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On the Costs and Benefits of Anti-Inflation Policies

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A prominent policy issue of the 1970s and one that seems certain to dominate the early 1980s is the appropriate response to a prevailing high rate of inflation. The view that there is a *long-run* trade-off between inflation and unemployment, widely accepted at the end of the sixties, is now held by only a small minority of economists. It is still widely believed, however, that there is a *short-run* trade-off between inflation and unemployment, which implies that restrictive macroeconomic policies designed to reduce inflation would cause a temporary rise in the unemployment rate. Therefore, both the time pattern of the response of inflation and unemployment to demand management policies and the relative cost of inflation and unemployment remain dominant issues in the design of macroeconomic policy.

There is relatively little consensus on either the costs or benefits of reducing inflation. Both income-expenditure and monetarist macroeconometric models indicate that a deceleration in monetary growth would gradually eradicate inflation but at a sizable cost in terms of foregone output. In contrast, recent theoretical analysis based on "rational expectations" suggests that the cost of reducing inflation could be small. Moreover, the literature contains still less information on the cost of inflation, which makes it difficult to obtain a careful balancing of the costs and benefits of policies intended to reduce or eliminate inflation.

This paper develops three views of the dynamics of inflation and unemployment: the expectations-augmented Phillips Curve model, a monetarist model of the relation of monetary change to both inflation and unemployment, and a rational expectations model. Based on each of these models, estimates of the cost of reducing inflation are presented. Finally, the size of the permanent per period gains associated with eradicating inflation that would justify incurring these temporary costs are estimated using both the Phillips Curve and monetarist models.

THREE VIEWS OF THE RELATION BETWEEN INFLATION AND UNEMPLOYMENT

The Phillips Curve approach, as employed in virtually all large-scale, income-expenditure macroeconometric models, relates inflation to the unemployment rate and inflation expectations and almost uniformly specifies inflation expectations as dependent exclusively on past actual inflation rates. Some monetarists, however, prefer to relate both inflation and unemployment directly to monetary change and reject the regularity between inflation and unemployment embodied in the Phillips Curve. A third view accepts the Phillips Curve but introduces an alternative hypothesis about expectations formation. This rational expectations approach yields conclusions quite different from the first two approaches.

The Phillips Curve

The Phillips Curve relates the rate of change in nominal wages to both the unemployment rate and the rate at which wages and/or prices are expected to rise. This is usually combined with a mark-up model of price determination in which prices are related to wages. A combination of the two hypotheses yields a relation between inflation (p), unemployment (u), and expected inflation (p^e):

$$(1)\ p = \alpha + \beta u + p^e, \quad \beta < 0.$$

There are two basic sources of inflation identified in equation 1: a *demand* factor and an *expectations* factor. The unemployment rate is a proxy for the balance between supply and demand in the labor market. The lower the unemployment rate, the greater the demand relative to the supply of labor. When there is excess demand for labor, wages are bid up at a rate proportional to the degree of excess demand. Workers and firms bargain directly about nominal wages, but labor supply and demand depend on the real wage rate.[1] Hence, the bargaining for nominal wage increases over any period will also depend on the rate of inflation expected over that period.

According to the Phillips Curve perspective, demand management policies affect inflation by affecting aggregate demand and, hence, unemployment. While in principle economic policy could affect inflation expectations directly, the specification of the Phillips Curve in macroeconometric models generally assumes that inflation expectations are formed *adaptively,* that is, they depend exclusively on past inflation rates. A simple form for such an equation is:

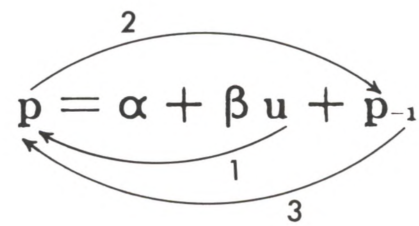
(1′) $p_t = \alpha + \beta u_t + p_{t-1}$,

where p_t is the rate of inflation over some period, u_t is the average unemployment rate over the period, and p_{t-1} is last period's inflation rate and, hence, this period's expected rate.

The role of lagged inflation in the Phillips Curve may also reflect the direct influence of past wage and price changes on current inflation due to catch-up effects and long-term contracts. Contracts that fix wages over some period, typically from one to three years, permit current wage settlements to influence wages and prices over the duration of the contract, building an element of persistence or inertia into the inflation process.[2]

In the specification given by equation 1′, there exists a critical unemployment rate consistent with either price stability or constant inflation.[3] Setting $p_t = p_{t-1}$, the critical value of u is $u^* = -\alpha/\beta$. This is often referred to as the natural rate of unemployment or the nonaccelerating inflation rate of unemployment

Figure 1



(NAIRU). Anti-inflation policy operates by raising u above u*; as long as u is greater than u*, inflation decelerates and ultimately is eradicated.

Figure 1 depicts this cycling down process. First, policy reduces aggregate demand. This raises u above u* and induces a deceleration in inflation (link 1). The decline in the actual inflation rate, in turn, reduces inflation expectations via the p_{-1} term (link 2), which further reduces actual inflation in the next period (link 3). As long as u remains above u*, this cycling down continues. Ultimately, u returns to u* when inflation has been fully eradicated. Thus, eradicating inflation requires a *temporary* rise in the unemployment rate during the transition to price stability.

Monetarist Reduced-Form Equations

Stein has developed a "monetarist" framework for assessing the relation between inflation and unemployment.[4] Stein's basic inflation equation can be expressed as:

(2) $p_t - p_{t-1} = a\,(m_t - p_{t-1})$,

where m_t is the rate of monetary growth in period t. According to this specification, inflation accelerates when monetary growth exceeds the previous period's rate of inflation.

The distinctive feature of the monetarist equation is not that it identifies monetary growth as the key factor driving inflation while the Phillips Curve ig-

[1]If escalator clauses were both universal and complete, bargaining would be in terms of real wages. The existence of partial escalator clauses for some workers speeds the response of wage to price change, but doesn't alter the fact that nominal wage bargains must directly reflect inflation expectations over the duration of the contract.

[2]See John B. Taylor, "Staggered Wage Setting in a Macro Model," *American Economic Review, Papers and Proceedings* (May 1979), pp. 108-13, for a model that incorporates both forward-looking and backward-looking elements in the wage setting decisions.

[3]The existence of an equilibrium or natural rate of unemployment independent of the rate of inflation depends on the coefficient of inflation expectations in equation 1 or lagged inflation in 1′ being equal to unity.

[4]Jerome L. Stein, "Inflation, Employment and Stagflation," *Journal of Monetary Economics* (April 1978), pp. 193-228. Similar approaches have been presented by Carlson and Tatom: Keith M. Carlson, "Inflation, Unemployment, and Money: Comparing the Evidence from Two Simple Models," this *Review* (September 1978), pp. 2-6; and John A. Tatom, "Does the Stage of the Business Cycle Affect the Inflation Rate?" this *Review* (September 1978), pp. 7-15.

nores the influence of monetary change on inflation. The Phillips Curve itself is consistent with monetary change as a dominant influence on the inflation rate. However, it is a specification of the *structure* of the inflation process, that is, how monetary change affects inflation. According to the Phillips Curve interpretation, a decline in monetary growth moderates inflation by temporarily raising unemployment. The monetarist equation, in contrast, directly relates monetary growth to inflation and is essentially a reduced-form equation relating inflation to policy instruments. In contrast to the Phillips Curve, however, equation 2 allows *only* monetary change to affect inflation. It also appears to make the acceleration of inflation independent of demand conditions in the economy. In fact, however, the unemployment rate itself is also affected by monetary growth in the Stein model.[5] Hence, in both the Phillips Curve and monetarist frameworks, a decline in monetary growth both increases unemployment *and* reduces inflation. Both approaches therefore permit us to calculate the temporary rise in unemployment associated with anti-inflation policy.[6]

Equilibrium Models and Rational Expectations

Recently there has been renewed interest in equilibrium models in which monetary change results in an immediate proportional change in the price level.[7] A useful point of departure here is a simple inflation reduced-form equation in which the inflation rate equals the rate of monetary growth:

(3) $p = m$.

This differs from traditional monetarist models in allowing the full effect of monetary change on prices to occur immediately. The Phillips Curve then determines the unemployment rate. It is convenient to rearrange equation 1 as:

(4) $u = u^* + 1/\beta\,(p - p^e)$,

which demonstrates that unemployment deviates from its natural rate only in response to *unanticipated* inflation.

Monetary change determines the actual inflation rate (via equation 3). Inflation expectations, according to the rational expectations view, are formed on the basis of the relevant economic theory — in this case on the relevant model of the inflation process — and are conditional on all relevant available information. Taking the expected value of inflation from equation 3,

(5) $p^e = E(p) = E(m)$,

where $E(m)$ is the expected rate of monetary growth conditional on information available prior to the period over which the expectations apply, equation 4 can be rewritten as:

(4′) $u = u^* + 1/\beta\,(m - E(m))$.

This implies that unemployment is affected only by *unanticipated monetary change.*

In the previous two models, a deceleration in monetary growth reduces the growth in nominal demand, but inflation unwinds gradually; the decline in the growth of nominal demand, therefore, initially falls heavily on real demand and, hence, initially reduces output and employment. In this model, in contrast, monetary deceleration increases unemployment only if the monetary deceleration is unexpected. If it is announced in advance and reflected in expectations, a rapid deceleration of inflation results with no temporary rise in unemployment and, hence, no cumulative output loss.

However, a question remains: How rapidly would the expected rate of monetary growth decelerate even if the Fed announced a policy of phased deceleration? Barro's attempt to implement this model empirically holds that economic agents base their expectations of monetary growth in part on past monetary growth.[8] In a sense, such a specification substitutes past actual rates of monetary growth for past actual inflation rates and, therefore, does not entirely remove the inflation inertia embedded in the traditional Phillips Curve. Meltzer also has recently emphasized the gradual process whereby expectations of future monetary growth respond to current observations of monetary policy actions.[9] The overall framework,

[5]Stein's unemployment rate equation is presented later when his model is used to derive the response of inflation and unemployment to monetary change.

[6]Note, however, that inflation is expected to fall as long as $u > u^*$ according to the Phillips Curve; in the monetarist model, on the other hand, an acceleration in monetary growth induces an acceleration in inflation even if the unemployment rate initially is above its critical u^* level. Despite this difference, the two approaches yield similar implications for the time path of unemployment and inflation in response to a deceleration in monetary growth.

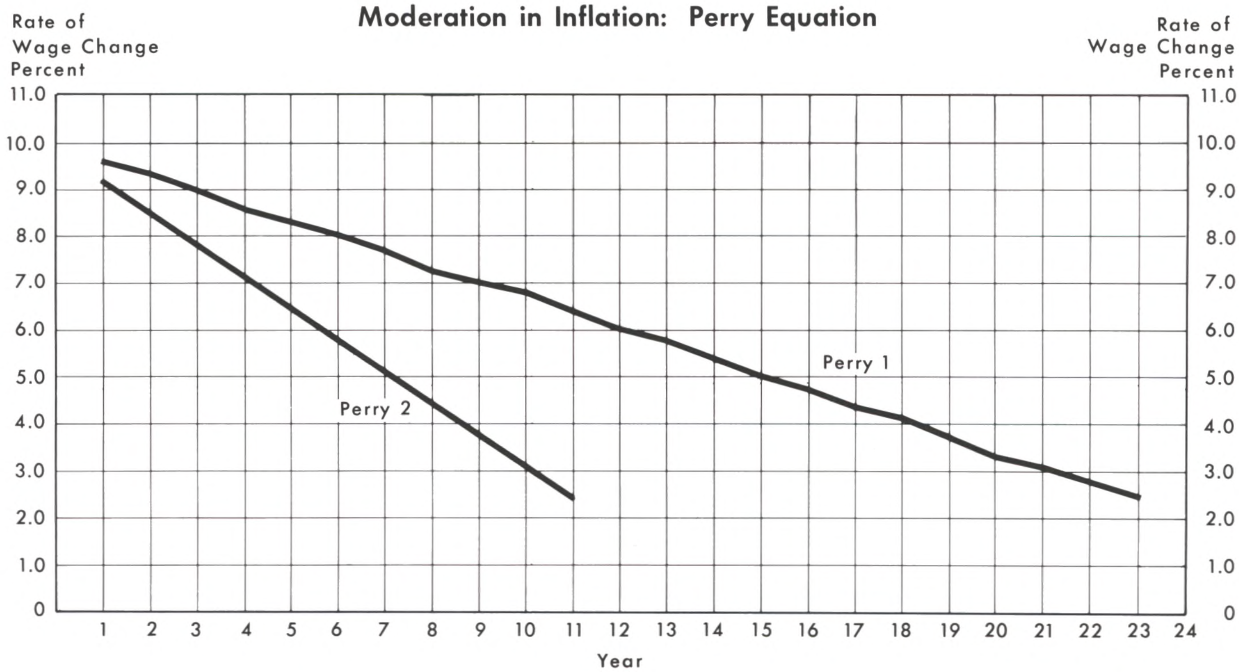
[7]For example, see Thomas J. Sargent and Neil Wallace, "Rational Expectations and the Theory of Economic Policy," *Journal of Monetary Economics* (April 1976), pp. 169-85. The model developed below is similar to the one developed by Sargent and Wallace.

