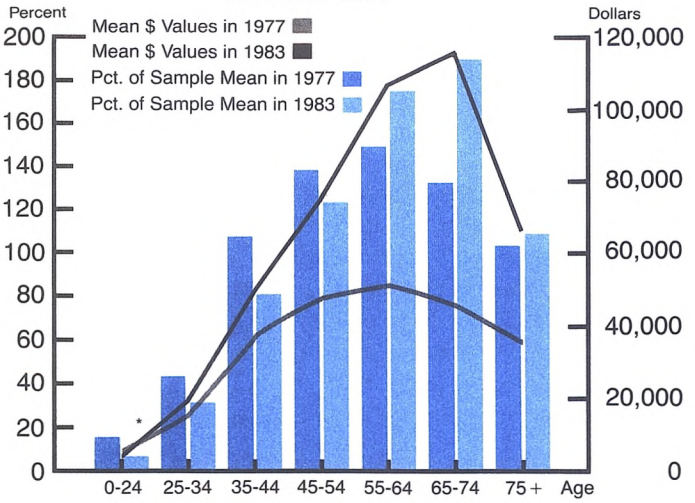
We turn first to the most aggregative measure of nonhuman household wealth explored in this paper — household financial "net worth." The net worth measure is the residual of the market value of assets and liabilities of the households in our sample. Chart 2 displays the average household net worth for selected age groups in 1977 and 1983.

From Chart 2, it is apparent that, on average, nominal net worth rose for all but the youngest category of households between 1977 and 1983. This is not particularly surprising since nominal income — at least for households as a group — was rising during this inflationary period. The life-cycle savings theory offers an explanation of the relationship between *real* wealth and *real* lifetime or permanent income: as nominal incomes rise, so should nominal net worth, everything else being equal.[21]

Also apparent from Chart 2 is the change in the shape of the age/net worth relationship. In 1977, the net worth relationship was "humped", with measured net worth peaking somewhere near the prevailing retirement age. The existence of saving and wealth relationships that are "humped" with age are predicted by the life-cycle saving theory only at different ages of a given cohort. Since our data measures net worth at a *cross section* of age cohorts at two points in time, we would expect a "humped" age-net worth relationship only if all of the age groups in our sample had the same life-cycle income expectations.[22]

In general, however, growth in life-cycle income over time (as would be expected in a growing economy) should cause each successively younger cohort to have higher life-cycle income expectations and, hence, higher observed accumulated savings per household. This would result in a skewing, over time, of the age/wealth distribution *toward younger individuals*. The data, in fact, show the opposite tendency. Specifically, the bar graph in Chart 2 presents net worth by age group as a percentage of the average household net worth for each of the two surveys. A significant *relative* shift in net worth per

Chart 2
Age – Distribution of Household Net Worth
1977 and 1983



* The difference between the 1977 and 1983 values is not statistically different from zero for this group at the 95% confidence level

household from young to older households is evident. In particular, between 1977 and 1983, families headed by individuals 55 years and older had increased net worth relative to the population while younger households displayed decreases. This drop is consistent with a relative secular deterioration in the lifetime income expectations of younger generations' households.

Homeownership and Wealth Changes

By decomposing average household net worth into its constituent elements, we find that a significant proportion of the observed increase in net worth between 1977 and 1983 is "explained" — in an accounting sense — by an increase in the value of residential real estate. As data from the Net Worth table indicates, the value of residential real estate per household increased sharply and represented nearly 75 percent of total asset changes between 1977 and 1983.

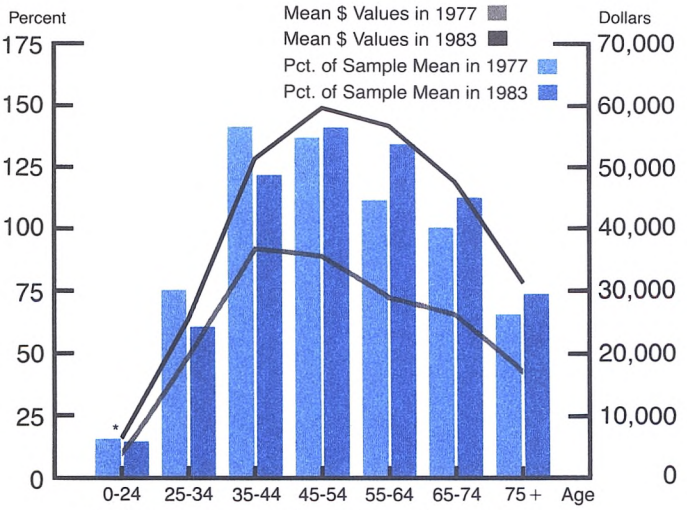
Furthermore, the mean value of residential real estate assets increased for all household age groups. Chart 3 shows that the average value rose from $29,870 in 1977 to $53,947 per household in 1983. The bar graphs in Chart 3, which express the nominal value as a percentage of the relevant sample means, reveal a skewing in the age-distribution of this asset toward older households that is similar, although less pronounced, to that observed for net worth in the aggregate (Chart 2). In addition, households in the 45-54 age category had consistently higher holdings of real estate assets relative to the sample mean in 1983 than in 1977, contrary to the finding for their total net worth.

Data on homeownership derived from the surveys also suggest that homeownership prospects deteriorated for younger households. The percentage of homeowners is greater in 1983 than in 1977 for all age categories except the youngest. In fact, the increase in homeownership observed in the oldest age groups is progressively greater for older groups.

Liquid Assets, Stocks and Bonds

Differences in liquid asset and stock and bond holdings also contribute significantly to the observed shift in the age-distribution of wealth toward older households. Chart 4 displays the distribution by age in the two samples of liquid assets (defined as the value of bank deposits, money market mutual fund shares and savings bonds) and holdings of other bonds and stocks. Once again, these measures are presented in bar graphs as a

Chart 3
Age – Distribution of Residential Real Estate
1977 and 1983



* The difference between the 1977 and 1983 values is not statistically different from zero for this group at the 95% confidence level

percent of the sample means in each of the two survey periods.

For both categories of financial assets, an interesting pattern emerges. First, generally speaking, households headed by individuals younger than 55 years of age actually hold less (in dollar terms) of these assets in 1983 than in 1977, whereas older households hold significantly more. This change is reflected in a shift in the age-distribution of the asset categories when household holdings are measured relative to sample means.

Among the older households, those aged 75 years and older display the smallest increase between 1977 and 1983. Data disaggregation by type of asset (not shown here) show that the position in stock and bond holdings of this age category deteriorated relative to the sample means in 1983. In contrast, the largest absolute and relative "gains" between 1977 and 1983 are displayed by households aged 65 to 74.

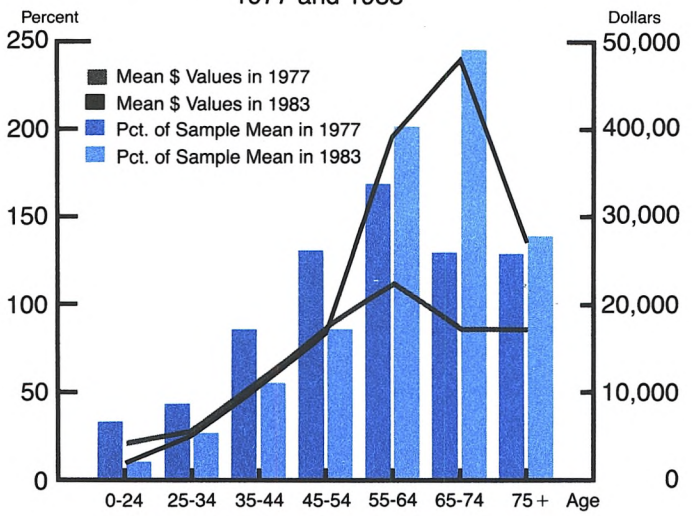
Lacking true panel data, it is not possible to explain this somewhat inconsistent behavior by the oldest (75 years and older) household category with any confidence. The pattern is consistent, however, with what one would expect if, upon retirement, households relocated their residences to areas with lower housing costs than those in which they lived while employed. They then would have been able to "capture" a portion of the net worth in real estate and increase their holdings of financial assets. The oldest households (those aged 75 years and older) may already have made their relocation decisions and, in the time frame of our study, "missed" the opportunity to capture increases in housing value.[23]

Such a scenario may help explain the seemingly paradoxical finding discussed earlier that the age-distribution of residential real estate assets did not shift as dramatically as net worth in favor of older households despite increases in rates of home-ownership. The economic conditions of the late 1970s and early 1980s simply afforded retirement-aged households the opportunity both to capture appreciated real estate values and to increase home-ownership by migrating to lower cost areas.

Mortgage and Consumer Debt

Growth in mortgage and consumer debt liabilities of the average household were a significant — but far from complete — offset to the growth in the average value of household assets. As the Net Worth table indicates, changes in average mortgage and consumer debt liabilities constituted only 20 percent of the total increase in asset holdings observed between 1977 and 1983. Charts 5 and 6 show that

Chart 4
Age – Distribution of Stocks, Bonds and Liquid Assets
1977 and 1983



nominal mortgage and consumer debt increased for virtually all age categories between 1977 and 1983. In addition, as illustrated by the bar graphs (which display these nominal values as a percentage of sample means), there was a greater propensity for older households to hold both categories of debt in 1983 than in 1977.

That is, the age-distribution of debt, as well as of wealth, shifted toward older households. This shift is consistent with the notion that the demand for debt is positively related to wealth,[24] and with the notion that older households may have been borrowing against equity in relatively illiquid real estate assets to make other desired changes in their portfolio or consumption habits.

Unfortunately, a conceptual problem in the measurement of the market value of mortgage debt makes it difficult to be confident about these findings. In particular, the mortgage measure used here is the book value of outstanding debt rather than its market value. Since interest rates increased significantly between the survey periods, it would be desirable to re-value fixed coupon debt outstanding in 1983 accordingly. Everything else being equal, this re-valuation would tend to reduce the value of mortgage debt held, particularly the debt in the form of older, low-coupon mortgages typically held by older households.

The problem for our analysis is one of potential double counting. Since many of these low-coupon mortgages also were assumable, the estimates of

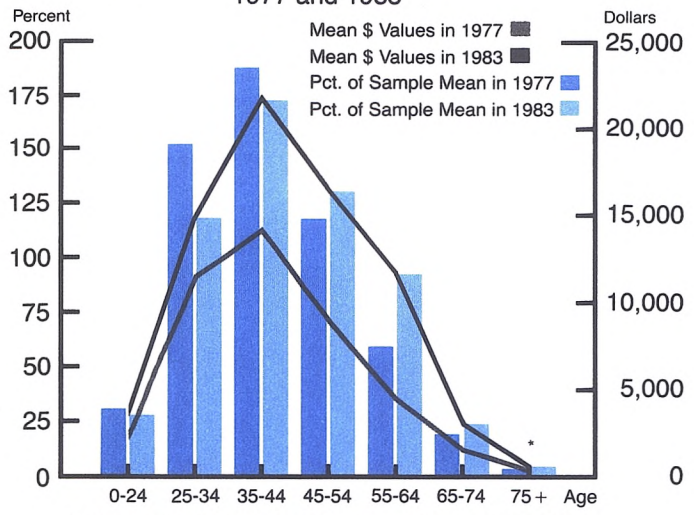
Average Household Net Worth and Its Components, 1977 and 1983

	1977	1983	Difference
Assets			
Total Assets	$43,262	$76,614	$33,352
Total Real Estate	29,870	53,947	24,077
Liquid Assets	8,292	11,607	3,315
Stocks	4,288	5,641	1,353
Bonds	812	2,347	1,535
Other	N/A	3,072	N/A
Liabilities			
Total Debt Liabilities	9,123	15,858	6,735
Real Estate Debt	7,465	12,568	5,103
Consumer Debt	1,658	3,399	1,741
Net Worth	34,139	60,755	26,616
n =	2,563	3,823	

Source: Federal Reserve System, Surveys of Consumer Finances, 1977 and 1983.

Chart 5

Age – Distribution of Mortgage Debt
1977 and 1983



* The difference between the 1977 and 1983 values is not statistically different from zero for this group at the 95% confidence level

home value reported by households may include a premium that represents the households' ability to sell their property with an assumable, low-coupon first mortgage.

Thus, although the data are available in the surveys to estimate the market as well as the book value of outstanding mortgage debt, we do not report those computations here.[25] Reporting those computations also would simply reinforce the observed overall changes in the age-distribution of net worth in favor of older households. In addition, a similar pattern in the age-distribution of debt holding for consumer debt (which is typically of shorter term and therefore has a book value that may approximate its market value despite interest rate changes) lends further support to our finding that the demand for at least certain categories of debt appears positively related to household wealth.

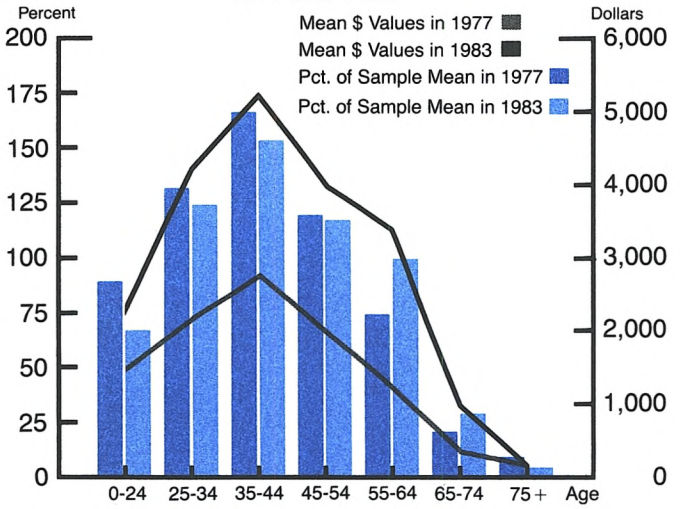
IV. Other Observations

The finding that the distribution of household net worth has shifted in favor of older households is only one measure of the changing economic circumstances of older Americans. It also is interesting to examine the average incomes to households of different ages. The available data suggest that the income position of older households also has been improving steadily relative to younger households. In Chart 7, for example, the mean family income for families headed by someone 65 years of age and older is compared with that of younger families. Relative to the average income of all families, the average incomes of older households have increased dramatically in the last decade or so, whereas the relative incomes of younger households have declined.

The incidence of extreme poverty among the elderly also has declined. In Chart 8, the percent of households of various age groups living below the officially defined poverty level is plotted. Those families headed by someone 65 years and older enjoyed (as of 1984) the lowest incidence of poverty of any age group. In addition, the incidence of this measure of poverty declined by 20 percent between 1977 and 1984 for those older than retirement age; the incidence of poverty increased — sharply in some cases — for all younger households over the same time period.