[8]Robert J. Barro, "Unanticipated Money Growth and Unemployment in the United States," *American Economic Review* (March 1977), pp. 101-15.

[9]Allan H. Meltzer, "The Case for Gradualism in Policies to Reduce Inflation," *Stabilization Policies: Lessons from the 1970s and Implications for the 1980s* (St. Louis: Washington University, Center for the Study of American Business), forthcoming.

Chart 1

Moderation in Inflation: Perry Equation



however, suggests that the Fed can minimize the cumulative output loss by carrying out its anti-inflation policy in a manner that makes it easy for the public to discern its intent; this means developing a reputation for meeting its monetary aggregate targets and reducing the volatility of monetary growth so it is easy to recognize changes in the target rate when they occur.

THE RESPONSE OF INFLATION AND OUTPUT TO ANTI-INFLATION POLICY

Results Based on Estimated Phillips Curves

When developing an estimate of the cost of anti-inflation policy using a Phillips Curve, anti-inflation "policy" is identified with an increase in the unemployment rate above the critical rate. Underlying the change in the unemployment rate, but implicit in the analysis, are changes in monetary and fiscal policy instruments. As long as the unemployment rate is maintained above the critical rate, inflation will decelerate. Based on the assumed initial inflation rate and on the estimated parameters in the Phillips Curve, it is simple to calculate how long it will take to eradicate inflation.

The final step in estimating the cost of an anti-inflation policy is to convert the increased unemployment into a measure of the cumulative output loss. This is done via Okun's Law: Each 1 percentage point increase in the unemployment rate reduces real output by 3.2 percent.[10] Thus, at the 1978 value for potential output, for example, a 1 percentage-point rise in unemployment translates into a 45.6 billion dollar loss in output. The cumulative but undiscounted loss can be found by assuming that potential output will rise at a 3.3 percent rate in line with projections by the CEA. The cumulative loss (L) in this case is:

$$(6)\ L = \sum_{t=0}^{n} \gamma\,(u - u^*)\,(1 + \rho)^t,$$

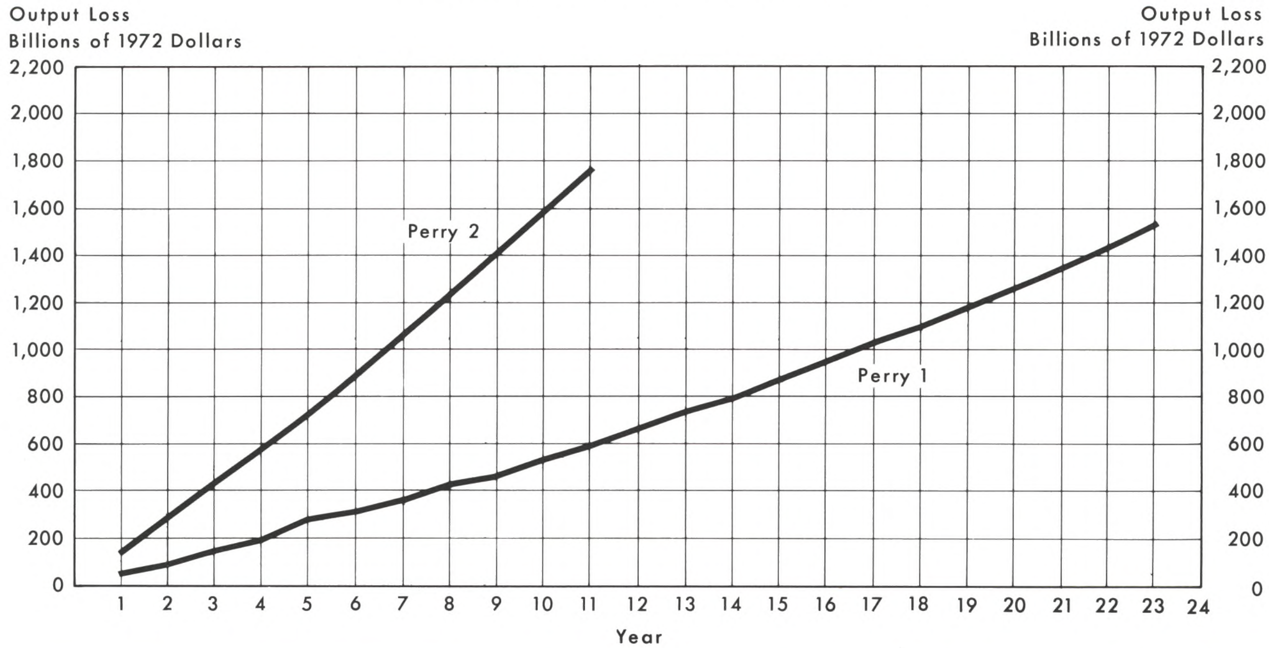
where,

γ = the Okun coefficient,
u = the level of unemployment brought on by policy,
u^* = the critical unemployment rate,
ρ = the rate of growth of potential output, and
n = the number of years required to eradicate inflation.

[10] Arthur M. Okun, "Potential GNP: Its Measurement and Significance," from *Proceedings* of the Business and Economics Statistics Section of the American Statistical Association (1962), pp. 98-104. More recent estimates of Okun's Law suggest that the output loss might be only 2.5 percent for each 1 percent increase in unemployment. See, for example, the estimates in the St. Louis model in Leonall C. Andersen and Keith M. Carlson, "A Monetarist Model for Economic Stabilization," this *Review* (April 1970), pp. 7-25, and Tatom's discussion of Okun's Law in "Does the Stage of the Business Cycle?"

Chart 2

Cumulative Output Loss: Perry Equation



The discounted output loss is simply the product of the initial year's loss and the number of years required to complete the program.[11]

The estimate of the cumulative output loss based on a Phillips Curve equation presented in this section is derived from the results of a study by Perry.[12] Perry's results are based on a wage change equation, using the inverse of his weighted unemployment rate and lagged wage change, estimated using annual observations over the 1954-77 period:

$$(7)\quad \Delta \ln W = \underset{(-2.2)}{-1.88} + \underset{(3.5)}{7.44}\,(1/Uw) + \underset{(4.6)}{0.79}\,\Delta \ln W_{-1} + \underset{(1.1)}{0.21}\,\Delta \ln W_{-2} + \underset{(2.9)}{1.07}\,DNIX \qquad SE = 0.70,$$

where W is adjusted hourly earnings in the private nonfarm sector and DNIX is a dummy for the controls equal to –1 in 1972 and 1973 and +1 in 1974 and 1975. His preferred equation yielded a NAIRU of 4.0 in terms of his weighted unemployment rate (which corresponds to about 5.5 percent in the official unemployment rate in 1977). Hence, any unemployment rate above 5.5 percent, if maintained long enough, would eradicate inflation.

In the following simulations, inflation is assumed initially to be 7.5 percent, and the economy is assumed initially to be at the critical unemployment rate (NAIRU). The time it would take to eliminate inflation if unemployment were raised by either 1 or 3 percentage points is then calculated.

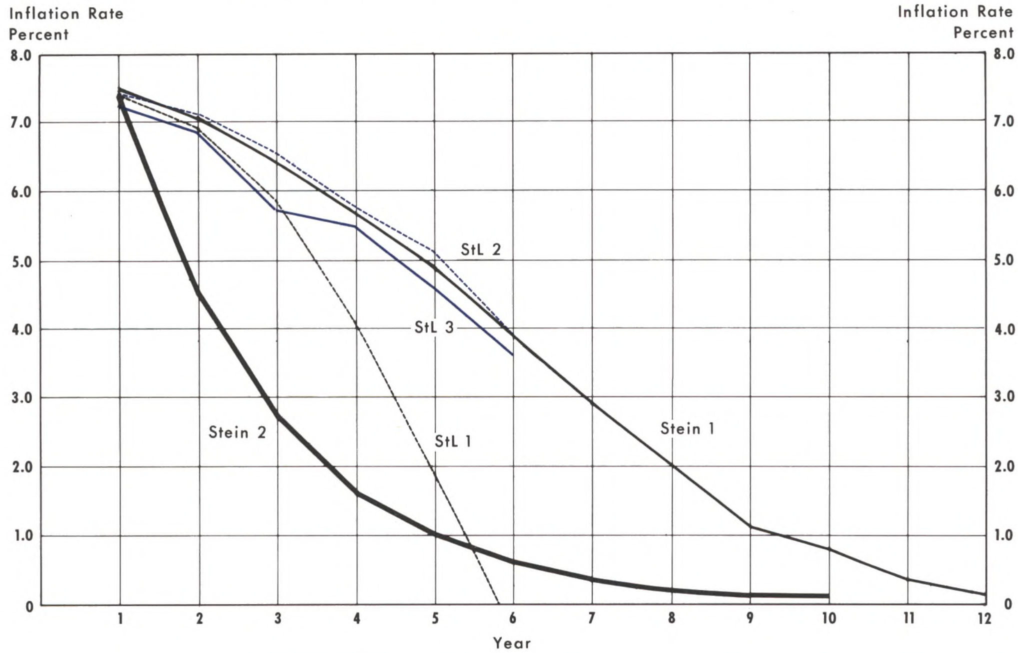
The response of inflation to a rise in the unemployment rate and the accompanying cumulative output loss are depicted in charts 1 and 2: Perry 1 corresponds to a 1 percentage point rise in the unemployment rate and Perry 2 to a 3 percentage-point rise. Beginning with $\Delta \ln W$ (approximately the percentage change in the wage rate) equal to 10 percent, the unemployment rate is raised above NAIRU and held there until the rate of wage change declines to 2.5 percent, the rate presumed consistent with the trend growth in labor productivity and, hence, with price stability. When unemployment is raised 1 percentage point, the rate of change in the wage rate falls from 10 percent to 9.6 percent in the first year and declines about 0.3 percentage points per year thereafter, taking 23 years to reach the 2.5 percent rate consistent with zero price inflation. The undiscounted cumulative output loss is $1.5 trillion, and the discounted cumulative output loss is $1 trillion.

[11]This is the same as discounting future years' losses by a 3.3 percent real interest rate.

[12]George L. Perry, "Slowing the Wage Price Spiral: The Macroeconomic View," *Brookings Papers on Economic Activity* (2: 1978), pp. 259-91. Similar estimates have been presented by Okun and Gramlich. Arthur M. Okun, "Efficient Disinflationary Policies," *American Economic Review, Papers and Proceedings* (May 1978), pp. 348-52; and Edward M. Gramlich, "Macro Policy Responses to Price Shocks," *Brookings Papers on Economic Activity* (1: 1979), pp. 125-66.

Chart 3

Moderation in Inflation: St. Louis and Stein Models



If unemployment is raised by 3 percentage points, inflation is eliminated after 11 years. The cumulative output loss, however, is greater in this case: \$1.8 trillion in the undiscounted case and \$1.5 trillion in the discounted case.[13]

Results Based on a Monetarist Model

According to Stein's monetarist model, monetary change affects both inflation and unemployment. Stein's two-equation model is:

(8) $\Delta u_t = 3.0 - 0.6\, u_{t-1} + 0.4\, p_{t-1} - 0.4\, m_{t-1}$

(9) $\Delta p_t = - 0.4\, p_{t-1} + 0.4\, m_{t-1}$.

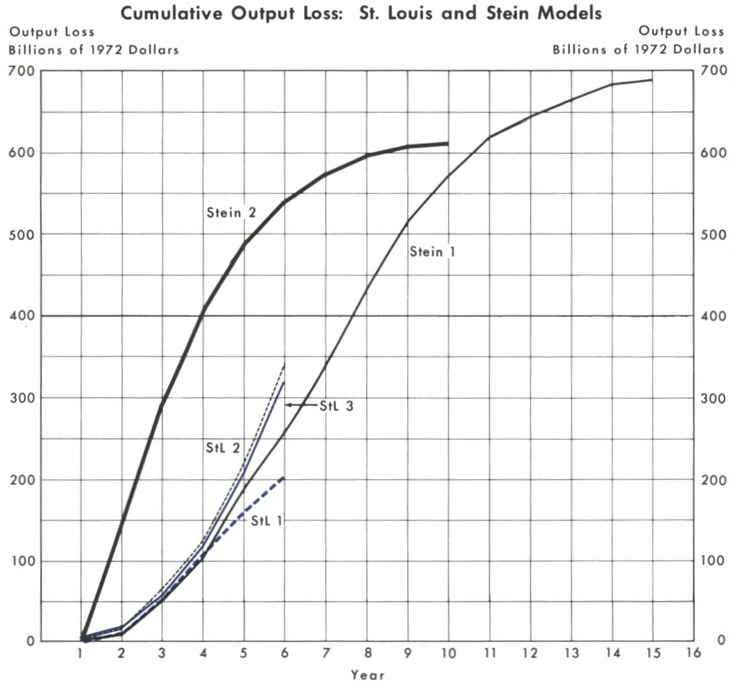
If monetary growth remains constant, inflation converges to the rate of monetary growth, and unemployment converges to a constant rate, equal to 5 percent in Stein's model. Hence, the equilibrium rate of inflation equals the rate of monetary growth, and the critical unemployment rate is 5 percent. If monetary growth declines below the rate of inflation, inflation decelerates and unemployment temporarily rises above its equilibrium rate.

The simulation used to derive an estimate of the cumulative output loss from Stein's model differs from that used in the Phillips Curve approach. Since inflation and unemployment are both linked directly to monetary change in the monetarist model, the rate of monetary growth can be used as the policy instrument. Assume that the rates of monetary growth and inflation are both 7.5 percent initially and that the economy is at the equilibrium unemployment rate. Anti-inflation policy is identified with a deceleration in the rate of monetary expansion. Now, consider two scenarios: a phased deceleration of monetary growth by 1 percentage point per year until the rate of monetary growth declines to a rate which, if maintained, would be consistent with price stability (zero in this model) and an immediate deceleration to the rate consistent with long-run price stability. Imposing these alternative paths of monetary change on the model generates the associated implied paths of inflation and unemployment; the rise in unemployment above 5 percent is then translated into a measure of the cumulative output loss.

The effects of each policy on inflation and output loss are depicted in charts 3 and 4; the Stein 1 lines correspond to the gradual deceleration in monetary

[13]While most reported Phillips Curves yield high estimates of cumulative output loss in line with Perry's, there are some that imply much lower estimates. For example, see the Phillips Curve presented by Phillip Cagan in "The Reduction of Inflation by Slack Demand," in William Fellner, Project Director, *Contemporary Economic Problems in 1978* (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1978), pp. 13-45. The cumulative output loss based on Cagan's equation is only about one quarter of that implied by Perry's equation.

Chart 4
Cumulative Output Loss: St. Louis and Stein Models



growth, the Stein 2 lines represent the more aggressive policy. Under the gradual policy, unemployment begins to rise in year 2, peaks in year 8 at 6.6 percent, and returns to almost 5 percent by year 16. The inflation rate, on the other hand, begins to decelerate in year 2, initially at a 0.4 percentage point a year rate, ultimately reaching 1.0 point per year by year 7. The inflation rate is down to 2 percent by year 8 and thereafter declines gradually to about zero by year 16. The undiscounted cumulative output loss is $687.5 billion. Interestingly, the more aggressive policy incurs a smaller undiscounted output loss, $613 billion.

Note that, *qualitatively*, the results are similar to those based on the Phillips Curve: Restrictive demand management policy temporarily will raise unemployment as it induces deceleration in the rate of inflation. The size of the cumulative output loss in the Stein model, however, is dramatically lower than that based on Perry's equation.

Results Using the St. Louis Model

The St. Louis model is in some sense a compromise between the Phillips Curve and the monetarist reduced-form approaches developed above.[14] The two key equations in the St. Louis model are a reduced-form equation for the rate of growth in nominal income based on the Andersen-Jordan equation and an expectations-augmented Phillips Curve.[15] The rate of monetary change is the principal determinant of the rate of change in nominal income, although the rate of change in high-employment government expenditures also has a small, transitory effect. Thus, a decline in the rate of monetary growth is quickly translated into a decline in the rate of increase in nominal income. The distribution of the latter decline between prices and output depends on the Phillips Curve; the slower the deceleration of inflation as nominal income falls, the greater the impact of monetary change on output and the greater the resulting cumulative output loss of anti-inflation policy.

To begin, a base run in which the rate of monetary growth is held steady at 7.5 percent from III/1968 through IV/1978 was generated. This builds in inflation inertia and provides the base against which to evaluate the effects of gradual monetary deceleration. Beginning in I/1973, monetary growth was gradually decelerated by 1 percentage point in the first quarter of each year. The results from this policy run were then compared with those from the base run and the cumulative output loss associated with this policy was derived by comparing the output solution assuming monetary growth remains at 7.5 percent per year with that assuming a phased monetary deceleration.[16]

The first set of simulations was generated using the St. Louis model estimated over the sample period I/1953-IV/1978. The results, labeled StL1, are reported in charts 3 and 4. The inflation rate begins to decline slowly; indeed, it takes 2 years to reduce it by 1 percentage point. Thereafter, the deceleration speeds up; after 5½ years, inflation has declined by 7.5 percentage points. The unemployment rate initially rises slowly, and the maximum increase is only 1.8

[14]The St. Louis model is described in Andersen and Carlson, "A Monetarist Model."

[15]Leonall C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," this *Review* (November 1968), pp. 11-24.

[16]Because the model produces direct solutions for the response of output to monetary deceleration, the use of Okun's Law is not required.

percentage points. The undiscounted cumulative output loss is only about $200 billion.[17]

The estimate of the cumulative output loss in this case is dramatically lower than for either the Stein model or the Perry equation. However, the small size of the cumulative output loss reflects, in part, the suspiciously large coefficient on the demand slack variable in the model's Phillips Curve — almost three times the size of the same coefficient estimated through II/1971 or I/1975, for example. This rise in the demand slack coefficient is neither readily explained nor mirrored in other estimates of Phillips Curves. Consequently, two additional runs with modified versions of the St. Louis model were made.

First, a simulation of the model estimated through III/1971 in which the coefficient on the demand slack variable is substantially smaller was run. The results are depicted by the StL2 lines in charts 3 and 4. Inflation decelerates much more gradually; after six years, it has declined by only 4 percentage points. The cumulative output loss, already at $350 billion, is escalating rapidly.

In the second modified version of the St. Louis model, the Phillips Curve was replaced with a monetarist reduced form for the inflation rate in which inflation depends on a 20-period distributed lag on the rate of change in the money supply.[18] The lines labeled StL3 in charts 3 and 4 present the implications of gradual monetary deceleration on inflation and output in this case. The results are remarkably similar to those generated by the first modified version of the St. Louis model (StL2 lines in charts 3 and 4). The inflation rate declines somewhat more rapidly and the output loss is a bit smaller, but both the time pattern and magnitude of inflation deceleration and output loss are very close.

The StL2 and StL3 simulations were not run long enough to eradicate inflation and, therefore, are not directly comparable with the Phillips Curve and monetarist reduced-form results. Nonetheless, the results at the end of six years were qualitatively similar to the Perry and Stein results: Anti-inflation policies impose a sizable cost in the form of lost output during the transition to lower inflation rates.[19]

The Credibility Effect and Rational Expectations

The Phillips Curve-based results reported above related inflation to a distributed lag of past inflation rates, which implies a gradual unwinding of inflation in response to anti-inflation policies. In this specification, inflation expectations are formed exclusively on the basis of *past* actual inflation. This ignores the possibility that the public will adjust their inflation expectations to both recent policy actions and expectations about future policy. A well-defined, credible anti-inflation policy might induce a more rapid deceleration of inflation expectations than is suggested by the conventional equations. Fellner, for example, maintains that ". . . the standard model coefficients . . . would change significantly for the better — in the direction of a much more rapid rate of reduction of inflation for any given slack — if a demand management policy . . . changed to a credible policy of consistent demand disinflation."[20]

But, by how much do standard econometric approaches overestimate inflation inertia and the associated cumulative output loss? Unfortunately, reliable quantitative estimates of the extent to which policymakers can speed the deceleration of inflation by clearly defining their anti-inflation policies and convincing the public that they intend to follow through do not exist. Nevertheless, there is widespread agreement that anti-inflation policies ought to be set out clearly and supported by both the Federal Reserve and the Treasury to maximize credibility.

There are, however, two empirical applications of rational expectations macro models that provide some insight into the predictions of that approach for the response to a phased monetary deceleration. Paul A.

[17]In the Perry and Stein results, the initial level of potential output was that for 1978. The $200 billion cost estimate for the St. Louis model is based on an initial level of income in 1973. To make the St. Louis result comparable with the Perry and Stein results, it would be appropriate to multiply it by a factor equal to the ratio of potential output in 1978 to that in 1973.

[18]The inflation reduced form was provided by Tatom and is similar to the one he presented in "Does the Stage of the Business Cycle?" In addition to the distributed lag on monetary change, it also includes a four-quarter distributed lag on the differential in the rates of change in producer prices for energy and the price index for the nonfarm business sector, as well as two dummies, one for the effects of the freeze and Phase II and one for the subsequent catch-up effect.

[19]Dewald recently presented simulations of the response of inflation, output, and unemployment to monetary deceleration based on a modified version of the St. Louis model. William G. Dewald, "Fast vs. Gradual Policies for Controlling Inflation," Federal Reserve Bank of Kansas City *Economic Review* (January 1980), pp. 16-25. He estimates the Phillips Curve in the rate of change as opposed to the first difference form used in the St. Louis model. This procedure does not yield a coefficient on the demand slack variable as high as in the St. Louis specification. Hence, Dewald also finds that monetary deceleration yields a large cumulative output loss.

[20]William Fellner, "The Credibility Effect and Rational Expectations: Implications of the Gramlich Study," *Brookings Papers on Economic Activity* (1: 1979), pp. 167-78.