It should be emphasized that none of these findings is based on a direct measure of changes in the level of well-being of older versus younger Americans. Older households face considerable uncer-

Chart 6
Age – Distribution of Consumer Debt
1977 and 1983

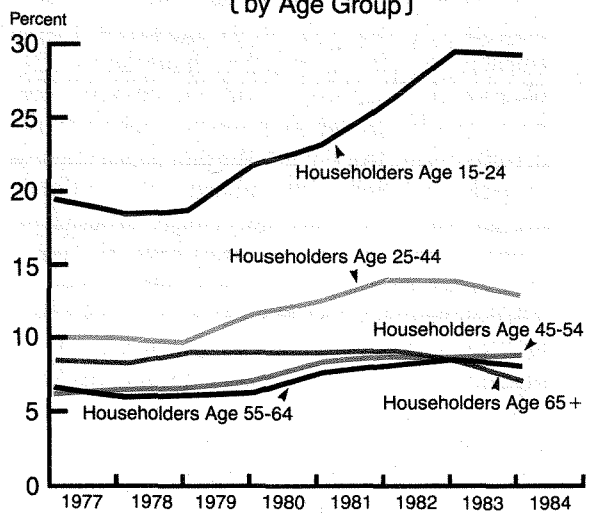


tainty about inflation, their future health, the reliability of Social Security programs, and other influences on the quality of their lives. In addition, the "average" measures presented here do not provide information on the disparities in net worth or income that may exist *within* an age category.

Nevertheless, the data are consistent with the view that changes in Social Security programs and inflation — particularly as inflation affected the housing market — benefitted older households. Not only do the incomes of older households appear to be rising relative to younger households, the observed skewing in the pattern of net worth toward older households is consistent with the view that older households have enjoyed enhanced *lifetime* income expectations.

Chart 8

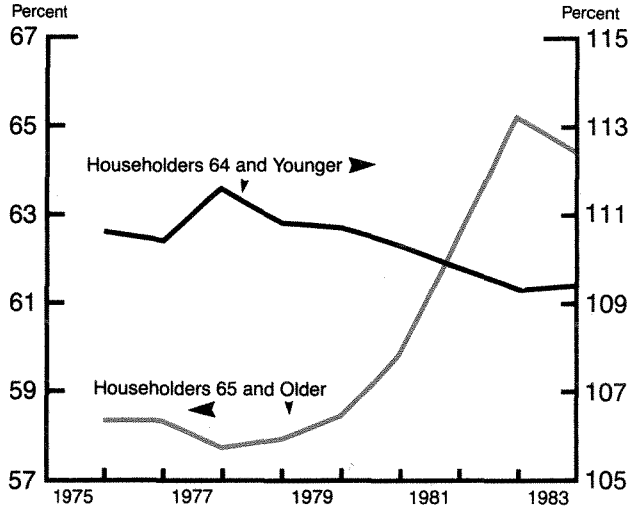
Percent of Households with Income Below Poverty Level (by Age Group)



Source: U.S. Bureau of the Census
Current Population Reports, Series P-60

Chart 7

Household Income by Age Group as a Percent of the Mean Income of All Households



Source: U.S. Bureau of the Census
Current Population Reports, Series P-60

V. Conclusions and Policy Implications

In summary, our data reveal a significant shift between 1977 and 1983 in the age-distribution of financial wealth toward older households. This observation is consistent with the changing economic conditions and increases in Social Security benefits during that time.[26] The data do not allow us to ascertain whether the dramatic shift occurred because the beneficiary age groups believed the economic changes were transitory (causing them to save rather than spend out of windfall gains) or whether they believed them to be permanent enhancements to their income and wealth at the expense of younger age groups. Even if the latter were the case, the higher-than-average net worth observed for even the most elderly age groups may reflect a desire to make a compensating bequest to the younger households.

What is clear from the Survey of Consumer Finances is that, as of 1983 at least, older households on average were not a disadvantaged group with respect to financial net worth. Indeed, household wealth became an increasing function of the age of the household. This observation, coupled with data from other sources that show changes in the poverty rate and average household income favorable to older households, suggests that the conventional view that older households should receive greater income transfers may be outdated. Given the significance of programs directed at assisting older groups in the federal budget, this observation may imply that changing the level or structure of these programs could be part of an equitable solution to the problem of federal budgetary imbalance.

FOOTNOTES

1. Edward Foster, "Costs and Benefits of Inflation," Federal Reserve Bank of Minneapolis, March 1972.

2. Conceptually, the accumulated stock of human capital also should be embodied in any definition of a societal "wealth" measure. Colloquially, however, the term wealth is employed to describe accumulations of money or property net of claims on those assets — (or, more formally, net worth). Our analysis focuses only on the nonhuman aspects of wealth. In keeping with colloquial usage, terms "wealth" and "net worth" will be used interchangeably to refer to the net value of accumulated nonhuman assets and financial liabilities. An analysis of changes in the broader concept of wealth (namely, one that includes changes in accumulated human capital), while potentially more relevant to a formal study of changes in economic well-being, is not feasible with the available data.

3. Bureau of Labor Statistics, U.S. Department of the Census data.

4. In 1974, special supplementation income (SSI) also was begun for the poor, aged, blind and disabled. The rate of increase in these benefits has been modest, with average monthly benefits only doubling between 1974 and 1984.

5. See, for example, Duesenberry, J. S., *Income, Saving and the Theory of Consumer Behavior,* Cambridge: Harvard University Press, 1949.

6. The life-cycle saving hypothesis and the permanent income hypothesis were articulated at approximately the same time. See, for example, Friedman, Milton, *A Theory of the Consumption Function,* New York: NBER, 1957; Modigliani and Brumberg, "Utility Analysis and the Consumption Function," in *Post-Keynesian Economics,* New Brunswick, New Jersey: Rutgers University Press, 1954; and Ando and Modigliani, "The Life Cycle Hypothesis of Saving," *American Economic Review,* March 1963, pp. 55-84.

7. See Ando and Modigliani, *ibid.*

8. This is because the rate of interest at which an individual can borrow and save influences his ability to smooth consumption optimally in response to stochastic changes in income flows, whereas the rate of time preference is the implicit "discount rate" which the individual uses to evaluate consumption flows in present terms.

9. The theoretical conditions necessary to produce this pattern are discussed in King, M. A. and Dicks-Mireaux, L., "Asset Holdings and the Life Cycle," *The Economic Journal,* June 1982, pp. 247-266.

10. This is discussed in some detail in Pozdena, R. J. "Inflation Expectations and the Housing Market," *Economic Review,* San Francisco: Federal Reserve Bank of San Francisco, Fall 1980.

11. See Blinder, Gordon, and Wise," Social Security, Bequests and the Life Cycle Theory of Saving," National Bureau of Economic Research, Working Paper No. 619, January 1981.

12. *Flow of Funds Accounts,* Board of Governors of the Federal Reserve System, 1985.

13. A watershed legal case in California, *Wellenkamp v. Bank of America,* was decided in favor of a mortgage borrower who attempted to sell her home without retiring the mortgage as called for by the "Due-On-Sale" clause in the mortgage instrument. Virtually throughout the period studied in this paper, the Due-on-Sale clause, while present in most mortgages, was voided or of uncertain legal status, permitting sellers of homes to provide implicit below-market financing for buyers.

14. See Blinder, *et al, op cit.*

15. Martin Feldstein, "Social Security, Induced Retirement and Aggregate Capital Accumulation", *Journal of Political Economy,* 1974, pp. 905-926.

16. Robert Barro, "Reply to Feldstein and Buchanan," *Journal of Political Economy,* April 1976, pp. 343-349.

17. The complexity of the computation of net expected Social Security wealth and its dependency upon age, income and family structure is well illustrated by the simulation performed in A. Pellechio and G. Goodfellow, "Individual Gains and Losses from Social Security Before and After the 1983 Amendments," the *CATO Journal,* Fall 1983, pp. 417-442.

18. The Retirement History Survey (RHS) conducted by the Social Security Administration between 1969 and 1979 followed a sample of near-retirement individuals, and accumulated data on prior work, health and wealth circumstances as well as pre- and post-retirement consumption and saving behavior. This survey has proved very useful in testing a number of hypotheses about retirement, but the detail and reliability of the financial asset data and the particular age group studied do not make it useful here. However, it does permit interesting (though somewhat dated) analyses of a particular age cohort's pre- and post-retirement income. See M. Boskin and J. Shoven, "Poverty Among the Elderly, Are There Holes In The Safety Net?" NBER Working Paper No. 1923, May 1986, who find that there are "pockets" of problems within a generally comfortable retired population. The Michigan panel survey also assembles data on a variety of variables regarding household behavior on a frequent basis. Unfortunately, the financial asset data in this survey is relatively crude.

19. The data sources are the 1977 and 1983 Surveys of Consumer Finances, jointly sponsored by the Federal Reserve Board, the Department of Health and Human Services and five other federal agencies. The surveys were random samples by household; in 1983 a special additional survey of high income households was conducted. This nonrandom sample is not employed in our study. For details on the surveys, see the series of articles by Robert Avery *et al,* in the *Federal Reserve Bulletin,* September 1979, December 1984 and March 1986.

In 1977 total assets consisted of (1) value of the family's home, (2) value of other properties, (3) liquid assets, (4) stocks, and (5) bonds. Detail within these categories varied across surveys. For example, in 1983 separate categories for notes and land contracts, trusts and investment accounts, and other assets were isolated.

Total liabilities included mortgages on homes and other properties and consumer debt defined as (1) installment debt, (2) single payment loans, and (3) credit card debt. These variables were constructed directly from survey detail.

In 1983, an outlying observation was eliminated because during the process of computing aggregate variables we observed reported bond holdings in excess of twelve million dollars for tax-free bonds and stock holdings in excess of three million dollars. These were deemed to be unreliable estimates and would have arbitrarily biased our analysis.

For details on the surveys, see the series of articles by Robert Avery *et al*, in the *Federal Reserve Bulletin*, September 1979, December 1984 and March 1986.

20. See Feldstein, *op cit*, for example.

21. Indeed, one of the difficulties encountered in attempts to explore the shape of the age cohort relationship in wealth using cross-section data is design of the appropriate "real life-cycle income" measure. See, for example, King and Dicks-Mireaux, *op cit.*

22. That is, the cross-section age-distribution of wealth must be "deflated" by cohort-linked changes in life cycle income expectations. For a "humped" age-distribution of wealth to be taken as evidence of a humped pattern over the life-cycle, it must be assumed that all age groups have the same life-cycle income expectations.

23. The opportunity is "missed" on the assumption that households, upon retiring, tend to become increasingly fixed in their residential location, particularly with advancing age.

24. Dunkelberg, W. and Stafford, F., "Debt in the Consumer Portfolio," *American Economic Review*, September 1971, pp. 598-613.

25. In particular, the possibility exists that during the time period of our study, because of widespread assumability of mortgages, perceived home values and actual transactions prices capitalized, at least partly, the difference between book and market value of the assumed mortgages.

26. An interesting direct study of the effect of Social Security on wealth accumulation in the aggregate, however, is available in Feldstein, M. and Pellechio, A., "Social Security and Household Wealth Accumulation: New Microeconomic Evidence," *Review of Economics and Statistics*, 1979, pp. 361-368.

Policy Coordination and Financial Intermediaries

Michael C. Keeley and Carl E. Walsh*

Summary of proceedings from the 1986 Fall Academic Conference sponsored by the Federal Reserve Bank of San Francisco.

On November 20 and 21, 1986, the Federal Reserve Bank of San Francisco held its annual Fall Academic Conference. This conference provides a forum for academic and business economists, together with the staff economists of the Federal Reserve Bank of San Francisco, to discuss recent academic research on topics of current policy interest.

The 1986 conference focused on two topics. The first, macroeconomic policy coordination, is a topic that has figured prominently in recent discussions of the United States' monetary policy. Frequently during 1986, commentators linked the Federal Reserve's setting of the discount rate to attempts to coordinate interest rate cuts with Japan and West Germany. The Reagan Administration also expressed a desire to coordinate U.S. monetary and fiscal policy with more expansionary policies in Japan and W. Germany as a means of reducing the U.S. trade deficit. Two papers and a panel discussion during the first day of the conference examined various aspects of international policy coordination. A third paper examined domestic policy interaction between independent monetary and fiscal authorities.

Financial intermediaries and their role in the economy comprised the second topic discussed at the conference. The course of financial innovation and deregulation over the last decade in the U.S. has brought to prominence several important policy issues related to banking regulation and the responsibility of the Federal Reserve to maintain the stability of the financial system. Five papers presented at the conference addressed issues related to the role of financial intermediaries in the economy, specifically those important to the debate over the appropriate scope of and need for financial regulation and ways of reforming our current regulatory system.

This article contains a brief survey of the papers presented at the 1986 Fall Academic Conference with an emphasis on their policy implications. Copies of any of the individual papers may be requested by writing to Public Information, Federal Reserve Bank of San Francisco, 101 Market Street, San Francisco, California 94105.

I. Policy Coordination

Recent developments in the analysis of macroeconomic policy have emphasized the role played by expectations about future policy actions. In particular, the impact of current policy on the economy can be influenced by the private sector's expectations about future policy. The influence of expectations raises two issues: first, whether we can understand the effects of current economic policy without an explicit understanding of how policy is likely to be determined in the future; second, whether policymakers can influence the economy by announcing that they will take certain actions in the future.

These issues are particularly important when trying to understand economic policy in the presence of two or more independent policy authorities. Recent concern in two areas highlight the timely relevance of research on the interactions among policy authorities. In this nation, where authority for fiscal and monetary policy resides in separate institutions, some authors have expressed concern

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over the extent to which the Federal Reserve might be forced by fiscal inaction to monetize the growing federal debt. On the international scene, where policy decisions taken by one country can affect the policy choices open to other countries, much attention has been placed on recent attempts by the U.S. to reduce the American trade deficit by persuading Japan and W. Germany to stimulate their economies.

Money, Deficit and Public Debt: An Empirical Investigation

by Guido Tabellini and Vincenzo La Via

The paper by Guido Tabellini of UCLA and Vincenzo La Via of the World Bank entitled "Money, Deficit and Public Debt: An Empirical Investigation" focuses on the joint behavior of domestic monetary and fiscal authorities. Recent theoretical work has emphasized that the relationship between macroeconomic variables, such as real interest rates and the current budget deficit, will depend critically on the expectations the public holds about the course of future budget deficits. These expectations will, in turn, depend on future monetary and fiscal policy. Therefore, to analyze the impact of current and projected federal budget deficits, for example, it would be necessary to forecast how the Federal Reserve and the Congress are likely to act in the future. Specifically, will the Federal Reserve eventually generate renewed inflation by monetizing future deficits, or will Congress be forced eventually to raise taxes to reduce the debt?

To forecast future monetary and fiscal policy, it is necessary to understand how relatively independent policy authorities will interact. Such interaction may be particularly complex when, as seems likely, the policy authorities have conflicting objectives. In such an environment, Tabellini and La Via take the view that "future policies must be viewed as the equilibrium outcome of a dynamic game between the two authorities."

The game that the authors model separates the strategic interaction of the monetary and fiscal authorities into two stages. In the first stage, each authority chooses an optimal path for the policy instrument under its control in order to achieve its macroeconomic objectives without considering the choices being made by the other authority. The policy instruments in the United States consist of the monetary base for the central bank and the cyclically adjusted fiscal deficit net of interest for the fiscal authority. In the second stage, each policy authority attempts to achieve the best trade-off between keeping its policy instrument close to the value that achieves its macroeconomic objectives and minimizing deviations of the stock of public debt from a desired target.