Anderson modifies the St. Louis model by respecifying its Phillips Curve to be consistent with rational expectations.[21] He begins with a Phillips Curve of the following form:

$$(10)\ p = \alpha + \beta\chi + ep^e + \varepsilon,$$

where χ is a measure of demand slack in the economy, and ε is a random disturbance term with mean zero. Instead of specifying p^e as a distributed lag on past actual inflation rates as in the equation in the St. Louis model, Anderson imposes rational expectations by setting p equal to the expected value of inflation based on equation 10. Setting $p^e = E(p)$, he solves for the expected value of inflation:

$$(10')\ E(p) = \frac{\alpha}{1-e} + \frac{\beta}{1-e}\chi.$$

Anderson uses this equation to determine the inflation rate in the St. Louis model, based on the estimates of α, β, and e from the St. Louis Phillips Curve. In particular he sets e = .86. This procedure, in effect, dramatically raises the response of inflation to changes in demand slack. He runs simulations of the response to an acceleration in the rate of monetary growth. In the original St. Louis version, inflation increases gradually and unemployment declines; in the rational expectations version, inflation increases more rapidly and the effect on unemployment virtually disappears.

If e is viewed as the coefficient on expected inflation, however, it seems inappropriate to employ its value of .86 as estimated in the St. Louis model in the rational expectations version of the St. Louis model because it was estimated originally under the assumption that expectations are formed adaptively. Taking e = 1, as seems essential to the rational expectations framework, equation 10′ is no longer a meaningful equation for p. Instead, setting $p^e = E(p)$ and solving for E(p), we obtain:

$$(10'')\ 0 = \alpha + \beta\chi,$$

which indicates that there is a unique value of the demand slack variable ($\chi^* = -\alpha/\beta$), corresponding, of course, to the natural rate of unemployment. Only random disturbances (with zero mean) can cause χ to differ from χ^*. In this case, the impact of monetary deceleration on the rate of growth of nominal income is transformed immediately and fully into a decline in inflation without any cumulative output loss.

An alternative empirical application of a rational expectations macro model is presented by Barro.[22] He relates deviations in unemployment from its natural rate to unanticipated monetary change (as in equation 4′ above) and, in addition, provides a model describing how economic agents form expectations about the rate of monetary growth. On the surface at least, Barro's model seems well suited to provide an estimate of unemployment's response to a policy of phased deceleration in monetary growth. The crucial issue here is how rapidly economic agents *learn* that the policy rule has in fact changed. They may learn this from an announcement by the Fed. Given some doubt about the Fed's commitment to follow through on any announced deceleration, however, economic agents may insist on learning the new policy rule by observing the new pattern of monetary growth rates. This involves reestimating the policy rule and incorporating new observations each period. Eventually, economic agents will learn that the Fed intends to decelerate monetary growth and then stabilize it at a noninflationary rate. But this learning process may take some time; meanwhile, monetary change will be less than expected and unemployment will exceed the natural rate. Hence, the Barro model also allows for the existence of a cumulative output loss during the transition to price level stability.[23]

The survey above provides the following cost estimates: the extremely large estimate of the cumulative output loss based on Perry's Phillips Curve, the smaller but still sizable loss based on Stein's monetarist model, the evidence from simulations with the St. Louis model which, on balance, also suggest a large output loss, and the rational expectations results as modeled by Anderson, which suggest virtually no output loss if monetary deceleration is perfectly anticipated. Unfortunately, in addition to the uncertainty surrounding the actual cumulative output loss likely to be associated with anti-inflation policy, there is also uncertainty about the benefits to be derived from eradicating inflation.

BALANCING THE GAINS AGAINST THE COSTS

The cumulative output loss is a measure of the *costs* of anti-inflation policies. To evaluate the desirability of such policies, an assessment of the *gains* from reducing inflation is required. Unfortunately, the costs of

[21]Paul A. Anderson, "Rational Expectations Forecasts from Nonrational Models," *Journal of Monetary Economics* (January 1979), pp. 67-80.

[22]Barro, "Unanticipated Money Growth."

[23]This is an application of the learning mechanism emphasized by John B. Taylor, "Monetary Policy During a Transition to Rational Expectations," *Journal of Political Economy* (October 1975), pp. 1009-21; and by Benjamin M. Friedman, "Optimal Expectations and the Extreme Information Assumptions of 'Rational Expectations' Macromodels," *Journal of Monetary Economics* (January 1979), pp. 23-41.

inflation (and hence the benefits of reducing inflation) are not as clear cut or easily quantifiable as the costs of unemployment. Currently, no studies provide estimates of the benefits that would accrue from reducing or eliminating inflation, which could in turn be compared directly to the cumulative output loss required to eradicate inflation. What can be computed, however, is the minimum size of the *permanent* gain in output per year due to the eradication of inflation that would justify incurring the cumulative output loss associated with the transition to price stability.

The Costs of Inflation

There are at least three dimensions to the costs of inflation.[24] First, there are the costs associated with anticipated inflation that would be incurred even in a fully indexed economy where institutions have completely adapted to an inflationary environment. Second, there are the costs of anticipated inflation that arise from a set of institutions that have only partially adapted to the inflationary environment. Third, there are the costs associated with unanticipated inflation and uncertainty about the rate of inflation.

A fully indexed economy is one in which all nominal payments and receipts (including wages, coupon payments, taxes, transfers, etc.) are tied (indexed) to the inflation rate. All debt instruments except for currency are indexed also. Currency is not indexed because indexing it is assumed to be impractical.

The major costs of anticipated inflation in a fully indexed economy can be labeled "menu" and "shoe leather" costs. Menu costs refer to the resource costs imposed by the necessity of frequent adjustments to published price lists in an inflationary economy. Shoe leather costs describe the costs incurred by more frequent trips to the bank (or to the market) as a result of the incentive to economize on currency holdings.[25]

Recently there has been a growing emphasis on the costs imposed by inflation that reflect the existence of institutions that are not fully adapted to an inflationary environment. The major source of these costs is the tax system, and the major effect is on saving and investment incentives and, therefore, on capital accumulation and the growth of output. The taxation of personal interest income, for example, may induce a decline in the after-tax real rate of return to savers as inflation increases.[26] Furthermore, the tying of the depreciation deduction for tax purposes to the historical rather than the replacement cost of capital goods tends to raise the cost of using capital goods in an inflationary environment. While inflation has many other effects on saving and investment, there is growing concern that its net effect is to discourage both saving and investment.

Unanticipated inflation imposes costs by inducing redistributions of income and wealth. These "transfer effects" arise because contracts have been written in nominal terms embodying expectations about future inflation which turn out to be incorrect. The social cost of such redistributions is difficult to assess because there is a gainer for every loser. However, many consider the "transfer" costs associated with unanticipated inflation the most serious cost associated with inflation.[27]

Uncertainty about the inflation rate may impose additional costs by increasing the uncertainty associated with the outcome of economic decisions. Above, a cost was ascribed to the actual redistributions that follow from unanticipated inflation. There may also be utility losses associated with the increased likelihood of such arbitrary transfers when there is considerable uncertainty about expected inflation. A number of studies have suggested that inflation uncertainty tends to be systematically related to the level of inflation. If this is the case, reducing the level of inflation will also reduce inflation uncertainty.[28]

Fischer and Modigliani do not provide estimates for the various effects of inflation since "any measures

[24]The discussion of the costs of inflation in this section draws upon the recent survey by Stanley Fischer and Franco Modigliani, "Towards an Understanding of the Real Effects and Costs of Inflation," *Weltwirtschaftliches Archiv* (4: 1978), pp. 810-33.

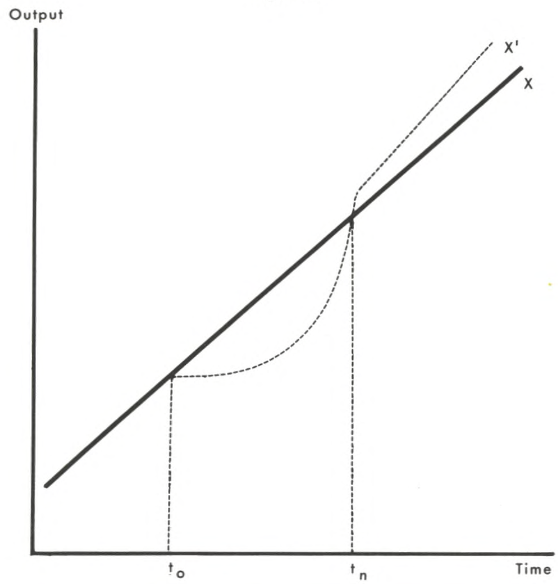
[25]For a discussion of the welfare cost of anticipated inflation, see John A. Tatom, "The Welfare Cost of Inflation," this *Review* (November 1976), pp. 9-22.

[26]For a discussion of the effect of taxation of interest income on the response of nominal interest rates to a change in expected inflation, see Martin Feldstein, "Inflation, Income Taxes, and the Rate of Interest: A Theoretical Analysis," *American Economic Review* (December 1976), pp. 809-20.

[27]Franco Modigliani and Lucas Papademos, "Optimal Demand Policies Against Stagflation," *Weltwirtschaftliches Archiv* (4: 1978), pp. 736-82.

[28]See, for example, Arthur M. Okun, "The Mirage of Steady Inflation," *Brookings Papers on Economic Activity* (2:1971), pp. 485-98; and Dennis E. Logue and Thomas D. Willett, "A Note on the Relation Between the Rate and Variability of Inflation," *Economica* (May 1976), pp. 151-58. These studies generally associate an increase in inflation uncertainty directly with an increase in the welfare cost of inflation. This follows only if increased uncertainty about inflation increases uncertainty about real income, real wealth, etc. For a discussion of the relation of inflation uncertainty to the welfare cost of inflation, see Lionel Kalish III, Laurence H. Meyer, and David H. Resler, "Inflation Uncertainty and the Welfare Cost of Inflation," mimeographed (Federal Reserve Bank of St. Louis, 1980).

Figure 2



would be totally speculative at this stage."[29] In the absence of a measure of these costs, however, it is possible to compute the *minimum* total costs associated with continued inflation necessary to justify incurring the previously calculated costs of eradicating inflation.[30]

Evaluating the Minimum Gain Per Year Required to Justify Policies to Eradicate Inflation

The solid line (X) in figure 2 is the rate of growth of potential output if inflation remains indefinitely at 7.5 percent. If anti-inflation policies are pursued, output is assumed to follow the dashed line (X′). The transitional costs of eradicating inflation occur between t_o and t_n as unemployment rises above the rate associated with potential output.

The cost of inflation may involve decreases in potential output due to disincentives to saving and/or investment and/or welfare losses due to anticipated or unanticipated inflation. The benefit of eradicating inflation is shown in figure 2 as an increase in output above the level that would have prevailed had inflation continued to average 7.5 percent; hence, the dashed X′ line rises above the solid X line after t_n.[31] This analysis emphasizes the necessity of comparing the *transitional* cost incurred over the period during which inflation is eradicated with the *permanent* benefit attributable to the eradication of inflation.

Table 1
The Minimum Value of the Per Year Gain (g) That Justifies Eradicating Inflation (billions of 1972 dollars)

Equation/ model	Value of g
Perry 1	$73.0
Perry 2	70.9
Stein 1	31.0
Stein 2	25.4

G is the present value of the permanent per period output gain, evaluated from period n to ∞:

$$(11)\ G = \sum_{t=n}^{\infty} \frac{g_t}{(1+r)^t}.$$

To simplify further, g_t is assumed to be constant for all $t \geq n$. The value of g, which equates the discounted cost of unemployment and the gain from eradicating inflation is then calculated. This is the minimum value of the permanent per period gain from eradicating inflation that would justify incurring the transitional costs. The values of g, based on transitional costs estimated from the Perry equation and Stein model and calculated under the assumption of a 3.3 percent discount rate, are presented in table 1. The minimum value of g varies from about $25 billion per year in the Stein model to $73 billion based on Perry's Phillips Curve under a moderate policy.

This analysis provides an alternative perspective on the case for gradualism. A gradual policy will impose a lower cost of eradicating inflation if the Phillips Curve is nonlinear. For Perry's nonlinear Phillips Curve, for example, the discounted cost was $1.0 billion for the gradual policy and $1.5 billion for the

[29]Fischer and Modigliani, "Towards an Understanding of the Real Effects and Costs of Inflation," p. 813.

[30]This approach was suggested to us by Jerry Jordan and Allan Meltzer.

[31]The gains of reducing inflation should begin being registered during the transition period. To simplify the calculation, the benefits are assumed to begin only at t_n, when inflation is eradicated. This assumption biases the calculation of the present value of benefits downward.

more aggressive policy. A more gradual policy, however, also postpones the benefits from eliminating inflation. The size of the permanent per period gain required to justify the anti-inflation policy may therefore be smaller under the more aggressive policy. Indeed, this is the case for the Perry results. Although the cumulative output loss is smaller under the gradual policy (Perry 1), the size of the per period gain required to justify eradicating inflation is smaller under the more aggressive policy (Perry 2). The more aggressive policy also yields a smaller minimum per period gain using the Stein model, although this was expected since the cost turned out to be lower in the radical case using Stein's model.

The calculations reported above presumed that the gains from reducing inflation could be meaningfully represented as a fixed real sum per period. Suppose, instead, that the gains are more meaningfully specified as a real sum which grows at the same rate as potential output. For example, the cost of a fully anticipated increase in inflation is generally measured by the reduction in the area under the demand curve for real money balances as wealthowners reduce their demand for money in response to the associated rise in nominal interest rates. The decline in demand for real money due to a rise in the interest rate is generally considered proportional to the overall scale of money holdings which, in turn, is determined by the level of transactions (e.g., real income). The cost of a given rate of inflation and, hence, the benefits of eliminating inflation may, therefore, grow at the rate of increase of potential output. In this case:

$$(11') \quad G = \sum_{t=n}^{\infty} \frac{g(1+\rho)^t}{(1+r)^t},$$

where g is the value of the gain in period n (the first period in which a gain is registered). For $\rho \geq r$, G $\rightarrow \infty$. This corresponds to the result recently derived by Feldstein: If the cost of inflation grows at a rate equal to or greater than the discount rate, *any positive initial gain (any $g > 0$) is sufficient to justify incurring any finite transitional cost!*[32]

CONCLUSION

The existence of large transitional costs of eradicating inflation is not a sufficient reason to reject anti-inflation policies. The potential existence of large benefits associated with reducing inflation requires a careful assessment of the *net* effects of anti-inflation policies. Unfortunately, the range of the estimates of the cumulative output loss, the uncertainty about the adjustment in those results required to allow for the credibility effect, and the lack of quantitative estimates of the cost of inflation make it extremely difficult to obtain a meaningful comparison of the costs and benefits of an anti-inflation policy. Narrowing the range of estimates of output loss and developing a measure of the benefits associated with anti-inflation policies should be high on the priorities for macroeconomic research in the 1980s.

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[32]Martin S. Feldstein, "The Welfare Cost of Permanent Inflation and Optimal Short-Run Economic Policy," *Journal of Political Economy* (August 1979), pp. 749-67.

Access to the Discount Window for All Commercial Banks: Is It Important for Monetary Policy?

R. ALTON GILBERT

PROPONENTS of legislation to induce or require more banks to be members of the Federal Reserve System often argue that the existence of nonmember commercial banks creates problems for the conduct of monetary policy. Two of the most frequently mentioned of these problems are: First, the ratio of net demand deposits to bank reserves may become more variable as nonmember banks have a larger share of demand deposit liabilities.[1] Second, as banks withdraw from membership, the average ratio of net demand deposits to reserves rises. With a lower average reserve base, fluctuations in reserves due to such factors as changes in float and currency holdings of the public make net demand deposits more variable.[2] These potential problems have been subjected to extensive theoretical analysis.

Recently, a third possible problem with declining membership has been suggested — the fact that nonmember banks do not have access to the discount window on a day-to-day basis. Lack of direct access to the discount window for all commercial banks, it has been alleged, may preclude the adoption of appropriate monetary policy because of the Federal Reserve's concern about the differential impacts of these policies on member and nonmember banks. During periods of tight monetary policy, for example, declining Federal Reserve membership might increase the liquidity risk for the entire banking system, since fewer banks would be able to use the discount window to provide a temporary offset to unexpected reserve outflows.[3]

The validity of this argument hinges on whether credit from the discount window significantly would help nonmember banks adjust to deposit withdrawals. Under existing legislation, the Federal Reserve has the authority to lend to nonmember banks in unusual emergencies in which these banks would fail without additional reserves.[4] Increasing the number of banks that are members, therefore, would not increase the ability of the Federal Reserve to respond to such *emergency* situations.

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[1]Dennis R. Starleaf, "Nonmember Banks and Monetary Control," *Journal of Finance* (September 1975), pp. 955-75; and Kenneth J. Kopecky, "Nonmember Banks and Empirical Measures of the Variability of Reserves and Money: A Theoretical Analysis," *Journal of Finance* (March 1978), pp. 311-18.

[2]See, for example, J. A. Cacy, "Reserve Requirements and Monetary Control," Federal Reserve Bank of Kansas City *Monthly Review* (May 1976), pp. 3-13.

[3]G. William Miller, "Statement," *Monetary Control and the Membership Problem*, U.S. Congress, House, Committee on Banking, Finance, and Urban Affairs, 95th Congress, 2nd Session, July 27, 1978, pp. 60-62; and statements by Sen. William Proxmire and Paul Volcker, Chairman of the Federal Reserve Board, before the U.S. Senate Committee on Banking, Housing, and Urban Affairs, February 4, 1980.

[4]Credit from Federal Reserve Banks is classified as reserve adjustment credit, seasonal credit, and emergency credit. Adjustment credit is available for member banks to meet unexpected temporary credit demands caused by sudden deposit withdrawals or unanticipated loan demand. Seasonal credit is available to relatively small member banks that have seasonal patterns in their deposits and loans. Emergency credit may be made available to member or nonmember banks with severe financial difficulties. For additional information on the conditions under which the Federal Reserve makes credit available to banks, see R. Alton Gilbert, "Benefits of Borrowing from the Federal Reserve when the Discount Rate is Below Market Interest Rates," this *Review* (March 1979), pp. 25-32. This paper analyzes use of adjustment credit by member banks. For an analysis of seasonal borrowing, see Stanley L. Graham, "Is the Fed's Seasonal Borrowing Privilege Justified?" Federal Reserve Bank of Minneapolis *Quarterly Review* (Fall 1979), pp. 9-14.

The type of monetary policy that the Federal Reserve may be precluded from adopting out of concern for liquidity pressures on nonmember banks is presumably *not* that designed to create liquidity emergencies for the banking system. Concern that declining membership would increase liquidity risk to the banking system suggests, rather, that nonmember banks have greater difficulty than member banks in adjusting to *unanticipated deposit withdrawals* or changes in demands for credit in more *normal* circumstances than those emergencies in which the Federal Reserve would make credit available to nonmember banks. Since monetary policymakers are justifiably concerned about possible influences of Federal Reserve membership on the conduct of monetary policy, it is important to clarify whether lack of direct access to the discount window for nonmember banks does, indeed, pose a serious problem for monetary policy.

This article takes an indirect approach to determining whether nonmember banks have greater reserve management difficulties due to lack of access to the discount window. If borrowing from the discount window is a useful way to adjust to unanticipated reserve outflows, member banks would borrow from the discount window on at least a few occasions each year, taking advantage of their regular, reliable, day-to-day access to the discount window to meet unexpected withdrawals or to cushion themselves against temporary liquidity pressures. If, however, most member banks manage their reserve positions without borrowing at the discount window, it is doubtful that nonmember banks have significantly greater difficulty than members in responding to similar reserve outflows. In this case, lack of access to the discount window for nonmember banks is simply irrelevant to the membership issue.

DO MEMBER BANKS BORROW FREQUENTLY FROM THE DISCOUNT WINDOW?

Most member banks do not borrow from the discount window; those few that do so generally borrow infrequently. From 1974 to 1977, the proportion of the 430 member banks in the Eighth District that borrowed in any one year was as high as 25 percent only in 1974, when the discount rate was substantially below alternative short-term interest rates.[5] Of the 115 member banks that borrowed during 1974, only 21 did so on more than 10 occasions, and only 55 borrowed five or more times (table 1).[6] During 1975, only nine banks borrowed five times or more, and in 1976 only 10 banks borrowed that frequently.

The infrequent borrowing of member banks from the Federal Reserve indicates that, in most circumstances, they adjust to reserve losses without resort to the discount window. This is sufficient evidence for rejecting the view that nonmember banks *necessarily* have greater problems than member banks in coping with reserve outflows because they lack direct access to the discount window. If borrowing from the discount window were an important means for banks to adjust their reserve positions to reserve outflows, most member banks would borrow from the discount window.[7] Yet, they do not do so.

HOW DO MEMBER BANKS ADJUST TO RESERVE DRAINS?

Most member banks manage their reserve positions by means other than borrowing at the discount window. This has implications for the significance of the discount window for the banking system's operation.

Effects of Deposit Fluctuations on the Reserve Positions of Member Banks

Cash management by member banks is investigated by considering the factors that determine their desired cash holdings, the types of events that cause their cash holdings to be different from desired levels,

[5]For further discussion of member bank borrowing, see Gilbert, "Benefits of Borrowing from the Federal Reserve."

[6]Although Reserve Banks classify borrowing by member banks as reserve adjustment or seasonal credit, it is often difficult to distinguish the purpose of borrowing in actual practice. Member banks that have the privilege of receiving seasonal credit often change the amount of seasonal credit they borrow daily or weekly. Use of the discount window for reserve adjustment is gauged in this article by the number of occasions on which a bank borrows from the discount window during a year, measured as the number of times when borrowing is positive followed by periods when borrowing is zero. Member banks that use the discount window for reserve adjustment on a routine basis tend to borrow on several occasions each year.

[7]This conclusion is reinforced by noting that Fed reserve requirements are binding for most member banks, in the sense that they hold larger cash balances than they would in the absence of Fed reserve requirements, whereas state reserve requirements are not binding for most nonmember banks. In most states, required cash reserves of nonmember banks are substantially smaller than the cash reserves nonmember banks actually hold. See R. Alton Gilbert, "Effectiveness of State Reserve Requirements," this *Review* (September 1978), pp. 16-28. If most member banks do not borrow at the discount window to offset reserve drains in order to meet binding reserve requirements, nonmember banks would be even less likely to borrow at the discount window, if made available to them, unless they were made subject to member bank reserve requirements.

Table 1
Frequency of Borrowing from the Federal Reserve by Member Banks

Bank size (Total deposits in millions of dollars)	Number of Eighth District member banks that borrowed on the following number of occasions each year: 1	2-4	5-10	11-15	16-20	Over 20	Total number of banks borrowing
1974							
$ 0 - $ 10	7	8	7	8	0	0	30
10 - 25	14	21	8	0	1	0	44
25 - 50	3	2	11	2	0	0	18
50 - 100	2	1	4	1	0	1	9
Over 100	1	1	4	2	3	3	14
1975							
$ 0 - $ 10	2	2	1	0	1	0	6
10 - 25	2	8	1	1	0	0	12
25 - 50	6	4	1	1	0	0	12
50 - 100	3	2	0	0	1	0	6
Over 100	4	2	0	2	0	0	8
1976							
$ 0 - $ 10	2	2	1	1	0	0	6
10 - 25	4	0	1	1	0	0	6
25 - 50	2	3	5	0	0	0	10
50 - 100	1	1	0	0	1	0	3
Over 100	4	4	0	0	0	0	8
1977							
$ 0 - $ 10	1	5	1	0	0	1	8
10 - 25	3	4	4	0	1	0	12
25 - 50	5	6	3	3	0	0	17
50 - 100	2	4	2	0	0	0	8
Over 100	2	5	7	3	1	0	18

and their response to deviations of actual from desired cash balances. Cash balances of member banks can be classified into three components: vault cash, reserve balances at Federal Reserve Banks, and demand balances due from correspondents.