The second stage of this game is made interesting by the dynamic government budget constraint that links the debt to the actions of the monetary and fiscal authorities. The fiscal policymaker can lower the debt held by the public by choosing to run a budget surplus, but this course of action may conflict with the fiscal stance necessary to achieve the reference path. The monetary authority can reduce the debt held by the public by monetizing it, but this choice may conflict with the path of the monetary base necessary to achieve goals such as price stability.

The solution to this game yields a set of equations that describe the behavior of the monetary base, the noncyclical fiscal deficit, and the stock of debt held by the public. The heart of the authors' theory lies in the restrictions the theory implies for the coefficients in the equations for the base, the deficit, and the debt. Most importantly, these coefficients depend on the parameters characterizing the weight each policymaker gives to achieving its desired value for the debt.

If the fiscal authority cares about achieving its target for debt, while the monetary authority does not, then the monetary authority will set its instrument to achieve its macroeconomic objective without regard to the debt and the fiscal authority will be forced to give up its desired reference path in order to keep the total debt near the desired target. Conversely, if the monetary authority cares about the debt target and the fiscal authority does not, the monetary authority will be forced to sacrifice such macro goals as low inflation, for example, in order to achieve the target level of the debt. These two alternative outcomes represent the extremes in which one policymaker or the other dominates. The actual outcome will depend on the relative weight each authority places on its policy objectives.

A chief purpose of the Tabellini and La Via paper is to provide a framework for empirical analysis that might allow these weights to be estimated. The

framework would then allow a conclusion to be drawn as to whether U.S. policy is best characterized as a game in which the monetary authority dominates or one in which the fiscal authority dominates.

The main finding of the paper is that the burden of stabilizing public debt during the period 1955-1985 fell on the fiscal authority. The authors conclude that "there is no evidence of debt monetization on the part of the monetary authorities, while instead there is strong evidence that fiscal deficits were reduced when the stock of public debt inherited from the past increased." In other words, the evidence suggests that the Federal Reserve has not, in the past, tended to monetize government debt. Other findings are that both fiscal and monetary policy tend to be more expansionary under Democratic administrations, and that there is evidence of a political business cycle in both monetary and fiscal policy related to national elections.

Comments *by Steve Sheffrin*

Steve Sheffrin of the University of California at Davis raised three issues in his comments on the Tabellini and La Via paper. First, he questioned the division of the policy game into two separate stages. In particular, he felt that it seems unreasonable to expect policy authorities to act in the first stage as if they were totally unaware of the second stage of the game. Tabellini agreed that this separation was somewhat artificial, but argued that it allowed the analysis to be greatly simplified.

Second, Sheffrin expressed concern about the use of the cyclically adjusted federal budget deficit as the fiscal policy instrument. He claimed the use of the deficit ignores the choice between spending changes and tax changes.[1] In addition, the use of a cyclically adjusted deficit was not introduced into macroeconomic policy discussions until the 1960s so he believed that its use in the empirical work as a measure of the fiscal policy instrument for the entire 1955-1983 period may be inappropriate.

Finally, Sheffrin questioned whether Tabellini and La Via had really succeeded in estimating structural parameters that can be used as guides to understanding future policy. In particular, he referred to parameters estimated by Tabellini and La Via which they describe as representing the preferences of the monetary and fiscal authorities. To Sheffrin, it seemed unlikely that such preference parameters would remain unchanged as the personalities of the individuals determining policy changed. Tabellini noted that an attempt was made to test for parameter stability over the sample period, and that dummy variables were included in the empirical analysis to capture the effects of changes in the chairmanship of the Federal Reserve. The results suggested monetary policy was most restrictive under William Martin's chairmanship.

Noncooperative Monetary Policies in Interdependent Economies

by Matthew Canzoneri and Dale Henderson

Tabellini and La Via examine only the Nash equilibrium to their dynamic policy game; they do not consider how the outcomes might be affected if the monetary and fiscal authorities can coordinate their policies or build reputations for "good" behavior. The role of such reputation building is one of the central foci of the Conference's second paper, "Noncooperative Monetary Policies in Interdependent Economies: Time Inconsistency and Reputation" by Matthew Canzoneri and Dale Henderson, both of Georgetown University. The paper represents a chapter from the authors' forthcoming book, *Noncooperative Monetary Policies in Interdependent Countries*.

Like Tabellini and La Via, Canzoneri and Henderson employ a game-theoretic framework to study the interaction of two policy authorities. However, Canzoneri and Henderson shift the focus from the domestic interaction of monetary and fiscal authorities to the international context in which the different policymakers are the monetary authorities in different countries. The authors argue that one can obtain misleading conclusions from models with only one active policy authority and illustrate their argument with an example. In their example, a requirement that policy be pre-committed to certain actions necessarily leads to better outcomes when only one policymaker is active but may lead to worse outcomes when two policymakers are active.

Canzoneri and Henderson note that if the current behavior of private agents depends on their expectations of the future, credible announcements about future policy instrument settings may provide pol-

icy authorities with an extra instrument for affecting the current values of their target variables. Thus, the ability to pre-commit to future actions increases the number of effective policy instruments available to policymakers. The authors examine the role of pre-commitment within the context of a two-country model in which monetary policies in the two countries can be either cooperative or noncooperative.

As a framework for their analysis, the authors use a model in which each monetary authority cares about employment and price volatility in its own country. The price the authority cares about, however, corresponds to the Consumer Price Index (CPI) — an average of the price of home goods and the home price of foreign goods — which is affected by monetary policy actions in the other country through the real exchange rate.

For example, a rise in the home country's money supply raises the price of home output and further raises the home CPI by causing the home country currency to depreciate in real terms. This depreciation comes about because an increase in the home money supply lowers real wages, given that nominal wages are predetermined by contracts, thereby causing home output to rise and creating an excess supply of domestic output. The home currency must depreciate in real terms to raise demand for domestic output and restore equilibrium in the market for home output. While a domestic monetary expansion raises the home CPI, the associated real depreciation of the home currency lowers the foreign CPI.

In the Canzoneri and Henderson model, credible announcements about future monetary policies affect current CPIs because they affect expected real exchange rates. This connection depends critically on the assumption that wage contracts last for more than one period.[2] The existence of multi-period wage contracts imparts a short-run rigidity to wages that allows announced monetary policy actions to have real effects.

Canzoneri and Henderson then show how pre-committing to future policy actions in the absence of cooperation among policymakers can be undesirable. They cite the case of a symmetric disturbance in which each policymaker will consider responding with the two tools available: the current money supply and a commitment for next period's money supply. Since Canzoneri and Henderson assume that the monetary policymakers in the two countries also respond symmetrically, their commitments to change next period's money supplies are counterproductive. Their symmetric pre-commitments have no effect on this period's employment and CPIs because the pre-commitments leave the expected real exchange rate unchanged. The only effects of the pre-commitments are undesirable changes in the next period's CPIs. According to this model, each policymaker makes a counterproductive commitment to change next period's money supply because if he did not, the other policymaker would make a commitment that would leave him in an even worse position.

In his presentation at the Conference, Henderson developed a four-way classification of policy according to whether cooperative or noncooperative behavior and pre-commitment or no pre-commitment are involved. He then argued that two combinations — noncooperative behavior with no pre-commitment and cooperative behavior with pre-commitment — were the most relevant options for future study. In most cases, cooperation among policy authorities, together with pre-commitment to future policy, is likely to yield the best results since, as Richard Sweeney of Claremont McKenna College, the paper's discussant, pointed out, cooperation maximizes the economic pie and pre-commitment maximizes the number of instruments available to the policy authorities.

Canzoneri and Henderson also consider what happens when the policymakers interact in an infinite sequence of two-period games. In this situation, the policymakers can establish reputations for good behavior. Over an infinite succession of two-period games, noncooperative behavior without pre-commitment may result in what can usefully be called the efficient outcome, that is, the outcome that would result with cooperative behavior and pre-commitment in a single two-period game. The inefficient outcome is the outcome that would result with noncooperative behavior and no pre-commitment in a single two-period game.

In playing the succession of games, each policymaker thinks that if he does not cheat, the other policymaker will continue to choose the policy associated with the efficient outcome, and that if he does cheat, the other policymaker will revert to the

policy associated with the inefficient outcome for some number of two-period games in the future, perhaps forever. Each policymaker would choose the policy associated with the efficient outcome only if the future reward for not cheating were high enough. The Canzoneri and Henderson analysis suggests that when reputation building is possible, the outcomes of noncooperative behavior without pre-commitment may not be inefficient.

Comments *by Richard Sweeney*

In discussing Canzoneri and Henderson's paper, Richard Sweeney felt that actual experience with policy coordination suggests that policy authorities have usually tried to get other countries to follow bad policies. In addition, policy authorities may have preferences that differ from those of private agents — a point of view emphasized in recent theories of public choice.

An Econometric Evaluation of International Monetary Policy Rules

by John Taylor

Whereas the Henderson and Canzoneri paper provided a theoretical framework for analyzing policy coordination, the purpose of the conference's third paper, "An Econometric Evaluation of International Monetary Policy Rules: Fixed versus Flexible Exchange Rates" by John Taylor of Stanford University, was to report on a model designed to evaluate alternative policy regimes empirically. This paper represents part of an ongoing research project by Taylor that involves the estimation of a rational expectations model of seven industrial countries — the U.S., Canada, France, Germany, Italy, Japan and the United Kingdom. Taylor strongly argued that even if agreement were reached on the theoretical effects of disturbances in open economies, estimates of the empirical magnitudes involved would remain crucial for actual policy analysis.

Taylor attempts in his paper "to evaluate and compare flexible versus fixed exchange rate systems using a rational expectations policy evaluation technique . . ." The estimated multi-country model he uses is subjected to random shocks, first under the assumption of flexible exchange rates and then under the assumption of fixed exchange rates. He then evaluates the two different exchange rate systems by comparing the fluctuations in output, prices, imports, and exports under each system. His results seem to indicate that economic fluctuations would be smaller under a flexible exchange rate system.

Taylor's evaluation of the exchange rate regime focuses only on aggregate supply disturbances. At this stage of the research project, Taylor has not fully evaluated the two exchange rate systems in the face of aggregate spending and financial market disturbances. Also, he makes very specific assumptions about monetary policy and fiscal policy to compare fixed and flexible exchange rates. Under both systems, he holds fiscal policy constant. Under the flexible rate system, he assumes that all seven countries in the model hold constant the rate of growth of their money supplies. In contrast, under the fixed rate system, he assumes that the U.S. holds its money growth rate constant while the other six countries allow whatever money supply movements are necessary to keep their exchange rates fixed.

Taylor compares these alternative exchange rate systems using a model characterized by two important features. First, the aggregate wage level is modelled as determined by the existence of multi-period, overlapping contracts of the type studied by Taylor in earlier work.[3] The wage equations are estimated for the United States, and the wage equations in the other six countries are then assumed to be the same as that for the U.S. Second, the model assumes perfect capital mobility as reflected in its requirement that deviation from uncovered interest parity be zero on average. This requirement means that the differential between interest rates in each country must equal the expected change in the exchange rate. In Taylor's model, therefore, this interest rate parity condition and the wage equations are two channels through which expectations of the future influence the economy's current equilibrium.

The presence of expectations of future variables, together with the assumption that these expectations are rational, greatly complicates the derivation of the policy simulations. Within Taylor's model, the solution for the current period depends on expectations of next period's equilibrium, which depends on expectations of the following period's equilibrium, and so on. Hence, to simulate the model for

even one quarter requires that the model be solved into the distant future to ensure that the expectations of the future are consistent with the actual future behavior implied by the model.

In addition to providing a comparison of alternative exchange rate regimes in the face of supply shocks, Taylor's paper also reports the estimated effects of unanticipated U.S. monetary and fiscal policy changes. He examines the effects of these policy changes under both fixed and flexible exchange rates.

Under flexible exchange rates, Taylor shows that a U.S. monetary expansion raises U.S. real output during the first year of the expansion; output then returns to its baseline level over the next two years, reflecting the long-run neutrality of money. The dollar depreciates in response to the monetary expansion in this simulation, but the effects of U.S. monetary expansion on other countries are small. The rise in domestic output raises U.S. demand for imports, which causes some output expansion in the other countries, but this foreign expansion is dampened by the dollar depreciation that shifts demand to U.S. output.

According to Taylor, when a fixed exchange rate regime is in operation, a similar U.S. monetary expansion produces a large expansion in the other countries. In contrast to the flexible exchange rate case, the other countries must keep their currencies from appreciating relative to the dollar under fixed exchange rates. To do so they must let their money supplies expand. These induced monetary expansions lead to the greater output effects Taylor finds with fixed rates.

Taylor finds a similar contrast in the effects of a U.S. fiscal expansion under fixed and flexible exchange rates. Under flexible exchange rates, he finds that an increase in U.S. government expenditures produces a dollar appreciation and a trade deficit for the U.S. that leads to some real expansion in the other countries in the short-run. In contrast, under a fixed exchange rate system, he finds that a U.S. fiscal expansion leads to a sharp contraction abroad as the other countries are forced to reduce their money growth to keep exchange rates from changing. While these results agree qualitatively with standard open economy theoretical models, Taylor's research yields estimates of the quantitative magnitudes involved.

Comments *by Roger Craine*

Roger Craine from the University of California, Berkeley, was the discussant of Taylor's paper. Craine applauded Taylor's approach to policy evaluation in which the behavior of a model representing an economy or policy regime is studied while it is disturbed by random shocks.

Craine did, however, question whether the parameters of Taylor's model would remain unaffected by a shift in the exchange rate regime. In his empirical work, Taylor does account for changes in the way expectations of the future are formed when the exchange rate regime shifts, but other aspects of the model, such as the average length of wage contracts, are assumed to remain unchanged.

One method for testing the stability of the model over exchange rate regime shifts was suggested by Craine. Since the model was estimated over a period of flexible exchange rates with data from the period 1971 to 1985 used in the estimation, Craine noted it should be possible to use the model to "forecast" backward. One could then see if the model is able to fit the period of fixed exchange rates prior to 1971.

First Day Panel Discussion

The first day of the Conference concluded with a panel discussion on policy coordination. Panel members were Peter B. Clark, Acting Division Chief of the International Monetary Fund (IMF), Professor Robert W. Clower of the University of South Carolina, H. Robert Heller, member of the Board of Governors of the Federal Reserve System, and Professor Thomas Willett of Claremont Graduate School.

Peter Clark began the discussion by reviewing the role played by the IMF in international policy coordination. He explained that the role is played at two levels. First, at the bilateral level, the IMF focuses on the policies of one country in relation to the rest of the world. Since most countries are "small", the focus at this level is on the impact of external factors on the country's domestic economy. For "large" countries such as the U.S., IMF discussions focus on the impact of that country's domestic policy on the rest of the world. Clark cites discussions with U.S. policymakers over the impact of fiscal deficits on world interest rates as an example of the difficulties inherent in policy coordination when policy-

makers hold different views about the true workings of the world economy.