The amount of vault cash banks desire to hold is based upon their expectations of depositors' demand for currency. Reserve balances held by most member banks at the Federal Reserve are determined by their required reserve balances, which are based upon their deposit liabilities and vault cash held two weeks earlier. Required reserve balances change each week, and member banks must meet their required reserves on a weekly average basis. Finally, demand balances of member banks due from correspondents are determined by both the volume of transactions through those accounts and the balances their correspondents require as compensation for services provided. Correspondent banks generally do not charge respondents explicit fees for services; they require, instead, that respondents hold certain average demand balances with them.[8]

The primary cause of deviation between a bank's actual and desired cash balances is unanticipated fluctuation in demand deposit liabilities. Time deposits mature on specific dates, and therefore bank management can anticipate when it must be ready to

[8]Robert E. Knight, "Correspondent Banking Part III: Account Analysis," Federal Reserve Bank of Kansas City *Monthly Review* (December 1971), pp. 3-17.

make payments to holders of time deposits. Demand deposit liabilities, however, fluctuate more from day to day and are, therefore, more difficult to estimate.

The effects of unanticipated loan demand on banks' reserve positions are reflected in changes in their demand deposit liabilities. When banks make loans, they increase the demand deposit balances of borrowers. If borrowers did not withdraw those deposits to make payments, there would be no disturbance in the current week to the reserve positions of banks making loans. Increases in loans cause banks to lose reserves only when borrowers withdraw deposits.

Bank customers withdraw deposits from their demand accounts either by demanding currency or by writing checks. When depositors demand currency, a bank's assets (vault cash) and liabilities (demand deposits) decrease simultaneously. Member banks lose reserves when depositors demand currency, but due to lagged reserve accounting, this decline in vault cash does not affect reserves available to meet reserve requirements in the current week. Likewise, the decline in demand deposit liabilities that results when depositors demand currency does not affect required reserves in the current settlement week, but two weeks later instead.[9] Therefore, member banks may choose to make no initial response to a loss of reserves in the form of vault cash, unless total vault cash falls below some critical level at which the risks of temporary currency shortages become sufficiently great.

When customers withdraw demand deposits by writing checks, the effect on a member bank's cash assets depends upon how the bank clears checks and how it pays for checks drawn on its customers' accounts. Banks receive checks as their customers make deposits and, therefore, need a mechanism for collecting checks drawn on other banks. Some member banks receive payment for checks by having their reserve balance at their Reserve Bank credited, while paying for checks drawn on their depositors' accounts by having their reserve balances debited. Frequent debits and credits to member banks' reserve accounts cause these balances to change on most business days.

If a member bank clears checks through its reserve account, net withdrawals of deposit liabilities cause its reserve balance to decline. Required reserves for the current week, however, are not affected by deposit withdrawals in the current week due to lagged reserve requirements. Thus, if its initial reserve balance just equaled its required balance for the current week, deposit withdrawals during the week would cause a member bank's reserve balance to be deficient. Borrowing through the discount window is one means of increasing reserves on short notice.

Other member banks clear checks through their balances at correspondents. They deposit checks with their correspondents and pay for checks drawn on depositors' accounts by having their demand balances due from correspondents debited, including checks presented for payment by the Federal Reserve. If these banks do not use other Reserve Bank services that cause their reserve balances to change, these balances would change only when banks adjusted them to equal their required reserve balances.[10] Thus, the reserve balances of member banks that use services of correspondents tend to change less frequently than those of member banks that make greater use of Reserve Bank services.

For a member bank that clears checks through a correspondent bank, net withdrawals of deposit liabilities would not disrupt its balance between actual and required reserves for the current week. The decline in demand deposit liabilities instead would affect the bank's required reserves in coming weeks. Since checks are cleared through the bank's correspondent account, its reserve balance is unaffected by net deposit withdrawals.

The response of these member banks to deposit withdrawals depends upon the constraints placed on them by their correspondents. If respondent banks were required to hold certain minimum amounts of demand balances at correspondents on a weekly average basis, they occasionally would have to obtain additional cash balances when experiencing net withdrawals of deposit liabilities. Studies of correspondent banking, however, indicate that respondent banks may average their balances over longer periods of time, such as a quarter or even a year, in meeting the balance requirements of correspondents.[11] Respondent

[9]Required reserves of a member bank in the current settlement week are based upon its deposit liabilities two weeks earlier. The reserves that count toward meeting a member bank's required reserves in the current settlement week are average daily vault cash held two weeks earlier and average daily reserve balances at the Fed in the current week. For a comparison of how contemporaneous and lagged reserve accounting affects the reserve management of member banks, see R. Alton Gilbert, "The Effects of Lagged Reserve Requirements on the Reserve Adjustment Pressure on Banks," *Financial Analysts Journal* (September-October 1973), pp. 34-43.

[10]Use of the following Reserve Bank services may involve debits and credits to reserve balances: wire transfers, coin and currency shipments, and collection of coupons on securities held in safekeeping and matured securities.

[11]Knight, "Correspondent Banking."

banks may have enough flexibility in managing their cash positions to simply let their demand balances due from correspondents fluctuate as their deposit liabilities fluctuate with no additional response to deposit outflows.

One method of determining whether respondent banks may temporarily reduce their demand balances due from correspondents by amounts equal to short-term deposit outflows is to compare the dollar magnitude of changes in demand deposit liabilities to changes in their demand balances due from correspondents. When large decreases in demand balances due from correspondents were compared to large decreases in gross demand deposit liabilities for 95 member banks that obtain most of their services through correspondents, the ratio of the former to the latter averaged 1.04.[12] Thus, large weekly decreases in demand balances due from correspondents are of approximately the same dollar magnitude as large weekly decreases in gross demand deposits. These results indicate that respondents have enough short-term flexibility in managing their cash positions that they can cope with relatively large decreases in their gross demand deposit liabilities by letting their demand balances due from correspondents decline temporarily.

Are Demand Deposit Withdrawals Large Enough to Induce Banks to Borrow?

Only those member banks that clear checks through their reserve accounts have reductions in their reserve balances when experiencing net demand deposit outflows. These are the banks, therefore, that tend to borrow frequently from the discount window. Even for those banks that use their reserve balances for clearing checks, however, fluctuations in demand deposit liabilities may not be large enough to induce them to borrow to avoid reserve deficiencies. If fluctuations in their reserve balances are smaller than their normal excess reserves, no response to declines in demand deposit liabilities is necessary.

This issue is investigated by comparing average excess reserves to large decreases in demand deposit liabilities for a group of 102 member banks that make extensive use of Reserve Bank services.[13] The fifth largest weekly decrease in gross demand deposits was larger than their average excess reserves in 1976 for all but one of these banks. Those relatively large decreases in deposits were, on the average, about 60 times larger than average excess reserves.[14] Therefore, excess reserves could *not* fluctuate by as much as demand deposits during at least several weeks each year. When demand deposit liabilities decline by relatively large amounts, member banks that clear checks through their reserve accounts must obtain additional reserves to avoid reserve deficiencies.

Do Frequent Borrowers Clear Checks Through Their Reserve Accounts?

The next step is to determine whether member banks that borrow from the discount window *most frequently* are, in fact, primarily among those banks that clear checks through their reserve accounts. A reliable indicator of whether a member bank uses its reserve balance for settlement in check collection is the frequency of changes in its reserve balance from day to day. Check collection is the only Reserve Bank

[12]The 95 member banks, located in the Eighth District portions of Illinois and Missouri, had total deposits of less than $50 million in 1976. None of these banks cleared checks through the Reserve Bank regularly. These banks had so little activity in their reserve balances at the Fed that the dollar amounts in their reserve balances remained unchanged for 150 days or more during 1976. Relatively large declines in the demand deposit liabilities at individual banks are measured by calculating the changes in gross demand deposits from each reserve settlement week to the next and determining the fifth largest decline. That amount is compared to the fifth largest weekly decline in demand balances due from correspondents, a measure of relatively large weekly declines in balances due from correspondents. An alternative comparison would be of the greatest weekly decline in demand deposit liabilities to the greatest weekly decline in demand balances due from correspondents. Such comparisons were not reported because, for many banks, the greatest weekly declines were substantially different from declines in other weeks and, therefore, not representative of the relatively large weekly declines in these series. Examination of weekly declines in both series indicated that the fifth greatest weekly declines tend to be fairly representative of large declines. For instance, the third greatest weekly decline in demand balances due from correspondents divided by the third greatest decline in gross demand deposits averages 1.06.

[13]The reserve balances of these member banks were unchanged on no more than five business days during 1976.

[14]The ratio of the fifth largest weekly decline in gross demand deposits to average excess reserves was higher for larger banks, as indicated in the following display:

Size group (Total deposits, in millions of dollars)	Number of banks	Sum of the fifth largest weekly decrease in gross demand deposits divided by the sum of average excess reserves
$ 0 - $ 10	7	4.46
10 - 25	31	10.02
25 - 50	33	84.88
50 - 100	18	83.16
100 and over	13	92.50

Table 2

Comparison of the Frequency of Changes in Reserve Balances of Frequent Borrowers and Other Member Banks[1]

Size category (Annual average total deposits, millions of dollars)	Type of bank	Distribution of banks by the measure of frequency of change in reserve balances at the Fed (Number of days during a year when a member bank's reserve balances at the Fed were the same as on the previous day)									
		Up to 115	116-120	121-130	131-150	151-175	176-200	201-250	251-300	301 & Over	Number of banks
$0 - $10	Infrequent borrowers	3	2	4	3	3	5	18	8	7	53
	Frequent borrowers in:										
	1974	5	3	1	2		1	1	2		15
	1975	2									2
	1976	1					1				2
	1977	1			1						2
$10 - $25	Infrequent borrowers	17	7	9	8	10	5	14	10	2	82
	Frequent borrowers in:										
	1974	7			1	1					9
	1975	2									2
	1976	2									2
	1977	5									5
$25 - $50	Infrequent borrowers	15	5	5	4	5	3	1			38
	Frequent borrowers in:										
	1974	12				1					13
	1975	2									2
	1976	4			1						5
	1977	6									6
$5 - $100	Infrequent borrowers	11	2		1						14
	Frequent borrowers in:										
	1974	6									6
	1975	1									1
	1976	1									1
	1977	2									2
Over $100	Infrequent borrowers	0									0
	Frequent borrowers in:										
	1974	12									12
	1975	2									2
	1976	0									0
	1977	11									11

[1]Banks designated as frequent borrowers are all Eighth District member banks that borrowed at the discount window on five or more occasions during a year. Those designated as infrequent borrowers are member banks in the Eighth District portions of Illinois and Missouri that did not borrow at the discount window in 1976 and were not frequent borrowers during 1974, 1975, or 1977.

service that is likely to cause a member bank's reserve balance to change each business day.[15]

The distribution of nonborrowers and frequent borrowers by activity in their reserve balances is presented in table 2. Almost all of the Eighth District member banks that borrowed on five or more occasions per year in 1975-77 had changes in their reserve balances on each business day. Incentive to borrow from the discount window was relatively great during 1974 due to the large spread between market interest rates and the discount rate. Several banks that borrowed frequently in 1974 had relatively idle reserve balances. More of the frequent borrowers during 1974, however, had relatively active reserve balances than nonborrowers of comparable size.[16] Thus, evidence in table 2 supports the hypothesis that *banks which borrow frequently are primarily among those that have relatively active reserve balances.*

Why Are Only Some of the Member Banks with Active Reserve Balances Frequent Borrowers?

Fluctuations in deposit liabilities at member banks that use correspondent services tend not to induce frequent, short-term borrowings from the discount window since those banks can adjust to decreases in deposit liabilities by letting their balances at correspondents decline temporarily. Thus, banks that use services of correspondents may not be induced to borrow from any source in response to relatively large withdrawals of deposit liabilities. But among member banks that clear checks through their reserve accounts, and consequently have frequent changes in their reserve balances, why do some borrow from the discount window frequently and others never do?

One possible answer is that, among member banks with relatively active reserve balances, the frequent borrowers have more highly variable deposit liabilities, and thus are induced to borrow from the discount window more frequently to replace reserves lost due to deposit withdrawals. Table 3 indicates that frequent borrowers in the years 1975-77 tend to have more highly variable demand deposit liabilities than other banks of comparable size with similar activity in their reserve balances.[17]

Another factor that might account for the difference in frequency of borrowing is the difference in ratios of loan to deposits. Banks with higher ratios of loan to deposits tend to have smaller amounts of liquid assets, which they can sell quickly to replace reserve drains. Frequent borrowers had significantly higher loan-to-deposit ratios in 1976; the difference was positive, but not statistically significant at the 5 percent level in 1977. Thus, there is some evidence that, among the relatively small member banks with active reserve balances, those that borrow frequently from the discount window have higher ratios of loans to deposits.[18]

Differences in federal funds positions might also explain the varied use of the discount window by banks with active reserve balances. Reserve balances can be increased either by borrowing from the discount window or by reducing federal funds sold to correspondents. Loans in the federal funds market

[15]The relation between use of Fed services and frequency of changes in reserve balances can be illustrated for member banks in the Eighth District portions of Illinois and Missouri, based on a survey of utilization of Fed services during 1976-77. Frequency of change in reserve balances is measured over 126 calendar days from mid-September 1976 to mid-January 1977. The minimum number of days that a member bank's reserve balance would be unchanged during that period is 39. For the 68 banks that deposited more than five checks to their reserve balances during January 1977, reserve balances were unchanged an average of 39.9 days. A contrasting group is composed of 69 banks that cleared no checks through the Fed and used the reserve balances of their correspondents in remitting for the Fed's cash letters and handling transactions with the Fed for coin and currency. Their reserve balances remained unchanged for an average of 75.6 days.

[16]Among member banks with total deposits up to $50 million, about 65 percent of the banks that borrowed frequently in 1974 had reserve balances that remained unchanged for 115 days or less, whereas only 20 percent of nonborrowers had such active reserve balances.

[17]The characteristics of member banks that borrowed from the discount window on five or more occasions in 1974, but were not frequent borrowers in the following three years, were also compared to those of member banks with relatively active reserve balances that did not borrow frequently in any of the years 1974-1977. The banks that borrowed frequently only during 1974 did not have greater variability in their demand deposit liabilities than the other banks. They did have higher ratios of loans to deposits than nonborrowers. However, the banks that borrowed frequently only during 1974 had such large proportions of their assets invested in federal funds sold on average, and positive net federal funds sold so often, that they were not induced to borrow frequently from the discount window during the following years. Analysis in table 3 is limited to banks with total deposits up to $50 million because there were only two frequent borrowers in 1975-77 with total deposits between $50 million and $100 million (average for 1976); including those two banks in the analysis, and making comparisons to nonborrowers with total deposits up to $100 million might bias some of the comparisons in table 3.

[18]A study of Tenth District member banks found that banks which borrowed from the discount window had higher ratios of loans to assets than nonborrowers of comparable size. See J. A. Cacy, "Determinants of Member Bank Borrowing," Federal Reserve Bank of Kansas City *Monthly Review* (February 1971), pp. 11-20.

Table 3

Comparison of Frequent Borrowers and Nonborrowers with Relatively Active Reserve Balances (1975-77)[1]

Measure	Frequent borrowers	Nonborrowers[2]	Difference	T-Statistic
Variability of demand deposits[3]	6.60%	4.82%	1.78%	2.0260
Percentage of average loans to average total deposits				
1976	61.81%	54.18%	7.63%	2.2991
1977	63.71	58.52	5.19	1.5895
Number of weeks in which net federal funds sold was zero or negative				
1976	20.44	7.98	12.46	3.5466
1977	20.44	10.64	9.80	2.7838
Average percentage of net federal funds sold to total deposits[4]				
1976	2.20%	5.87%	–3.67%	–2.2940
1977	2.32	5.41	–3.09	–2.1797
Number of banks	18	47		

[1]Analysis is limited to banks with average total deposits in 1976 of less than $50 million dollars.

[2]The reserve balances of these banks were unchanged on no more than 120 days during 1976.

[3]Variability of demand deposits is measured in the following way: A bank's demand deposit liabilities as of each business day are compared with average demand deposit liabilities in the five previous business days, and the percentage deviation of deposits of each day from the five-day moving average is calculated. The standard deviation of those percentage differences (positive and negative signs retained) is calculated for each year as a measure of the day-to-day variability of a bank's demand deposit liabilities. For interpretation of this measure, suppose a bank has a standard deviation of 5 percent. For that bank the percentage deviations of demand deposit balances from the five-day moving average would lie within a range 5 percentage points below and above the mean on about two-thirds of the days during the year. Measuring deposit variability with this standard deviation weights the measure toward the more extreme percentage deviations from the five-day moving averages, which is appropriate for a measure that might be correlated with frequency of borrowing by banks to avoid reserve deficiencies.

[4]Net federal funds sold are counted as zero for weeks in which banks purchased more federal funds than they sold.

generally have maturities of one day, and, therefore, banks that sell federal funds can increase their reserve balances quickly by reducing the amount of federal funds they sell. Federal Reserve regulations do not permit member banks to receive reserve adjustment credit through the discount window while selling federal funds. Infrequent borrowers with active reserve balances may sell federal funds so often that they are seldom permitted to borrow from the discount window.

Two aspects of federal funds positions are analyzed in table 3. One is the number of weeks during each year in which a bank's net federal funds sold was zero or negative. A bank with positive net federal funds sold during most weeks tends to have few occasions on which it would be induced to borrow. The number of weeks during which net federal funds sold were zero or negative is significantly greater for frequent borrowers in both 1976 and 1977.

The other measure of federal funds position is average federal funds sold as a percentage of average total deposits, a measure of the cushion of liquidity a bank maintains in the form of federal funds sold. This percentage is significantly lower for frequent borrowers in both 1976 and 1977.

Analysis of the characteristics of banks that borrow frequently from the discount window indicates that use of the discount window for reserve adjustment is a valuable service for frequent borrowers. Banks that borrow frequently are among those that make extensive use of Reserve Bank services. They tend to have greater short-term variability in their demand deposit liabilities and have higher ratios of loans to deposits. In addition, net federal funds sold, which are smaller on average and zero more often than for other banks, indicate that they substitute use of the discount window for holding liquid assets.

Most member banks, however, prefer to adjust their reserve positions to deposit fluctuations by methods other than borrowing at the discount window. Among relatively small member banks (those with total deposits less than $100 million), most clear checks through correspondents. These banks can cope with deposit fluctuations by allowing their demand balances due from correspondents to fluctuate. Of the relatively small member banks that clear checks through their reserve balances, most prefer to adjust their reserve positions to deposit outflows by drawing system that resulted from, or were compounded Only a small minority of member banks borrow from the discount window as a method of reserve adjustment.

STABILITY OF THE CORRESPONDENT BANKING SYSTEM

One of the reasons for creating the Federal Reserve System was concern over liquidity crises of the banking system that resulted from, or were compounded by, simultaneous demands for cash by respondent banks from their correspondents. This concern might still be relevant, given the continuing reliance of most banks on correspondents for liquid balances.

Percentage changes from week to week in demand balances of individual banks *due from* correspondents are often quite large. Does it follow that demand balances of correspondent banks *due to* respondents are also highly variable from week to week? Are correspondent banks vulnerable to liquidity problems as a result of large fluctuations in their demand balances due to respondent banks?

The variability of total demand balances due to respondents depends upon the size of the bank's total balances due to respondents (see table 4). For the three largest correspondent banks, total demand balances due to respondents are about as variable as total demand deposit liabilities due to private nonbank depositors. For smaller correspondent banks those balances are more variable than their other demand deposit liabilities. This contrast is greatest for the 21 smallest correspondent banks: The measures of variability in their demand deposit liabilities due to private *nonbank* depositors were about the same as for the larger correspondent banks, but balances due to respondents were substantially more variable. Their demand balances *due to* respondents were about as variable from week to week as demand balances *due from* correspondents of individual banks that clear checks through correspondents. For 95 member banks that obtain most of their services through correspondents, the average measure of weekly variability in their demand balances *due from* correspondents is 29.5, which is approximately equal to the average measure of variability in demand balances *due to* respondents of 30.3 for the 21 smallest correspondent banks.[19]

Table 4
Variability of Demand Balances Due to Commercial Banks and Private Nonbank Depositors[1]

Annual average of demand balances due to respondents (millions of dollars)	Measure of variability of demand balances due to[2] Commercial banks	Nonbank depositors other than the U.S. government
(10 largest correspondent banks)		
$ 162	5.5%	5.4%
141	7.3	5.7
141	7.8	6.7
91	6.1	3.7
60	14.1	3.0
59	10.6	3.8
53	8.0	4.0
35	9.8	7.1
27	11.7	7.5
8	12.0	3.5
(Averages for 21 smaller correspondent banks)		
$ 1.06	30.3%	5.1%

[1]These banks were selected from among all Eighth District member banks that borrowed from the discount window during 1976 and other Eighth District member banks in Illinois and Missouri. A bank is assumed to be offering correspondent services to other banks if its demand balances due to respondents are positive each day and change each business day.

[2]Variability of these balances is measured by calculating average balances for each reserve settlement week in 1976, percentage changes in balances from each week to the next, and then taking the standard deviation of the percentage changes.

[19]Variability of demand balances of correspondents due to respondents is measured as the standard deviation of percentage changes in those balances from week to week. Variability of demand balances due from correspondents is measured the same way. The 95 member banks which use correspondent services are described in footnote 12.

These comparisons indicate that the relatively large correspondent banks have an advantage over smaller correspondents in coping with the variability in demand balances due to individual respondent banks. For correspondents that serve the largest number of respondent banks, fluctuations in balances due to individual respondent banks tend to cancel each other out, causing their total demand balances due to other banks to be no more variable from week to week than the sum of other demand deposit liabilities. Correspondents that serve fewer respondents do not benefit as much from such cancellation. Thus, the largest correspondent banks are able to offer respondents the service of reserve adjustment mechanisms with no more vulnerability to occasional liquidity problems resulting from fluctuations in their balances due to respondents than that from fluctuations in balances due to nonbank depositors.

SUMMARY AND CONCLUSIONS

It recently has been suggested that one adverse effect of declining Federal Reserve membership is that the Federal Reserve may become more reluctant to pursue restrictive monetary policy because of its uneven impact on the banking system. Nonmember banks, without access to the discount window, might not have the means to cope with liquidity pressures resulting from restrictive monetary policy. Therefore, extending access to the discount window to more banks, by inducing or requiring more banks to be members, would facilitate the implementation of monetary policy.

The validity of this argument is investigated by examining the frequency with which member banks borrow at the discount window. If access to the discount window helps banks adjust to occasional liquidity pressures, most *member* banks would borrow frequently from the discount window as a means of coping with such pressures. Only a small minority of member banks, however, actually borrows frequently from the Federal Reserve. Therefore, while there are valid reasons for suggesting that reductions in membership may interfere with monetary control, analysis of reserve management by banks does *not* indicate that direct access to the discount window for nonmember banks is important for the conduct of monetary policy.

Many member banks adjust to declines in their cash balances by letting their demand balances due from correspondents decline temporarily. This reaction is automatic for banks that clear checks through correspondent balances. For banks that clear checks through accounts at their Reserve Bank, net withdrawals of deposit liabilities cause reductions in their reserve balances, and may occasionally cause reserve deficiencies unless offset. Banks that borrow frequently at the discount window are among these banks that clear checks through their reserve accounts. Most member banks that clear checks through reserve accounts, however, do not borrow frequently from the discount window, but instead rely upon federal funds sold to correspondents as a cushion of liquidity, reducing federal funds sold when experiencing reserve outflows.

The relatively large correspondent banks benefit from offsetting fluctuations in the deposits due to individual respondent banks. Thus, large correspondent banks can offer respondents means of adjusting their cash positions to deposit fluctuations without incurring any more variability in their own liabilities than results from fluctuations in demand balances due to nonbank customers. This indicates that correspondent banks offer member and nonmember banks adequate means of adjusting their cash position to fluctuations in deposit liabilities.