Second, at the global level, the IMF focuses on multilateral coordination of policy and provides a forum through which countries can exchange information on economic forecasts and policy assumptions. Clark's example of an issue addressed at this multilateral level was the problem of managing world aggregate demand in the face of declining world fiscal deficits.

Robert Clower emphasized that, in the absence of a better understanding of how economies work at the macro level, discussions of policy coordination are of little value. Such coordination requires forecasts of where economies are headed, but he stated that economists are simply not capable of providing believable forecasting models of real economies. In this situation, Clower believes, policies are usually based on "faith, hope, and bias."

Clower also argued that there is little short-run connection between demand, supply, and price in most markets. He felt that economists need to understand better how markets work before they worry about policy coordination.

In his remarks, Robert Heller praised the line of research presented in John Taylor's paper for its attempt to quantify some of the issues that are relevant for an evaluation of policy coordination. Heller drew a contrast between automatic regimes, such as the gold standard, and discretionary regimes, such as that which currently characterizes the international economy. He said that coordination was determined by rules in automatic regimes, and described discretionary regimes as characterized by "coordination by conference."

Heller argued that the desirability of flexible exchange rates will depend on the cost of reallocating resources within each country. He believed that small countries would tend to favor a fixed exchange rate system because rate adjustments are likely to be expensive for them. In contrast, he thought the large industrial economies would favor flexible exchange rates. Heller argued that a hierarchy of views exists. Among the U.S., Japan and Germany, for example, coordination may rely primarily on flexible exchange rates. Among Germany, France, and the U.K., greater reliance may be placed on fixed exchange rates within Europe and flexible rates with the rest of the world. In turn, each of these countries is likely to have a group of smaller nations, often former colonies, that fix their exchange rates against the larger country's currency.

Tom Willett emphasized that the disagreement among policymakers over the correct model of the world economy has played a major role in limiting past attempts to coordinate policy. He cited the recent revival of the locomotive argument, in which the U.S. wants Japan and W. Germany to expand more rapidly and thereby pull up the U.S. growth rate. Willett believed that one's view of the desirability and even effectiveness of such coordination depends on whether a Keynesian or monetarist model provides the more accurate view of economic movements.

Willett felt that the post-war record of avoiding "beggar-thy-neighbor" policies was fairly good. However, he also felt that recent discussions on coordinating policy to reduce exchange rate fluctuations have been misdirected. He believes that exchange rate stability, by itself, is not an appropriate objective of policy. International considerations can be important for monetary and fiscal policy formulations, but Willett stated the objective of policy coordination should be to promote overall economic stability and that this objective does not always correspond to a constant exchange rate. When macroeconomic policies themselves contribute to economic instability, he suggested that attempts to peg exchange rates within target zones may promote further instability.

II. Financial Intermediaries and the Economy

Many policymakers believe that financial intermediaries (that is, banks and thrifts) play a central and special role in the macroeconomy that is different from that played by other firms. This belief underlies the notion that maintaining the stability of financial intermediaries is key to ensuring a stable real sector and avoiding the economic downturns frequently associated with financial panics caused by bank failures. However, there has been a long-standing debate in the academic economics literature about just what it is that differentiates financial intermediaries from other firms, or even if they are different.

Some economists argue that banks' role in the macroeconomy is not inherently different from other firms even though banks undoubtedly provide valuable services. Proponents of this view believe that banking regulation is unnecessary and that an unregulated banking industry would be stable. To the extent banks currently have a special role, adherents of this view believe that this special role is a result of regulation, not a reason for regulation.

Others argue that banks are "special" because of externalities involved in the provision of payment and/or credit intermediation services. As a result, banking regulation is necessary to ensure the stability of the banking industry and the real economy. At a minimum, proponents of this view argue that some sort of federal protection is needed — in the form of either explicit or implicit deposit insurance — to prevent a systemic collapse of banking. Once such a guarantee is in place, they note that other sorts of regulations are needed to keep bank risk-taking in check.

A more complete understanding of the economic roles of banks and the influence of banks on the macroeconomy might have far-reaching implications for the regulation of the financial system and might well contribute to our understanding of the causes and effects of business cycles. Moreover, such understanding might have important implications for monetary policy.

The papers presented during the second session of the Conference contribute to our knowledge of these issues by analyzing the economic functions of banks (depository institutions), the relationship between banks and the macroeconomy, and the role of banking regulation.

Challenges in Deposit Insurance Reform

A Speech by Robert Parry

In a presentation entitled, "Challenges in Deposit Insurance Reform," Robert Parry, President of the Federal Reserve Bank in San Francisco, addressed one of the more pressing issues in bank regulation: reform of the deposit insurance system. He focused on how deposit insurance could be reformed in such a way as to eliminate the incentives it currently provides for excessive risk-taking while still preserving the ability of deposit insurance to prevent bank runs.

His topic is especially important in light of the rapid pace of financial innovation in recent years. Currently, bank regulation and supervision are the primary means used to keep bank risk-taking in check. Such oversight is needed because a virtual 100 percent deposit insurance guarantee essentially eliminates depositor surveillance — the mechanism through which market forces would restrict risk-taking in an unregulated environment. (In an unregulated environment, banks with more risky portfolios would have to pay higher interest rates on deposits.)

If banks were allowed to participate in the changing financial environment, it would be necessary to reduce restrictive regulation and maximize reliance on market incentives to keep risk-taking in check. The question then is whether it is possible to increase reliance on private market forces while still maintaining depositor protection to prevent bank runs.

Although Parry did not directly address the broader question of whether the banking industry would be stable in the absence of deposit insurance, he argued that there are ways of keeping the good features of deposit insurance — its ability to prevent runs — while at the same time minimizing the incentives it provides for excessive risk-taking. In particular, he argued for protecting the deposit insurance funds by shifting all of the risk of bank losses to bank equity holders.

He pointed out that although other approaches,

such as shifting risk to depositors, would increase market discipline, they would not provide protection against bank runs. In contrast, shifting risk to bank capital holders would simultaneously protect depositors and the insurance fund while eliminating the incentives for excessive risk-taking inherent in our current system.

To protect the insurance fund by shifting risk to capital holders, Parry proposed using market value accounting and closing banks before their market value could fall below zero when closure would result in losses to the insurance fund. He noted that such a policy might not be easy to implement, but that the costs of carrying it out would be less than the losses to the deposit insurance funds of not doing so. Moreover, failure to reform deposit insurance might result either in an expansion of the scope of insurance and the scope of regulation if banks were allowed to expand into new areas, or such severe bank regulations that many traditional banking functions would be undertaken outside the banking industry.

Discussion

The general discussion following Parry's speech focused mainly on the issue of whether deposit insurance was necessary — the implication being that if it were not needed, the easiest way to reform deposit insurance would be to eliminate it. However, there was little disagreement that if deposit protection were necessary, then some type of reform of deposit insurance is required.

Discussion then turned to the lender-of-last-resort function of the Federal Reserve as a potential replacement for deposit insurance. Some discussants pointed out that if the lender-of-last-resort function were used to prevent runs at failing (or failed) banks, the function would have the exact same incentives for excessive risk-taking as our current deposit insurance system. The lender-of-last-resort function would in effect maintain the federal guarantee of deposits and the undesirable incentives of deposit insurance for excessive risk-taking.

Some Evidence on the Uniqueness of Bank Loans

by Chris James

Although the discussion did not resolve the question of whether there is an inherent need for deposit insurance, a conference paper by Chris James of the University of Oregon shed additional light on one aspect of the issue: whether bank loans are special. James' paper, entitled "Some Evidence on the Uniqueness of Bank Loans," dealt with the questions of whether banks loans are somehow special and different from other types of credit. That is, whether bank loans are imperfect substitutes for other types of loans, such as public debt offerings.

The answer to this question has two important policy implications. First, if the credit intermediation services of banks were special, regulatory policies, such as 100 percent reserve requirements, that restrict the degree of bank-provided credit intermediation could be expected to have adverse consequences for the real economy. Second, if bank loans were special, a regulatory policy that ensured a stable provision of bank credit could have beneficial real economic effects.

In addition, monetary policy might have real effects even in a classical general equilibrium framework if bank loans were special. For example, if restrictive monetary policy reduced the degree of bank-provided financial intermediation, real economic activity as well as prices would decline. Thus, the James paper is of potential importance for both regulatory policy and monetary policy.

James examines two types of evidence supporting the uniqueness of bank loans. First, he analyzes the incidence of the reserve tax on bank certificates of deposit (CDs) to determine whether bank borrowers or bank depositors bear the reserve tax on CDs. Second, he compares the stock-price announcement effects of new bank credit with those of private placements and public straight debt offerings for a group of publicly traded banks.

James finds no evidence that bank depositors bear the reserve tax on CDs. First, James finds that CD rates do not differ significantly from other domestic open market rates with similar maturities. Second, when the reserve tax was increased between November 1978 and July 1980, there was no statistically significant decrease in the rate on CDs relative to the

rate on commercial paper or Treasury bills as might be expected if deposit holders bore the reserve tax.

These findings would seem to be compelling evidence that depositors do not bear the reserve tax and that CD deposits are perfect substitutes for other types of open-market instruments. More importantly, if the banking sector were competitive, these findings imply that bank borrowers must bear the reserve tax in the form of higher loan rates. If so, bank loans would be special in the sense that borrowers are willing to pay higher rates for them.

James also finds evidence supporting the uniqueness of bank loans in a comparison of the stock price responses of borrowing firms to the announcements of new bank loan agreements, private placements of debt (primarily with insurance companies), and public straight debt offerings.

James argues that bank loans might be special because they convey information to the market about the soundness of the borrowing firm. That is, the bank may have information about the firm that outside investors do not.[4] If so, one might expect announcements of bank loans to be associated with positive stock price effects while public debt offerings or private placements of debt would have no such effect.

As expected, James finds a positive stock-price response associated with the announcement of a bank loan that is larger than the stock-price responses observed for private placements and public straight debt offerings. In addition, the larger stock-price response associated with bank loan announcements does not appear to be attributable to any characteristic of the debt contract such as maturity, size of the loan, or differences in the type of borrower using each type of borrowing agreement.

James concludes that the stock-price evidence together with the incidence of the reserve tax on bank borrowers suggests that there must be something special or unique about bank loans. An implication of this view is that bank loans may provide a mechanism for reducing monitoring costs and agency costs and avoiding information asymmetries and the underinvestment problem associated with such asymmetries. Unfortunately, James' results offer no completely satisfactory explanation of the particular unique service or attribute of bank loans.

Comments *by David Pyle*

David Pyle of the University of California at Berkeley raised the following issues in his discussion of the James paper. First, he questioned the reliability of the evidence regarding the incidence of the reserve tax on CDs. He thought that pooling the data over a long period, as James did, might have problems because of changes in interest rate spreads that might have occurred because of factors not related to the reserve tax. He argued that, on statistical grounds, using shorter observation periods around the times of the actual changes in the reserve tax would be superior to pooling the data over the longer period.

Moreover, even if the findings of no change in the interest-rate spread held up, Pyle questioned whether one could conclude, as James does, that bank borrowers necessarily bear the reserve tax. For example, it is possible that bank owners might bear the tax if banking were not competitive — perhaps because of regulatory restrictions and subsidies. Because of this possibility, Pyle suggested examining the effects of the reserve tax on bank net worth by analyzing the stock-price responses when changes in the reserve requirements on CDs were announced.

Second, Pyle was highly supportive of James' analysis of the effects of different types of financing on stock price returns. He noted that James' finding that issues of straight debt used to refinance bank loans had a statistically significant negative effect on stock prices was strikingly different from previous findings by other researchers. The new finding provides a basis for arguing, as James does, that the inability of other researchers to find such an effect was due to their inability to discriminate among different uses of debt.

Pyle also asked whether the loan approval process itself (which presumably conveys information) or the actual takedown of loans accounts for the positive stock-price effect, and urged James to pursue this line of research further.

Explaining the Demand for Free Bank Notes

by Arthur Rolnick and Warren Weber

Although the James paper suggests that bank credit is special, it leaves open the question of whether banks' payment services might also be special. The paper by Arthur Rolnick and Warren Weber of the Federal Reserve Bank of Minneapolis, entitled "Explaining the Demand for Free Bank Notes," deals with this issue by examining a historical period during which banks were allowed to issue currency. (Warren Weber presented the paper.)

This subject is at the heart of an understanding of the nature of money and the demand for noninterest-bearing and possibly risky, privately issued money. It also bears on whether bank regulation is necessary to ensure the provision of a stable medium of exchange.

The paper presented at the Conference is one of a series by Rolnick and Weber (1983,1984) that re-examines the "free banking" era from 1837 to 1863, during which banks were permitted to issue their own banknotes (that is, currency). In these papers, they challenge the traditional view of the free banking era that characterized the era as chaotic, with widespread fraudulent "wildcat" banking, large numbers of bank failures, large losses to banknote holders, and frequent banking panics. The experiences of that era are often cited as evidence that strong government regulation of banking is necessary for banking and monetary stability, and that banks should not be allowed to issue their own banknotes.

The specific question addressed in the conference paper is why privately issued, risky banknotes were demanded as a medium of exchange when relatively safe specie (gold and silver coins) were available.[5] Rolnick and Weber have two answers to this question. First, banknotes issued in the states of New York, Wisconsin and Indiana were in fact not very risky because their backing (the assets banks acquired by issuing banknotes) was sufficiently strong. Although banknotes apparently circulated at par in these states, as did specie, the service return on banknotes may well have equalled that of specie even though some banks failed to pay off banknotes at par (although the losses were very small). The reason for comparable service returns was that wear on the coins imposed costs on the use of specie that approximated the expected losses on banknotes due to bank failures. Moreover, banknotes may have been more convenient than coin for large transactions.

Second, in Minnesota, where banknotes of the "railroad" banks eventually were redeemed at far below par because their backing was very poor, banknotes appear to have been exchanged at well below par and treated as small-denomination securities, not par-valued money. Rolnick and Weber point out that the notion that free banknotes were priced as risky securities rather than as safe currency implies that the public was able to judge the quality of the underlying assets. This view is much different from the conventional one that the public accepted banknotes at par regardless of the quality of the bank's assets presumably because they were either naive or misinformed.

If the acceptance of banknotes below par were characteristic of other states during the free banking era, the traditional literature may have misinterpreted the true economic function of some banks. According to Rolnick and Weber, banks may have acted more like mutual funds offering denomination intermediation than issuers of a par-value medium of exchange.

Comments *by Tom Cargill*

One unresolved but very important question mentioned by Tom Cargill of the University of Nevada at Reno in his discussion of Rolnick and Weber's paper is whether nonpar-valued banknotes such as those issued by the railroad banks actually circulated as a medium of exchange. If not, Cargill questioned whether silver and gold coins were used more than banknotes in Minnesota than in the other states.

If nonpar-valued banknotes did circulate as a medium of exchange, Cargill stated that a banking system in which bank deposits are equity shares (as are money market mutual fund shares) may be more feasible than is normally thought possible. This conclusion is important because such a banking system is not subject to runs and it may be that banking has developed along a different line because of unnecessary restrictions. If so, one avenue to solving the bank run problem while eliminating the deposit insurance guarantee would be to

allow (or perhaps require) banks to offer equity share deposits rather than par-valued deposits.

Cargill also raised the question of why Minnesota's experiences differed from those of New York, Indiana, and Wisconsin even though the ostensible regulatory environments were the same. For example, he asked whether the railroad banks in Minnesota were explicitly tolerated by state officials or the result of clever exploitations of loopholes by bankers?

In discussing the paper, Cargill also pointed out a limitation of the paper's applicability to current problems. He noted that banks during the free banking era operated in a commodity-based monetary system (gold was the numeraire) in which there would have been much less reason for concern with banks' issuance of currency than in our current system where currency itself is the numeraire.

Cargill applauded the authors for dispelling a number of common myths about the free banking era. He stressed that the paper's importance goes far beyond that of an interesting piece of historical research. In particular, he cited the paper's important implications for the rationalization of government regulation of financial institutions as well as its implications for the type of regulations that might enhance financial efficiency.

Perhaps most importantly, Cargill believed the paper debunks the idea that restrictive government regulation is necessary because the public cannot distinguish between good and bad banks. (The traditional argument is that such regulation is needed because the banking system would be destabilized by the contagion of bank runs if the public were unable to distinguish good from bad banks.)

The Intermediation Profit Margin and Market Share of S&Ls

by Alan Hess

Alan Hess of the University of Washington, in his paper entitled "The Intermediation Profit Margin and Market Share of Savings and Loan Associations," deals with the question of just what economic functions savings and loan associations (S&Ls) provide. He addresses two interrelated aspects of the question: (1) could S&Ls have earned a positive profit margin in the period from the 1950s to the 1980s if they had hedged their portfolios and thus provided only intermediation services, and (2) is there something special about S&L deposits that causes households to continue to hold relatively stable amounts of them even in the face of relatively large changes in the differential between the rate paid on such deposits and the rate on substitute assets?

The answers to these questions have several potentially important public policy implications. First, if S&Ls can earn a pure intermediation profit distinct from a profit resulting from assuming interest-rate risk, they must be providing a valuable economic function that somehow differs from the similar function performed by primary financial markets (for example, securities markets).

Second, if thrifts' economic functions are somehow special, part of the reason might be that thrifts' or other depositories' deposit-taking and loan origination services differ from similar functions provided by primary financial markets. Thus, like Chris James' paper, which deals with the question of whether bank loans are special, Hess' paper deals with the issue of whether the financial intermediation process is special.

Hess finds that the S&L intermediation profit margin has been positive since 1950 and has exhibited a strong upward trend since its trough in 1965. This intermediation profit margin contrasts with the actual profit margin of thrifts, which declined sharply and even became negative when interest rates rose in the early 1980s. Thus, Hess argues that had thrifts eliminated their duration imbalance, the sharp rise in interest rates in the early 1980s would not have caused so many of them to fail.

In a statistical analysis of the intermediation profit margin, Hess finds that both trend growth and deviations from trend growth are due mainly to the difference between the rate on one-year U.S. government securities and the average rate paid on S&L deposits. The differential increases whenever open market rates rise, thus increasing thrifts' intermediation profit margin.

These findings lead Hess to ask whether S&Ls lose market share to substitute assets when the rate differential and hence their intermediation profit margin increases. If such an effect were large

enough, aggregate industry income could actually fall when the intermediation profit margin increased because the size of the S&L industry would decline. Such a result would suggest that S&L deposits have a number of close substitutes and that they are not in any sense special.

In fact, Hess's results are quite the opposite. He finds that the substitutability of S&L deposits with other assets is very small, and interprets this finding as evidence that the S&Ls reduce information and/or transactions costs to depositors. This reduction in information costs, in turn, reduces depositors' portfolio substitution in response to interest rate differentials. Thus, when market interest rates rise relative to S&L deposit rates, the intermediation profit margin increases on a one-to-one basis while S&L's market shares fall only slightly. The net effect of these two forces on the aggregate industry intermediation profit margin is to increase industry profits when interest rates rise — a pattern opposite that observed when S&Ls do not hedge their interest rate risk.

Comments *by Herb Kaufman*

Herb Kaufman of Arizona State University discussed the paper. He wondered if the estimated interest elasticities of demand for deposits were sensitive to the estimation procedure, arguing that a multi-equation approach might produce different estimates.

Kaufman then discussed three other points: (1) the optimal number of thrift institutions, (2) their ability to immunize their portfolios, and (3) the underpricing of FSLIC insurance.

Kaufman agreed with Hess's point that fewer S&Ls would have failed if they had been able to immunize themselves from interest rate risk in the early 1980s. But he suggested that the optimal number of thrifts might have declined in the early 1980s due to changes in the economy, and that, as a result, some thrifts would have failed anyway. For example, he pointed out that some banks failed even though they were more or less immunized against interest rate risk.

Kaufman also noted that, until recently, market instruments were inadequate for thrifts to immunize themselves against interest rate risk. Instruments that hedge against interest rate risk, such as futures, adjustable rate mortgages, and securitized mortgage pools, are all relatively recent developments. Even now, with these instruments available, some thrifts choose not to use them to immunize themselves against interest rate risk. One reason for their choice might be the underpricing of FSLIC deposit insurance, which provides an incentive for thrifts to assume more interest-rate risk than is socially optimal.

Agency Cost, Collateral, and Business Fluctuations

by Ben Bernanke and Mark Gertler

The final paper by Ben Bernanke of Princeton and Mark Gertler of the University of Wisconsin, entitled "Agency Cost, Collateral and Business Fluctuations," provides a theoretical explanation of the microeconomic foundations of banking and the connection between banking and the macroeconomy. (The paper was presented by Ben Bernanke.) The paper focuses on special aspects of bank credit and thus is related to Chris James' paper on whether bank credit is special.

Bernanke and Gertler's paper has important implications for public policy since it highlights the interrelationships between the bank intermediation process and the real economy. In fact, Bernanke argues in another related paper (Bernanke, 1983) that the collapse of bank-provided intermediation services was a major contributing factor to the length and severity of the Great Depression. The results of the Conference paper also suggest that financial problems can have important effects at the macro level.

The two economists' analysis starts at the micro level with assumptions about informational structures regarding the outcome of investment projects, and shows that the "institutions" of debt and bankruptcy will arise. Bernanke and Gertler then show how a financial structure with both debt and bankruptcy leads to a connection between the financial and real parts of the economy.

Their paper is divided into two basic parts. In the first part, the authors provide a static partial equilibrium analysis of the financing of physical investments. In this analysis, investments are of such a large size that no single individual has sufficient resources to finance them. As a result, investments

are typically financed by both "inside" and "outside" funds — that is, equity and debt. This method of financing leads to a standard agency problem with divergent incentives between borrowers (firms) and lenders (debt holders). The key proposition Bernanke and Gertler establish is that the more collateral (equity) that the borrowers or insiders bring to a project, the lower are the agency costs and the more efficient will be the investment process.

The authors show that the existence of asymmetric information (the insider-equity holders have more information about the project's outcome than the outsider-lenders) leads to an optimal contract for outside financing that takes the form of a debt contract. A debt contract is one in which the insider announces the return to the project, say x. If the actual return were greater than or equal to x, the outsider would receive x, and if the actual return were less than x, the firm would go bankrupt and the outsider would receive all the remaining assets.

According to Bernanke and Gertler, there is a social loss or agency cost associated with bankruptcy because the lenders must audit a bankrupt firm to ensure that they receive all of the remaining assets of the firm. Bringing more collateral to the project lowers agency costs because the more collateral the insider brings to the project, ceteris paribus, the lower the probability of bankruptcy and the lower the expected auditing cost.

An implication of this analysis is that there is a connection between the financial arrangements in the economy and the real investment undertaken. For example, in a world in which there is a great deal of bankruptcy and default, the efficiency of physical investment will be lower.

In the second part of the paper, the authors embed their micro financial model into a macro model to examine its business cycle implications. In this macro model, output is in the demand-for-investment function because, according to the model, when firms do well and output is high, collateral also is high and high collateral lowers the cost of borrowing. Thus, as real income rises, saving increases but investment demand also increases because of the "financial-solvency" effect. Income therefore has to increase more to balance the demand for investment with savings.

The integration of a financial sector into the macro model leads to a more "persistent" business cycle with greater amplitudes. The intuition behind this result is that if productivity rises, for example, borrowers will become more solvent since they will have more collateral, and therefore agency costs will be lower and investment demand would be stimulated (due to lower borrowing costs). Moreover, since more investment occurs, the effects persist over time. (The story works in a similar way in a recession when collateral declines, borrowing costs increase, and investment decreases.)

A final point of Bernanke and Gertler's paper is that financial shocks themselves can be causes of business cycles. For example, a large unanticipated deflation would redistribute wealth away from borrowers to lenders, given that debt contracts are written in nominal terms. This wealth redistribution lowers collateral and makes the borrowing class less creditworthy, which in turn reduces the amount of financial intermediation and physical investment. This unanticipated deflation can have an adverse effect on real output.

One major limitation of the paper noted by Bernanke is that the model applies best to privately held firms. If firms could easily issue additional equity, for example, they would have no need for debt financing and the conclusions of the paper would not hold. Bernanke suggested one answer to this criticism is that there may be similar agency costs in publicly held firms, costs that preclude them from using equity issuance as a means of raising new funds.

Bernanke and Gertler's paper has potentially far-reaching policy implications. For one, it suggests that to the extent public policy can enhance the stability of the financial system, the real economy will benefit. It also suggests that unanticipated deflations caused, for example, by contractionary monetary policy, can have an adverse effect on the real economy.

Comments *by Aris Protopapadakis*

Aris Protopapadakis of the Claremont Graduate School, in his discussion of the paper, praised the paper as excellent and urged the authors to continue their research. He did suggest that the authors

consider adding risk-aversion to the model since the structure of the model precludes initially identical persons from holding identical portfolios (some persons hold debt while others hold equity).

Protopapadakis thought the main weakness of the paper, which was acknowledged in the paper's conclusion, is that it is somewhat hard to see how its findings apply to publicly held corporations. Although he thought that some of the elements of the paper might apply, he questioned whether it was possible to show that stock contracts as well as debt contracts would arise as a means of attracting outside funds.

FOOTNOTES

1. See Tom Sargent, Federal Reserve Bank of San Francisco *Economic Review*, Fall 1986.

2. The role of multiperiod wage contracts for the effectiveness of monetary policy is studied by Fischer [1977], Taylor [1980], and the conference paper by Taylor discussed below.

3. See, for example, Taylor (1980).

4. Although James does not focus on this explanation, it may be that banks obtain inside information about firms through their deposit relationships. If so, the special nature of bank loans cannot be separated from the special nature of deposits.

5. Although Rolnick and Weber provide an interesting explanation of why there was a demand for banknotes, there also are interesting questions regarding what factors limited their supply. For example, if (noninterest-bearing) banknotes could be used to buy (interest-bearing) state bonds (which could be deposited in turn for more banknotes) as the authors argue, seemingly a bank owner would buy an unlimited amount of bonds, thus infinitely leveraging original capital and earning an unlimited profit.

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Ricardo or Keynes: Does the Government Debt Affect Consumption?

Brian Motley*

This paper examines the hypothesis that although household consumption is affected by the share of the national income that is spent by government, it does not depend on whether government obtains command of its share by taxation or by borrowing. Estimates of annual consumption functions using alternative measures of income and wealth that differ in their treatment of government spending, borrowing, and debt, do not in general support this hypothesis. Changes in government tax revenues have a stronger influence on consumption than changes in government spending. However, there is some support for the hypothesis that increases in government debt do not stimulate consumption spending, suggesting that households recognize that debt interest payments must be financed out of future taxes.

In the last five years, as tax rates have been lowered with no corresponding reduction in federal outlays, the budget deficit of the federal government has increased sharply. By most conventional measures, fiscal policy has been strongly expansionary over this period. Since the tax reductions added to households' disposable incomes, they presumably enabled households to spend more on consumption, causing aggregate demand to be stronger than otherwise. However, this presumption that a policy of lowering taxes is stimulative rests on the assumption that consumers determine their levels of spending on the basis of their current after-tax incomes and do not take account of the huge increase in the amount of outstanding federal debt that results from the tax reduction.

In recent years, several economists have argued that households realize that the existence of government debt means that taxes will be higher in the future, and that they take account of this future tax liability when making their current saving and consumption decisions. This argument implies that tax cuts that are not accompanied by equal reductions in government outlays will not affect consumption, because households will view the tax cuts as necessarily temporary; taxes will have to be higher in the future to service the higher level of government debt. From this view, recent fiscal policy may not have been particularly expansionary despite the existence of unprecedented federal deficits.

This paper seeks to throw light on the interaction of government deficit spending and household consumption using newly available data on the assets and liabilities of the private and government sectors of the economy. These balance sheet data, assembled by the Federal Reserve as a supplement to the Flow of Funds Accounts, show how the savings of each sector of the economy are translated into changes in their net wealth. Using these data in conjunction with the flow of funds and national income accounts, it is possible to construct alternative measures of private income and wealth that differ in their treatment of government borrowing and debt. The paper uses these alternative measures to estimate equations to explain household con-

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sumption, with a view to discovering whether changes in government borrowing and debt affect household spending decisions.

The first section of the paper reviews the theory of household consumption behavior with particular emphasis on the role of the government debt. The argument that households recognize that additional government borrowing today will require higher taxes in the future, and that they take this into account when making their consumption and saving decisions, is described as the "Ricardian" view, after the nineteenth century English economist, David Ricardo. The alternative view, that households largely ignore the future tax burden implied by the existence of an outstanding federal debt, is described as the Keynesian hypothesis.[1] The second section of the paper derives the estimating equations that permit an empirical comparison between these alternative theories, and describes the statistical data used. The empirical results are presented in the third section. The fourth section provides a brief summary and suggests some conclusions.

I. Theory

Until about ten years ago, it was an article of faith among most economists that governments could influence the aggregate demand for goods and services in the economy by altering either their expenditures or their tax revenues. Increased government outlays were presumed to contribute directly to aggregate demand, while lower taxes — by adding to the disposable income of the private sector — were thought to stimulate private demand indirectly. This view of the effects of fiscal changes underlay the major Kennedy-Johnson tax cut of 1964, the ten-percent surcharge on personal taxes applied in 1968, and the series of smaller tax changes in the early 1970s — all of which were designed specifically to offset cyclical fluctuations in the economy.

Keynesian Approach

The view that aggregate demand may be "managed" through fiscal policy, usually identified with Keynesian economics, rested on the assumption that the method by which government spending is financed — by levying taxes or by borrowing in the financial markets[2] — is important in determining its impact on aggregate demand. Increasing government spending without raising taxes, or reducing tax revenues without cutting expenditures both were assumed to stimulate total demand, whereas equal changes in expenditure and taxes were thought to have much smaller effects.[3] In effect, this Keynesian approach to fiscal policy held that an increase in the amount of the government's expenditures financed by borrowing — "deficit financing" — rather than by levying taxes — "tax financing" — would significantly stimulate aggregate demand.

Ricardian Challenge

In recent years, a number of economists[4] have challenged this argument and, as a result, cast doubt upon whether changes in fiscal policy have any significant influence on aggregate demand.[5] These economists argue that the method by which government expenditures are financed is not relevant to their effect on aggregate demand. Their argument derives from the assertion that *eventually* all government outlays must be paid for out of tax revenues.

Suppose, they say, that the government cuts taxes in a given year but leaves its expenditures — except payments of interest and principal on the government debt — unchanged both in that year and *in all future years*. To pay its bills, the government must borrow by issuing government bonds to the private sector. However, by issuing more debt, the government puts itself in a position wherein it must raise taxes sometime in the future to meet the resulting higher payments of interest on the debt. For this reason, the government cannot reduce taxes *permanently* while maintaining its outlays on goods and services unchanged.

The government might attempt to avoid increasing taxes by financing higher future interest payments by additional borrowing. In such a case, the government's debt would rise at the same rate as the interest rate that it pays, even if the government were to meet all of its other expenditures (both current and future) fully out of tax revenues. Such a policy cannot be sustained in the long run if the interest rate exceeds the growth rate of GNP, because the interest payments on the debt will grow faster than (and eventually will consume the whole of) GNP. Even if

the interest rate were less than the economy's growth rate, the debt might still grow faster than GNP if the noninterest portion of the budget were to remain in deficit.

Alternatively, the government might seek to avoid raising taxes by financing future deficits through the creation of new money and thereby cause inflation. Although this financing method avoids higher *explicit* taxes, it imposes what is in effect an "inflation tax" on those groups in the society that are unable to protect themselves against the effects of rising prices.

The inevitable conclusion of both financing alternatives is that a reduction in current taxes must be repaid by higher taxes sometime in the future.[6] Thus, in present value terms, tax changes do not alter the liability of the private sector to pay taxes to the government; they only affect the *timing* of those payments, with tax cuts delaying them into the future and tax increases hastening them into the present.

This line of argument implies that tax changes will have no effect on the aggregate demand for goods and services when *two* conditions are satisfied. First, private spenders should recognize that such changes alter only the timing of tax payments and not their eventual amount and, second, they should be able and willing to offset such alterations in timing by appropriate amounts of borrowing or lending. The modern theory of consumer behavior argues that these conditions do indeed hold.

Consumption Theory

Since Milton Friedman developed the permanent income hypothesis of consumption and Modigliani and Brumberg the life-cycle approach in the mid-1950s, most economists have accepted the notion that households plan their consumption (in broad outline although not, of course, in detail) over a relatively long time horizon. The typical household seeks to "smooth out" over its life-cycle the effects on its living standards of variations in its income. The household does this by borrowing during periods when its current income is low, saving and repaying debt during its prime earning years, and living off its accumulated assets during retirement. Thus, a household's consumption in any given year depends on its estimate of the total resources it will have over its complete life-cycle, and thus may not be closely related to the household's income in that particular year.

The assertion that tax changes that do not reflect changes in present or future government outlays should have no net effect on private expenditures is a logical extension of this life-cycle argument. Consider, for example, a typical household faced with a tax increase after it has mapped out a long-term plan for consumption. In formulating its plan, the household will have taken account of its best estimates of future income and tax payments. The plan will be "optimal" in the sense that no further changes in consumption (in the form of reducing consumption in some years in order to increase it in other years) will add to the household's lifetime welfare.

Under such circumstances, a tax change that increases the household's *current* tax payments but lowers *future* payments by an equivalent amount will not cause it to alter its consumption plan because it has no effect on the household's ability to finance any particular consumption plan. The additional current taxes can be paid by borrowing and the lower future taxes will provide the funds needed to repay this loan. Since the original consumption plan was optimal and is still possible, the household has no reason to change it.

Ricardian Equivalence

Thus, the proposition that tax changes have no effect on household consumption plans follows directly from the modern life-cycle theory of consumption behavior. In fact, the proposition has a much longer history and originally was put forward by David Ricardo more than a hundred and fifty years ago.[7] For this reason, the modern proponents of this argument describe it as the *Ricardian equivalence theorem*.

Ricardian equivalence also implies that a household will reduce its current consumption if government spending increases today or is expected to increase in the future, *even if there is no change in current taxes*. The household will cut current consumption because it recognizes that additional government outlays *must* be financed eventually by higher taxes, and hence that its after-tax income will be reduced in the long run.

Two principal arguments have been advanced against the Ricardian approach.[8] The first is that households are myopic; they do not foresee the

higher taxes necessitated in the future when current taxes are lowered without a change in the government's current and prospective non-interest expenditures. Put somewhat differently, myopia means that, in estimating the resources they have available for consumption, households regard their holdings of government securities as part of their wealth, and the interest on those securities as part of their income, but ignore their corresponding liability as taxpayers to finance the payments of interest and principal on the securities.[9]

Economists describe this myopia as "fiscal illusion". Households suffering from fiscal illusion will regard a current tax cut as adding to their resources available for consumption, and ignore the higher taxes that will subtract from those resources in the future. Interestingly, Ricardo himself appears to have taken this view. While proposing Ricardian equivalence as a theoretical possibility, he argued that, in practice, households put more weight on current tax changes than future ones.[10] In particular, Ricardo proposed that wars should be financed by current taxes rather than by borrowing, since placing the full tax burden on the present generation would dissuade governments from engaging in war.[11]

A particular case of this argument is the situation where the higher future taxes will not fall on the present generation of households (those who receive the tax cut) but on their descendants. In this case, Ricardian equivalence implies that members of the present generation will add to their bequests in order to offset the higher taxes that will fall on their children. Critics (including, as we have seen, Ricardo himself) suggest that households either are not this farsighted or do not care enough about (possibly unborn) future generations to provide them with larger bequests to offset those generations' taxes.

A second argument against the Ricardian equivalence hypothesis is that households may be unable to offset the effects of a tax increase because their ability to borrow is limited. For example, a household faced with higher current taxes may wish to borrow in order to avoid a cut in its current consumption but be unable to do so because no lender is willing to make the loan. As a result, a tax increase may compel the household to reduce its consumption even though it recognizes that its taxes will be lower in the future. Conversely, a household that already is constrained by its ability to borrow — and so is consuming less than it would if it were free to borrow more — may take advantage of a tax cut to add to its current consumption even though it recognizes that its tax payments will be higher later.[12]

Formal Models

The Keynesian and Ricardian models of consumption behavior agree that households' consumption and saving decisions depend on the levels of their income[13] and wealth, but differ in the concepts of income and wealth to which the typical household pays attention.

In the traditional Keynesian approach, consumption is made to depend on income *after taxes*, while wealth is defined to include the value of households' holdings of government securities, without subtracting the capitalized value of the future taxes needed to service those securities. Thus, under the Keynesian approach:

$$C = a + bY^K + cW^K \quad (1)$$

where

$$Y^K = Y - T \quad (1a)$$

$$W^K = K + D \quad (1b)$$

In equation 1a, Y represents national income and T is net payments of taxes to government;[14] the income of the private sector, Y^K, is income minus taxes. In equation 1b, K represents the stock of tangible and equity capital owned by the private sector at the beginning of the year, and D represents the stock of privately held government debt outstanding.[15]

In contrast, the Ricardian approach implies that income should be defined as national income *less government expenditures on goods and services*[16] since this difference represents the portion of the national product that is available to the private sector for consumption. Ricardian equivalence means that the method (taxation or borrowing) by which the government obtains command over the share of the national income that *government* spends does not affect the amount of *their* share that *households* spend. The Ricardian approach also implies that the definition of private wealth should not

include the private sector's holdings of government securities since these are precisely offset by households' liability to pay future taxes. Thus, under the Ricardian approach:

$$C = a' + b'Y^R + c'W^R \quad (2)$$

where $$Y^R = Y - G \quad (2a)$$

$$W^R = K \quad (2b)$$

In equation 2, the income variable, Y^R, is defined as national income less government spending on goods and services, excluding government spending on transfer and interest payments, and wealth, W^R, excludes the private sector's holdings of government securities.

In conducting empirical tests of these alternative models of household behavior, it is important to choose definitions of income and wealth that treat the government's taxing and borrowing activities in the same way. If, for example, households regard their holdings of government debt as part of their wealth (the Keynesian view), then they also should regard taxes but not government borrowings as reductions from their income. In contrast, if households were to take the Ricardian view that all government expenditures represent claims against their incomes (whether these expenditures are financed by taxes or by borrowing), then they should not regard their holdings of government bonds as part of their wealth.

The definitions of income and wealth in the preceding equations are consistent in this sense. This consistency implies that, for either pair of definitions, private disposable income less consumption (that is, saving) during a year is equal to the annual change in private wealth.[17] To see this, recall that the national income is equal to the sum of consumption, investment and government expenditures on goods and services,

$$Y = C + I + G \quad (3)$$

Also, investment is equal to the change in the stock of tangible assets in the economy, and the government deficit is equal to the change in the stock of government debt outstanding,

$$I = \Delta K \quad (4)$$

$$G - T = \Delta D \quad (5)$$

In the Keynesian case, the private sector's disposable income is equal to national income less the taxes the private sector pays to the government. Hence,

$$\begin{aligned} Y^K - C &= (Y - T) - C = I + (G - T) \\ &= \Delta K + \Delta D \\ &= \Delta W^K \end{aligned} \quad (6)$$

where ΔW^K represents the change in Keynesian wealth over the year.

In the Ricardian case, by contrast, private disposable income is defined as the national income less government expenditures. Hence,

$$\begin{aligned} Y^R - C &= (Y - G) - C = I \\ &= \Delta K \\ &= \Delta W^R \end{aligned} \quad (7)$$

where ΔW^R represents the change in 'Ricardian' wealth over the year.

II. The Empirical Model

The approach used in this paper to test whether the Keynesian or the Ricardian approach to the role of government better explains average household consumption behavior is to estimate a series of annual consumption functions that use as explanatory variables different measure of real, or inflation-adjusted, income and wealth. The measures differ in the way in which government taxes, expenditure, and debt are treated.

To ensure that the definitions of income and wealth are consistent among the equations, they are made to satisfy accounting identities of the type illustrated in equations 6 and 7 in the preceding section. Consumption is defined as real personal consumption expenditures (in constant 1982 prices) on nondurable goods and services. Purchases of durable consumption goods are regarded as part of gross saving, and the stock of household durables as part of gross wealth. These definitions are used in the Federal Reserve's Flow of Funds Accounts and National Balance Sheets.

Income and Wealth

In the theoretical discussion of the previous section, it was assumed that consumption during a given year depends on the level of private wealth at the beginning of the year, and that the change in wealth from the beginning of one year to the beginning of the next is equal to gross private saving during the year. In reality, there are three other factors that contribute to the year-to-year change in the real value of private wealth. They[18] are (i) physical depreciation of tangible assets, (ii) changes in the values of assets due to changes in asset prices, and (iii) changes in the real value of wealth as a result of inflation in the prices of consumer goods.

These factors also should influence households' consumption decisions. If the real value of their wealth is reduced during the year by the physical depreciation of their stocks of tangible assets or as a result of increases in the prices of consumer goods, households are likely to want to save more and consume less. In contrast, if increases in asset prices were to add to the market values of their wealth over the year, households would be likely to want to consume more and save less. These considerations suggest that consumption should depend on the level of wealth, after accounting for changes caused by the three factors named. Equations 1 and 2 therefore should be modified to yield estimating equations of the general form:

$$C_t = a + bY_t + c[W_t - Dep_t + Rev_t - Inf_t] \quad (8)$$

where Y_t = Real gross private sector income in year t

W_t = Real gross private wealth at the beginning of year t

Dep_t = Depreciation of tangible assets in year t

Rev_t = Asset revaluations due to changes in asset prices during year t

Inf_t = Decrease in real value of wealth due to inflation during year t.

The definitions of income, Y_t, and wealth, W_t, in this equation will be different between the Keynesian and Ricardian cases. The differences in the definition of wealth in turn will imply different definitions of the inflation variable. In the Keynesian case, the inflation variable, Inf_t, will include the change in the real value of the government debt due to inflation;[19] in the Ricardian case, it will not.

Equation 8 assumes that all changes in real wealth have the same effects on household consumption. In particular, differences in the level of wealth at the beginning of the year, W_t, have the same impact on consumption as do changes in real wealth during the year due to depreciation, changes in asset prices, and general inflation (Dep_t, Rev_t, and Inf_t). Clearly, this is a very strong assumption.

Influence of Depreciation

Most studies of the consumption function take for granted that consumption decisions are made on the basis of *income net of depreciation* rather than gross income. Implicitly, this amounts to assuming that

households regard the making good of depreciation on their tangible assets as having some sort of prior claim on their current gross income before it is used for consumption. Equation 8 represents an alternative hypothesis that although households recognize that physical depreciation of their homes and stocks of consumer durables reduces their wealth (and so their lifetime consumption), they do not necessarily regard the making good of this depreciation as having a prior claim on their gross incomes in the year in which it actually occurs. On this hypothesis, consumption decisions are related to *wealth net of depreciation* rather than to income net of depreciation.

These alternative hypotheses may be tested by including gross income, gross wealth, and depreciation as *separate* explanatory variables in the equation. The coefficient on depreciation is expected to be negative. If consumption were related to *income* net of depreciation, the coefficients on the income and depreciation variables would be equal but of opposite signs. If *wealth* net of depreciation were the key variable, as equation 8 assumes, there would be equal and opposite-signed coefficients on the wealth and depreciation variables.

Asset Revaluations

Several studies have found that increases in the market value of household asset holdings tend to stimulate consumption expenditures.[20] In equation 8, such revaluations have the same impact on current consumption as do other changes in gross wealth. However, some changes in asset values may occur toward the end of a year and so have less effect on that year's consumption. Also, households may regard some revaluations as transitory (rather than permanent increases or decreases in their lifetime resources), and may not alter their consumption in response. For these reasons, the effect of the revaluation variable on consumption may be smaller than that of the wealth variable. To allow for this possibility, the equations estimated below include the revaluation variables, Rev_t, as a separate term.

Inflation

With regard to the effect of inflation, a number of economists in the Keynesian tradition have argued that only changes in the real, inflation-adjusted, value of the government debt should have an effect on household consumption.[21] Additions to the nominal debt (that is, budget deficits) that represent only the effect of inflation, should not influence private consumption behavior.[22] This argument means that reductions in the real value of the public debt due to inflation should reduce consumption in the Keynesian model. Such reductions should have no effect in the Ricardian model because inflation simultaneously reduces the real burden of the taxes required to service the debt.

Equation 8 permits a comparison of these hypotheses. In the Keynesian version of the equation, but not the Ricardian version, the "inflation loss" term, Inf_t, includes the effect of inflation on the real value of the government debt. However, as in the case of asset revaluations, the effect on consumption of inflation-induced losses of real wealth may be different (probably smaller) from the effect of other wealth changes. Hence, the estimated equations include a separate term representing inflation-caused losses of real wealth.

Interest Rate

In addition to the income and wealth variables, the estimated equations also include as an explanatory variable a measure of the real, inflation-adjusted, after-tax, short-term interest rate. That measure represents the terms on which households are able to substitute between current and future consumption. This real interest rate is constructed as a quarterly series and then aggregated into an annual rate.

The yield on six-month commercial paper is used as a measure of the pre-tax, nominal, short-term interest rate facing consumers. The after-tax rate is estimated by multiplying this yield by $(1 - Rtax)$, where Rtax is an estimate of the marginal tax rate paid by individuals.[23] The real yield in each quarter is derived by subtracting from the nominal yield a measure of the expected rate of inflation in the prices of consumer goods. The expected inflation rate in each quarter is proxied by the actual inflation rate over the five-quarter period centered in that quarter.[24]

Estimating Equations

These modifications to the simple theoretical model described in the last section yield an estimating equation of the form:

$$Ct = a + b.Yt + c.W_t + d.Dep_t + f.Rev_t + g.Inf_t + h.R_t \quad (9)$$

where R_t = real, after-tax, short-term interest rate

This equation represents a generalization of equation 8. Again, the definitions of Y_t, W_t and Inf_t will be different in the Keynesian and Ricardian cases. The coefficients on income and wealth are both expected to be positive. The coefficient on the revaluation variable (f in equation 9) is expected to be positive and of approximately the same order of magnitude as, or smaller than, that on the wealth variable. Similarly, the coefficient on the inflation-loss variable (g in equation 9) is expected to be negative, but again of approximately the same order of magnitude as, or smaller than, that on wealth.

Data for each of the variables (except the interest rate) were assembled using the recently revised National Income and Product Accounts constructed by the Department of Commerce and the corresponding Flow of Funds Accounts and National Balance Sheets[25] prepared by the Federal Reserve. The data used are annual series from 1953 to 1985. Care was taken to ensure that, with only very minor exceptions, the data[26] satisfied the condition that:

$$W_{t+1} - W_t = Y_t - C_t + Rev_t - Dep_t - Inf_t \quad (10)$$

All data are put on a per capita basis and are deflated by the implicit deflator for personal consumption expenditures on nondurable goods and services.

To allow for the possibility that private households may treat state and local governments differently from the federal government,[27] the income and wealth data were constructed for three alternate levels of consolidation. In each case, the revaluation and inflation-loss variables were defined so as to be consistent with the definitions of the corresponding income and wealth variables.[28]

In the first or Keynesian consumption equation, the income variable is defined as the portion of the gross national product received by the private (non-government) sector[29] after both federal and state and local government taxes and transfers. Similarly, the wealth variable[30] is defined to include the private sector's holdings of both federal and state and local government debt as well as of tangible and equity assets. Thus, equation 9 becomes

$$C_t = a_0 + a_1.(GNP_t - T_t^F - T_t^{SLG}) + a_2.(K_t + D_t^F + D_t^{SLG}) + \ldots. \quad (11)$$

where T represents tax and nontax payments to each level of government, net of all government transfer and interest payments.

In the second equation, the private and state and local government sectors are consolidated. The income variable is defined as the portion of GNP accruing to the private *and* state and local government sectors less those governments' expenditures on goods and services whether financed by net taxes or borrowing. This income variable includes transfer payments received from the federal government (including grants-in-aid to state and local governments) and is net of all federal taxes. Payments and receipts of taxes and transfer payments between the private and state and local government sectors are netted out. Wealth is defined to exclude the private sector's holdings of state and local government debt but to include holdings of federal government debt. Thus,

$$C_t = a_0 + a_1.(GNP_t - T_t^F - G_t^{SLG}) + a_2.(K_t + D_t^F) + \ldots. \quad (12)$$

This equation is a hybrid between the Keynesian and Ricardian approaches. Households are Ricardian with respect to local and state government taxes and debt, but Keynesian with respect to the federal government.

Finally, in the third equation, all tax and transfer payments (including inter-sector transfers between the federal and state and local governments) are netted out. Hence, the income variable represents the whole of GNP (except for the small portion that accrues to foreigners) less expenditures on goods and services by governments at all levels. Wealth consists only of the stocks of tangible capital, land,

and foreign assets less that portion that is owned directly or indirectly by foreigners. Thus,

$$C_t = a_0 + a_1.(GNP_t - G_t^F - G_t^{SLG}) + a_2.(K_t) + \ldots . \quad (13)$$

This equation is a fully Ricardian one, since wealth excludes the private sector's holdings of government debt whereas private income is defined by subtracting from GNP all government expenditures whether financed by taxes or borrowing.

III. Empirical Results

Table 1 reports the results of estimating consumption equations using the three alternative measures of income and wealth defined in equations 11, 12, and 13 in the preceding section. Each equation also includes the real after-tax interest rate and the revaluation and inflation variables; the last is defined to be consistent with the definitions of income and wealth.

In preliminary estimates of these equations, the coefficients on the depreciation variable (Dep_t in equation 9) were found to be positive and statistically significant. As explained above, theory predicts that these coefficients should be negative. Indeed, virtually all past estimates of consumption functions have simply assumed that consumption depends on income net of depreciation, and therefore have implicitly imposed the restriction that the coefficient on depreciation is equal but opposite in sign to that on gross income. Since the depreciation variable has a steady upward trend over the sample period, with little year-to-year variation, one possible explanation of its positive coefficient is that the depreciation variable is acting as a proxy for an upward trend in consumption caused by some omitted variable.

When an explicit trend variable[31] was added to the equation, the estimated coefficients on the depreciation variable were negative in all three equations. The hypothesis that consumption is related to wealth net of depreciation could not be rejected. Imposing this restriction yielded a better fit (lower standard errors of the equations) than the alternative restriction that consumption depends on income net of depreciation.

This result suggests, in contrast to the conventional assumption, that households treat depreciation of their tangible assets as reducing their *wealth* rather than current *income*. Hence the equations reported in Table 1 incorporate this restriction; that is, in them, wealth is defined *net* of depreciation.

In each equation in Table 1, both income and net wealth are found to have significant positive effects on consumption expenditures, regardless of the measure used. The coefficients on the revaluation variables also are positive, implying that households respond to increases in the market value of their net assets by adding to their consumption. The smaller coefficients on this variable compared to those on

TABLE 1

Consumption Equations Using Three Alternative Measures of Income and Wealth

Dependent Variable: Per Capita Consumption Expenditures on Nondurables and Services ($ 1982)

	Alternative Income/Wealth Variables		
Regressor	**Keynesian**	**Hybrid**	**Ricardian**
Constant	−0.306	−0.099	0.621
	(1.13)	(0.30)	(2.52)
Trend	0.306	0.289	0.553
	(4.55)	(3.63)	(9.52)
After-Tax Real Interest Rate	−0.009	−0.008)	−0.031
	(0.68)	(0.47)	(1.90)
Per Capita Real Income	0.339	0.328	0.183
	(6.65)	(5.68)	(3.50)
Per Capita Net Wealth	0.037	0.039	0.048
	(4.87)	(4.27)	(4.90)
Asset Revaluation	0.014	0.016	0.021
	(2.28)	(2.35)	(2.85)
Inflation Loss	−0.015	0.012	−0.058
	(1.002	(0.66)	(2.82)
SEE	0.063	0.072	0.082
R^2	0.997	0.995	0.993
Rho	0.244	0.302	0.360
	(1.20)	(1.52)	(1.85)

the wealth variable suggest either that households do not react to such revaluations within the year or that they treat a part of any addition to the market value of their assets in a given year as transitory. Reductions in the real value of wealth resulting from inflation are estimated to reduce consumption, although this negative effect is not statistically significant.

Inspection of the standard errors of the equations in Table 1 shows that the hybrid and Ricardian equations that consolidate the private and government sectors provide a less satisfactory fit to the data. Although the difference is not particularly large, it casts some doubt on the Ricardian approach since it suggests that households do not regard taxes and government borrowing as fully equivalent methods of financing government expenditures.

For a sharper test of this result, estimated equations that include the *differences* between the various alternative measures of income and wealth as additional explanatory variables are reported in Table 2. In these equations, private income is defined as the gross national product minus the net taxes that the private sector pays, and private wealth includes the stocks of both federal and state and local government debt outstanding. These are the same definitions of income and wealth used in the first equation in Table 1.

The first equation in Table 2 adds the differences between these income and wealth variables and the corresponding measures when the private and state and local government sectors are consolidated. In the case of income, the difference is equal to the current deficit of the state and local government sector; in the case of wealth, it is equal to the state and local government debt.[32] Thus,

$$\begin{aligned} C_t = a_0 &+ a_1.(GNP_t - T_t^{SLG} - T_t^F) \\ &+ a_{11}.(G_t^{SLG} - T_t^{SLG}) \\ &+ a_2.(K_t + D_t^F + D_t^{SLG}) \\ &+ a_{22}.(D_t^{SLG}) + \ldots\ldots \end{aligned} \qquad (14)$$

If (as the Ricardian approach assumes) households treat state and local government expenditures as claims against their own incomes, regardless of how these outlays are financed, and if they do not regard their holdings of state and local government

TABLE 2

Consumption Equations including Differences between Alternative Measures of Income and Wealth

Dependent Variable	Per Capita Consumption Expenditures on Nondurables and Services ($ 1982)		
Regressor	**I**	**II**	**III**
Constant	0.671	0.687	0.669
	(2.092	(1.76)	(1.34)
After-Tax Real Interest Rate	0.043	0.019	0.024
	(2.34)	(1.44)	(1.68)
Per Capita Real Income	0.514	0.475	0.502
	(12.16)	(13.58)	(16.51)
Per Capita Net Wealth	0.027	0.033	0.027
	(2.15)	(3.48)	(3.21)
Asset Revaluation	0.026	0.014	0.014
	(2.09)	(1.58)	(1.38)
Inflation Loss	−0.033	−0.012	−0.012
	(0.85)	(0.17)	(0.16)
State/Local Govt Deficit	−0.126	—	
	(0.25)		
State/Local Govt Debt	−0.309	—	
	(1.52)		
Federal Deficit	—	0.277	
		(2.84)	
Federal Debt	—	−0.008	
		(0.19)	
Total Govt. Deficit	—	—	0.215
			(2.20)
Total Govt. Debt	—	—	−0.016
			(0.27)
Inflation Loss Adjustment	5.81	0.543	0.431
	(1.56)	(0.50)	(0.44)
Revaluation Adjustment	—	0.091	0.087
		(0.56)	(0.50)
SEE	0.085	0.075	0.078
R^2	0.995	0.997	0.996
Rho	0.148	0.226	0.256
	(0.92)	(1.04)	(1.19)

debt as part of their net worth because they imply a corresponding liability to pay future taxes, we would expect [33]

$$a_{11} = -a_1 < 0 \text{ and } a_{22} = -a_2 < 0.$$

In contrast, if households do not consolidate the spending and borrowing of state and local governments with their own (as the Keynesian model assumes), we would expect $a_{11} = a_{22} = 0$.

Unfortunately, the results in this first equation are inconclusive as neither of these pairs of hypotheses may be rejected at conventional probability levels. However, a_{22} is negative and significant at a 14 percent probability level, which would imply that increases in state and local government debt have a smaller wealth effect on household consumption than do increases in other forms of wealth. This provides some support for the Ricardian approach.

In the second equation in Table 2, the income and wealth variables are the same as in the first equation, but the *federal* deficit and *federal* debt are included as additional variables. Thus, this equation assumes that households do not consolidate the debt and income of state and local governments with their own, and allows us to examine whether they do consolidate those of the federal government. Thus,

$$\begin{aligned} C_t = a_0 &+ a_1.(GNP_t - T_t^{SLG} - T_t^F) \\ &+ a_{11}.(G_t^F - T_t^F) \\ &+ a_2.(K_t + D_t^{SLG} + D_t^F) \\ &+ a_{22}.(D_t^F) + \ldots . \end{aligned} \tag{15}$$

If households were to treat federal expenditures as reductions from their spendable incomes, regardless of whether these are financed by taxation or bond issuance, we would expect $a_{11} = -a_1 < 0$. Similarly, if they were to regard federal debt as involving a future tax burden and therefore not representing net wealth, we expect $a_{22} = -a_2 < 0$. The first of these hypotheses is decisively rejected; in the second equation in Table 2, a_{11} is significantly positive rather than negative, implying that a decrease in federal taxes has a strong positive effect on consumption. The equation neither confirms nor rejects the second hypothesis, since although a_{22} is negative and not significantly different from $-a_2$, it also is not significantly different from zero.

Finally, in the third equation of Table 2, the implications of consolidating the state and local and federal governments are examined. This equation includes the combined deficit of the federal and state and local government sectors and the total government debt. Thus,

$$\begin{aligned} C_t = a_0 &+ a_1.(GNP_t - T_t^{SLG} - T_t^F) \\ &+ a_{11}.(G_t^{SLG} + G_t^F - T_t^{SLG} - T_t^F) \\ &+ a_2.(K_t + D_t^{SLG} + D_t^F) \\ &+ a_{22}.(D_t^{SLG} + D_t^F) + \ldots . \end{aligned} \tag{16}$$

As in the other equations, the Ricardian hypothesis implies[34] that $a_{11} = -a_1$ and $a_{22} = -a_2$.

In this equation, the coefficients on the wealth variable and on the stock of government debt (a_2 and a_{22}) are not significantly different in absolute value, as required by the Ricardian hypothesis. But since a_{22} also is not significantly different from zero, the first result is inconclusive. As in the second equation, a_{11} is positive and significant, implying that tax increases have a strongly negative effect on consumption.

The results in Table 1 with regard to the effects of asset revaluations and inflation on consumption decisions are not altered in Table 2. Additions to the nominal value of wealth resulting from increases in asset prices tend to encourage household consumption, whereas reductions in its real value due to inflation tend to discourage spending.

IV. Summary and Conclusions

This article has examined two views of the effect of government spending on household consumption. In what may be characterized as the Keynesian approach, households consider reductions in government taxes as additions to their income and wealth, and therefore, such tax changes have a stimulative effect on consumption. This approach also assumes that additions to government spending add directly to aggregate demand.

The Ricardian approach says that households would discount the stimulation of additional government spending or reduced taxes because they recognize that government expenditures reduce the spendable resources at their command regardless of how those expenditures are financed. When government spending is financed by current taxation, household income is reduced immediately. When it is financed by debt issuance, the need to extract taxes in the present is reduced but additional taxes will have to be levied in the future to finance the payment of interest and principal.

Thus, the Ricardian approach suggests that recent tax reductions would have little permanent effect on household spending since they do not reflect reductions in government outlays but only a switch from tax financing to debt issuance.

This issue has been examined in a number of earlier studies, several of which have found that the Ricardian hypothesis could not be rejected by the data. Several of these papers have stressed the argument that Ricardian households would pay attention to the permanent rather than the current level of government spending even though the concept of permanent government spending is difficult to measure empirically.

In this paper, the implications of this hypothesis for the definitions of both income and wealth have been treated simultaneously. In addition, this paper is the first to use national balance sheet data on private holdings of tangible and financial assets to examine this issue.

Overall, the results here do not support the Ricardian hypothesis.[35] Although they are somewhat mixed, all the equations reported in this paper find that consumption is affected by the level of real private sector wealth, but this finding does not depend on whether private wealth is defined to include or to exclude the stock of government debt. However, the overall fit of the equations is reduced when wealth is defined to exclude government debt.

In addition, contrary to the predictions of the Ricardian approach, the results indicate that, in the *current* year, consumption responds strongly to changes in government taxes. Decreases in federal government tax collections cause households to add to their household consumption, even if these decreases are not accompanied by cuts in government spending.

Nevertheless, although a federal tax reduction tends to stimulate the current year's consumption, the Ricardian hypothesis that the resulting higher level of government debt has no positive wealth effect on household outlays in subsequent years cannot be rejected at conventional levels of statistical significance. Proponents of the Ricardian view might interpret this result as indicating that households recognize and pay attention to the tax burdens associated with higher levels of federal debt once that debt has been issued. However, the alternate, Keynesian, view also is not rejected by the estimated equations.

The approach adopted in this paper has the advantage that income and wealth are treated in a consistent fashion. However, it must be recognized that some issues emphasized by earlier studies of the Ricardian equivalence hypothesis have been ignored. The most important of these are the assumptions that current income and current government expenditures are adequate proxies for the long-run or "permanent" levels of these variables.

In particular, the finding that changes in current taxes have a strong effect on consumption may be sensitive to the assumption that current government outlays provide a good forecast of future outlays. On the one hand, if the Ricardian hypothesis were correct, consumption would depend on the permanent level of government spending. In such a case, if the current level of government expenditures were a poor proxy for its permanent level, the equations would be mis-specified. On the other

hand, given the difficulty of predicting government outlays, it seems unlikely that an alternative proxy would be superior.

Subject to these limitations, the results presented here have implications for the conduct of fiscal policy. They suggest that while the immediate effects of deficit financing on household consumption and savings decisions are reasonably clear-cut, the long-run effects are more uncertain. In the short run, reductions in taxes tend to stimulate household outlays as a larger share of the GNP reaches the hands of the private sector. In the longer run, however, when deficit spending shows up in the form of a larger federal debt, it is uncertain whether taxpayers will treat that debt as an addition to their wealth justifying permanently higher expenditure levels.

FOOTNOTES

1. These are convenient but not wholly accurate labels. David Ricardo clearly had some doubts about the hypothesis that today bears his name. The theory of consumption that I describe as Keynesian in this paper reflects the views of several economists besides John Maynard Keynes, and might more accurately be labeled the "mainstream" approach.

2. In addition to levying taxes and borrowing, the government also has the option of financing its expenditures by creating new money. However, the choice between issuing new debt or new money is a matter of *monetary,* rather than *fiscal,* policy. In the United States, this decision is made by the Federal Reserve rather than the Treasury or the Congress. In order to focus attention on *fiscal* policy, I shall assume that monetary policy is constant — in the sense that there is no change in the rate of money creation — so that taxing and borrowing are the only alternative financing methods available.

3. Most economists in the Keynesian tradition argued that the effect on aggregate demand of an equal increase in both government expenditures and tax revenues would be small but not zero. This proposition is known as the 'balanced budget multiplier theorem'.

4. An early treatment of this argument can be found in Martin J. Bailey, *National Income and the Price Level,* McGraw-Hill Book Co., 1962, pp 71-81. Much of the recent interest in the argument stems from Robert J. Barro, "Are Government Bonds Net Wealth?", *Journal of Political Economy,* 82, Nov-Dec 1974.

5. It always was recognized that the expansionary effects of deficit financing might be partially offset ("crowded out") by a rise in interest rates if monetary policy did not accommodate the increased demand for money associated with rising levels of nominal income. For a detailed discussion of crowding out, see Alan S. Blinder and Robert M. Solow, "Does Fiscal Policy Matter", *Journal of Public Economics,* 1973. However, the recent challenges to fiscal policy do not rely on this crowding out argument, but instead deny that budget deficits *per se* stimulate aggregate demand.

6. Conversely, if current taxes are increased with no change in the government's non-interest outlays, the government debt will be lower in the future than it otherwise would have been, and hence future taxes also will be lower because the required payments of debt interest will be reduced.

7. David Ricardo, *Funding System,* 1820. Reprinted in P. Sraffa (Editor) *The Works and Correspondence of David Ricardo,* Vol IV, 1951, p. 143.

8. For a non-technical discussion of these issues, see Phillip Cagan, "The Effects of Government Deficits on Aggregate Demand and Financial Markets: A Wide-Ranging Review of the Literature and Current Policy Issues", *Proceedings of the Sixth West Coast Academic/Federal Reserve Economic Research Seminar,* Federal Reserve Bank of San Francisco, November 1983, pp 99-106.

9. Thus one of the first modern articles describing the Ricardian equivalence theorem was Robert J. Barro, "Are Government Bonds Net Wealth?", *Journal of Political Economy,* 82, Nov-Dec, 1974.

10. "It would be difficult to convince a man . . . that a perpetual payment of 50 pounds per annum was equally burdensome with a single tax of 1000 pounds. He would have some vague notion that the 50 pounds per annum would be paid by posterity, and would not be paid by him. . . That an annual tax of 50 pounds is not deemed the same in amount as 1000 pounds ready money, must have been observed by everybody." David Ricardo, *Funding System,* p. 187. In modern terms, it seems clear that in this passage Ricardo is suggesting that most persons are afflicted by fiscal illusion.

11. "When the pressure of the war is felt at once, without mitigation, we shall be less disposed wantonly to engage in an expensive contest, and if engaged in it, we shall be sooner disposed to get out of it, unless it be a contest for some great national interest." Ricardo, *Op. cit.,* p. 186.

12. A third argument against the equivalence theorem is that it assumes that private agents are able to borrow and lend at the same interest rate as the government, whereas, in fact, the private sector rate generally is higher. This means that when the government lowers taxes without reducing its expenditures, the value of the securities that it must issue *exceeds* the present value (to the private sector) of the resulting future tax burden, because the latter is discounted back to the present at a higher rate of interest than the securities yield. Hence such a policy action adds to the total wealth of the private sector and so encourages a higher level of consumption. The second argument made in the text really is an extreme case of this point, since if a household is totally unable to borrow, this means that the 'borrowing rate' it faces is infinitely large.

13. Most economists, regardless of whether they accept the Ricardian equivalence hypothesis, argue that consumption depends on some measure of long-run or 'permanent' income, rather than on current income, because household plans are made over a relatively long horizon. In this paper, my focus is on the role of government spending, taxing and borrowing in the consumption decision and hence the distinction between current and permanent income is ignored.

14. T represents *net* tax payments after deducting all government transfers to households, including payments of interest on the public debt.

15. The wealth of individual households also includes privately-issued financial assets. But for the economy as a whole, holdings of private financial claims are exactly offset by the corresponding private financial liabilities, so that *aggregate* private wealth includes only tangible assets and financial claims on the government (plus net claims on foreigners, which are ignored in this equation). Throughout this paper I assume that it is aggregate wealth that matters so that it is legitimate to 'net out' private financial assets against private liabilities. This assumption amounts to ignoring the effects of the *distribution* of assets and liabilities among households. Similarly, the use of national income rather than personal income as the income variable assumes that the distribution of income between households and corporations (that is, the distribution of profits between dividends and retained earnings) does not affect consumption.

16. As pointed out earlier, Ricardian equivalence implies that households should take account of any *expected future* changes in government spending, since these will imply future changes in taxes. Some studies of the equivalence hypothesis have made consumption depend on "permanent" or long-run government spending, though finding a suitable empirical proxy for this concept is not easy. See, for example, John J. Seater and Roberto S. Mariano, "New tests of the life cycle and tax discounting hypotheses", *Journal of Monetary Economics,* Volume 15, No. 2, March 1985. In this paper I essentially assume that current government spending is the best available forecast of future spending.

17. In the simple examples shown in the following equations, it is assumed that current saving is the only source of increases in real wealth. Other sources of change in real wealth — changes in the nominal prices of assets, the effects of inflation, and the depreciation of tangible assets — are ignored. These factors are discussed below and are incorporated in the empirical work. The examples also ignore foreign investment.

18. To show precisely how each of these factors enters the year-to-year change in the real value of wealth, let A_t represent the real stock of assets at date t, q_t the average price of these assets, d the rate of physical depreciation of assets, and S_t the flow of nominal saving in the year beginning at date t. Then

$$\begin{aligned} q_{t+1}A_{t+1} &= q_{t+1}A_t - dq_{t+1}A_t + S_t \\ &= q_tA_t - dq_{t+1}A_t + (q_{t+1} - q_t)A_t + S_t \end{aligned}$$

This equation says that the *nominal* value of assets at date $t+1$ is equal to their nominal value at date t, minus the physical depreciation occurring during the year beginning at date t, plus the revaluations due to changes in asset prices over that year and plus nominal gross saving in the year.

If p_t is the price of consumption goods in the year beginning at date t, this equation may be written in *real* terms as

$$\begin{aligned} &q_{t+1}A_{t+1}/p_t = \\ &\quad \{[q_tA_t - dq_{t+1}A_t + (q_{t+1} - q_t)A_t]/p_{t-1}\} \\ &- \{[q_tA_t - dq_{t+1}A_t + (q_{t+1} - q_t)A_t]/p_{t-1}\}\cdot\{(p_t - p_{t-1})/p_t\} \\ &+ S_t/p_t \end{aligned}$$

The left side of this expression represents the real value of wealth at the end of year t (date $t+1$). The first term in braces on the right side represents the value, deflated by year $t-1$ prices, of the asset stock at date t, minus the physical depreciation and plus the nominal valuation changes occurring in the year beginning at that date. The second term represents the change in the real value of these assets that results from the change in the general price level (that is, inflation) in year t, while the third term is gross real saving.

19. In principle, the revaluation variable should also be different in the two cases, since in the Keynesian case it should include, and in the Ricardian case it should exclude, changes in the value of the government debt due to variations in the prices of government securities. However, the national balance sheet data that are used in this study do not include estimates of revaluations of the government debt. Unofficial estimates of such revaluations do exist; however, in the interest of using a single consistent data set, these estimates were not used in this paper.

20. For an example, see Flint Brayton and Eileen Mauskopf, 'The Federal Reserve Board MPS quarterly economic model of the US economy', *Economic Modelling*, Volume 2, Number 2, July 1985, pp 182-186, and pp 222-226.

21. See Brian Horrigan and Aris Protopapadakis, 'Federal Deficits: A Faulty Gauge of Government's Impact on Financial Markets', *Business Review,* Federal Reserve Bank of Philadelphia, March/April 1982; and Robert Eisner, *How Real is the Federal Deficit?,* Free Press, New York, 1986.

22. Suppose there is no inflation, the government debt outstanding is $100, the interest rate is 5 percent so that the government's annual interest expense is $5, and this expense is fully paid out of taxes so there is no budget deficit. The inflation rate now rises to 10 percent and as a result the interest rate increases to 15 percent and the annual interest expense to $15. If the government does not raise taxes but instead borrows $10 a year, this will have no effect on the real value of the government debt because the added borrowing will exactly offset the inflation-induced decline in the real value of the previously-existing debt. Relying on this argument, these economists suggest that budget deficits resulting from inflation-induced increases in interest rates will have no effect on private demand.

23. The source of this estimate is Robert J Barro and Chaipat Shakosakul, "Measuring the Average Marginal Tax Rate from the Individual Income Tax", *Journal of Business,* October 1983.

24. Thus, the expected inflation rate in any quarter is being proxied by an average of the actually realized inflation rate before *and after* that quarter.

25. The national balance sheet data contain estimates of the annual depreciation on private tangible assets (including consumer durables) and of the revaluation of tangible, equity and foreign assets due to changes in asset prices. The 'loss' of real wealth due to inflation is calculated by multiplying the real value of wealth at the beginning of the year, less depreciation and plus asset revaluations, by the rate of consumer inflation during the year. In the "Keynesian" equations, real wealth includes, and in the Ricardian equations it excludes, the stock of government debt.

26. Full details of the definitions of the variables used are shown in a Statistical Appendix, available from the author.

27. The federal government sector is defined to include both the Federal Reserve Banks and the Sponsored Credit Agencies and Mortgage Pools, as well as the general government. This means that the undistributed profits of these bodies are included in the income of the federal government rather than the private sector as is done in the national income accounts. The government sectors are defined to exclude, and the private sector is defined to include, the operations of both federal and state and local government employee pension funds.

28. The depreciation variable is the same regardless of the level of consolidation. This is because the national balance sheets do not include the tangible assets of governments and thus all depreciation is on privately-owned tangibles.

29. The private sector includes both households and private business. Hence, the gross income of the private sector includes all corporate profits (except the retained profits of the Federal Reserve Banks) — whether or not these are distributed to households in the form of dividends — and is measured before allowance for depreciation of tangible assets owned by households and business.

30. Private wealth includes the assets of both households and business. In the published balance sheets of the private sector, the assets of corporate businesses are valued at their replacement cost, and the holdings of corporate equities by households and mutual funds, which represent claims to these corporate assets, are netted out. In the measure of private wealth used here, household equity-holdings are not netted out; instead, the value of corporate business assets is represented by the value of corporate equities held by the household sector, either directly or via mutual funds. Correspondingly, revaluations of corporate assets are represented by changes in equity values rather than in the replacement values of the underlying assets. Full details of these adjustments made to the published data are given in the Appendix. Preliminary tests indicated that this method of valuation yielded estimated equations that explained the levels of consumption more closely than equations using the published data.

31. This variable was constructed by estimating a log-linear regression of consumption on time and using the fitted values. That is Trend = Exp[FitLcon], where FitLcon represents the fitted values of the equation:

$$\text{Log(Consn)} = a + b.\text{Time}$$

Since the average growth rates of both income and wealth over the sample period are quite close to that of consumption, similar results would be obtained if the trends in either of these variables were used (although the coefficients on the trend variable itself would be different because the *levels* of these variables are different).

32. This equation also includes a variable that represents the inflation loss on the public's holdings of state and local government debt. This variable is extremely small but is included to ensure that the variables in the equation continue to satisfy the accounting identity in equation (10). It is not statistically significant at conventional probability levels. Since holdings of government debt are valued at par in the balance sheet data, there is no variable representing nominal revaluations of the public's holdings of state and local government debt.

33. Note that when $a_{11} = -a_1$ and $a_{22} = -a_2$, equation (14) is identical to equation (12). That is, the second or 'hybrid' equation in Table 1, defined income and wealth so as to impose these restrictions.

34. When $a_{11} = -a_1$ and $a_{22} = -a_2$, equation (16) is identical to equation (13). That is, the third or 'fully Ricardian' equation in Table 1, defined income and wealth so as to impose these restrictions.

35. Recall, however, that Ricardo himself was dubious of the hypothesis which today bears his name.