The New Monetary Aggregates

R. W. HAFER

A number of major financial innovations over the last decade have changed the composition of assets used by the public to make payments. Examples include the introduction of negotiable orders of withdrawal (NOW accounts), the implementation of automatic transfer systems (ATS accounts) whereby funds from savings accounts can be automatically transferred to checkable deposits, the growing use of money market mutual funds as substitutes for conventional savings accounts, and the dramatic growth in repurchase agreements (RPs).[1] Because of these and other developments, it increasingly was argued that the existing monetary aggregates did not measure the true financial position of the public and, therefore, were inadequate tools of monetary policy.

In response to these developments, the Federal Reserve Board recently announced redefinitions of the monetary aggregates.[2] This article describes the new aggregates, compares them to the old measures, and discusses some technical issues involved in their measurement.

[1]For a discussion of NOW and ATS accounts and their effect on the old monetary aggregates, see Steven M. Roberts, "Developing Money Substitutes: Current Trends and Their Implications for Redefining the Monetary Aggregates," *Improving the Monetary Aggregates: Staff Papers,* Board of Governors of the Federal Reserve System, Washington, D.C., 1978, pp. 147-70. Hereafter, this publication will be referred to as *Staff Papers.* See also John A. Tatom and Richard W. Lang, "Automatic Transfers and the Money Supply Process," this *Review* (February 1979), pp. 2-10. An introduction to repurchase agreements is found in Norman N. Bowsher, "Repurchase Agreements," this *Review* (September 1979), pp. 17-22.

[2]"Announcement," Board of Governors of the Federal Reserve System, Washington, D.C., February 7, 1980.

Definitions

Tables 1 and 2 compare the old and new monetary aggregates. As shown in table 1, the new basic transactions measure — M1A — is essentially the same as the old M1 measure, except for the deletion of demand deposits due to foreign commercial banks and

Table 1

Comparison of Old and New Transactions-Type Monetary Aggregates

Component	Old M1	New M1A	New M1B
Currency in circulation	X	X	X
At commercial banks:			
Demand deposits *inclusive* of deposits due to foreign commercial banks and official institutions	X		
Demand deposits *exclusive* of deposits due to foreign commercial banks and official institutions		X	X
NOW accounts			X
ATS accounts			X
At thrift institutions:			
Demand deposits			X
NOW accounts			X
ATS accounts			X
Credit union share draft balances			X

official institutions. This change, based on a recommendation of the Advisory Committee on Monetary Statistics, was made because such balances consist primarily of compensating balances held by foreign commercial banks at U.S. commercial banks for services performed.[3] Since the total of such balances is a small percentage of the old M1, this deletion does not produce large discrepancies between the old M1 and new M1A measures.[4]

Until the early 1970s, a clear distinction between interest-bearing deposits and non-interest-earning deposits held for transactions purposes existed. Since then, however, a series of financial innovations and regulatory changes have blurred this distinction.[5] The significant changes have taken the form of NOW accounts, which were established in several New England states in the early 1970s, ATS accounts, and the rapid growth of credit union share drafts as an alternative payments mechanism. The new M1B aggregate combines those financial items that have the dual characteristic of being held both for check-writing purposes and as savings accounts. Nearly all of these items are interest-bearing checkable deposits.[6] The new M1A and M1B aggregates focus on those monetary components that are employed primarily as a means of payment.

As shown in table 2, the old M2 aggregate was defined as the sum of currency, demand deposits, savings deposits, time deposits, and time certificates of deposit (CDs) other than those issued in denominations of $100,000 or more by large weekly reporting banks. The new M2 measure is much broader in scope. It is calculated by adding savings deposits and small time deposits (those issued in denominations of less than $100,000) at all depositary institutions, overnight RPs issued by commercial banks, overnight Eurodollars (issued by Caribbean branches of member banks) held by U.S. nonbank residents, money market mutual fund shares, and a consolidation component to the new M1B measure. This definition includes such a broad array of monetary components and institutions (e.g., commercial banks, U.S. agencies and branches of foreign banks, Edge Act corporations, foreign investment companies, mutual savings banks, savings and loan associations, and credit unions), that it is more directly comparable to old M3 than to the previous M2 definition (see table 2).

There is, however, one major difference between the new M2 measure and the old M3 definition: The new M2 includes overnight RPs and Eurodollars, and money market mutual funds shares which were not included in the old M3 measure.

The introduction of these items stems from their increasing substitutability for other non-transactions-type financial holdings already included in the broader monetary measures. For instance, money market mutual funds shares are viewed as substitutes for other non-transactions-type financial assets, despite the fact that owners of these shares are offered check-writing privileges. The fairly large minimum denomination requirement (usually $500 or more) for checks written on these accounts and the fact that these balances typically exhibit relatively slow turnover rates suggest that these accounts are used primarily as savings rather than transactions accounts.[7]

The transactions and investment characteristics of overnight RPs have been subjected to considerable investigation in recent years. For example, studies by Garcia and Pak, Wenninger and Sivesind, and Tinsley, Garrett, and Friar have viewed these RPs as close substitutes for existing demand deposits. Consequently, they have explained a large part of the decline in the public's demand for transactions balances which occurred in the mid-1970s by including RPs in the definition of a transactions-type money (i.e., old M1). In contrast, others have regarded RPs as short-term, highly liquid investment items that are significantly different from demand deposits.[8]

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[3]See *Improving the Monetary Aggregates: Report of the Advisory Committee on Monetary Statistics,* Board of Governors of the Federal Reserve System, Washington, D.C., 1976, pp. 15-20. Hereafter, this publication will be referred to as *Report.*

[4]For example, during 1978 the amount of demand deposits due to foreign-related banking offices averaged less than 2 percent of total demand deposits.

[5]For an excellent description of this, see Roberts, "Developing Money Substitutes."

[6]This distinction is necessary because not all of the new checkable deposits are interest-bearing at present. For example, some depositary institutions currently offer non-interest-bearing NOW accounts (NINOWs), and demand deposits at mutual savings banks do not currently pay interest. Also, some non-interest-earning demand deposits that are held at thrift institutions and cannot be separated from interest-bearing checkable deposits are included in M1B. At present, the amount of such deposits is small.

[7]Thomas D. Simpson, "The Redefined Monetary Aggregates," *Federal Reserve Bulletin* (February 1980), p. 100.

[8]See Gillian Garcia and Simon Pak, "Some Clues in the Case of the Missing Money," *American Economic Review; Papers and Proceedings* (May 1979), pp. 330-34; John Wenninger and Charles Sivesind, "Defining Money for a Changing Financial System," Federal Reserve Bank of New York *Quarterly Review* (Spring 1979) pp. 1-8; Peter A. Tinsley, Bonnie Garrett, and Monica Friar, "The Measurement of Money Demand," Staff Study #133 (Board of Governors of the Federal Reserve System, 1978); and Thomas D. Simpson, "The Market for Federal Funds and Repurchase Agreements," Staff Study #166 (Board of Governors of the Federal Reserve System, 1979).

Table 2
Comparison of Old and New Non-Transactions-Type Monetary Aggregates

Component	Old M2	New M2	Old M3	New M3	Old M4	Old M5	L
Currency	X	X	X	X	X	X	X
At commercial banks:							
Demand deposits *inclusive* of deposits due to foreign commercial banks and official institutions	X		X		X	X	
Demand deposits *exclusive* of deposits due to foreign commercial banks and official institutions		X		X			X
NOW accounts[1]		X		X			X
ATS accounts[1]		X		X			X
Overnight RPs		X		X			X
Savings deposits	X	X	X	X	X	X	X
Small time deposits (< $100,000)	X	X	X	X	X	X	X
Large time deposits							
Other than large negotiable CDs	X		X	X	X	X	X
Including large negotiable CDs				X	X	X	X
Term RPs				X			X
At thrift institutions:							
Demand deposits		X		X			X
NOW accounts[1]		X		X			X
ATS accounts[1]		X		X			X
Credit union share draft balances		X	X	X		X	X
Savings deposits (Mutual savings banks and savings and loan associations)		X	X	X		X	X
Small time deposits (< $100,000)		X	X	X		X	X
Large time deposits (> $100,000)			X	X		X	X
Term RPs (Commercial banks and savings and loan associations)				X			X
Other:							
Overnight Eurodollar deposits of U.S. nonbank residents[2]		X		X			X
Money market mutual funds shares		X		X			X
Term Eurodollars held by U.S. nonbank residents							X
Bankers acceptances							X
Commercial paper							X
U.S. savings bonds							X
Liquid Treasury securities							X
M2 consolidation component[3]		X		X			X

[1]These accounts were included previously in the savings deposit component of the definitions.

[2]Overnight Eurodollars issued by Caribbean branches of member banks.

[3]See text, p. 30, for a discussion of this component.

There presently is no consensus as to whether overnight RPs and Eurodollars, and money market mutual funds shares primarily constitute transactions- or investment-type assets. These items are included in the new M2 definition. Data on each of these series will be published separately, however, so a direct comparison of these components with the new transactions aggregates M1A and M1B will be possible.

The new M3 series is defined as new M2 plus large time deposits (those issued in denominations of $100,000 or more) at all depositary institutions and term RPs issued by commercial banks and savings and loan associations. The new M3 aggregate is similar to the old M5 definition primarily because of the large-denomination time deposits component. The combination of the large-denomination time deposits and term RPs in this aggregate is based on the belief that these items are relatively close substitutes in many financial portfolios.[9]

The broadest of the new monetary aggregate definitions is the "L" series. This aggregate, which measures total liquid assets, adds to the new M3 series such financial items as other Eurodollar holdings by nonbank U.S. residents, bankers acceptances, commercial paper, U.S. savings bonds, and liquid Treasury obligations.[10] This measure closely approximates the credit expansion generated through the commercial banking sector and other financial channels.

COMPARISON OF GROWTH RATES

A comparison of the growth rates of the old and new monetary aggregates provides a useful way to assess the differences resulting from the redefinitions. As shown in table 3, there is relatively little quantitative difference between the annual growth rates of the M1 aggregate and the new M1A and M1B measures over the 1970-1979 period. For example, the average difference in annual growth rates between M1 and M1A over this period is only 0.18 percentage points, the largest divergence occurring in 1973 when M1 grew 0.5 percent faster than M1A.

Table 3

Rates of Growth for Transactions-Type Monetary Aggregates

	Annual Rate of Growth[1]		
Year	Old M1	New M1A	New M1B
1970	4.8%	4.8%	4.8%
1971	6.6	6.6	6.6
1972	8.4	8.5	8.5
1973	6.2	5.7	5.8
1974	5.1	4.7	4.7
1975	4.6	4.7	4.9
1976	5.8	5.5	6.0
1977	7.9	7.7	8.1
1978	7.2	7.4	8.2
1979	5.5	5.5	8.0

	Quarterly Rate of Growth[2]		
Quarter	Old M1	New M1A	New M1B
I/1975	2.0%	2.6%	2.9%
II/1975	5.8	5.9	5.9
III/1975	7.2	7.0	7.3
IV/1975	3.0	2.9	3.2
I/1976	4.6	5.4	5.7
II/1976	6.4	5.8	6.3
III/1976	4.1	3.4	3.9
IV/1976	7.4	7.0	7.6
I/1977	7.4	8.8	9.3
II/1977	7.4	6.7	6.9
III/1977	8.6	6.0	6.5
IV/1977	7.4	8.4	8.7
I/1978	6.6	7.6	7.9
II/1978	9.2	8.7	9.1
III/1978	7.9	7.1	7.3
IV/1978	4.3	5.6	7.4
I/1979	–1.3	0.2	4.8
II/1979	8.1	7.8	10.7
III/1979	9.7	8.8	10.1
IV/1979	5.0	4.7	5.3

[1]Fourth-quarter-to-fourth-quarter growth rates.

[2]Annualized growth rates based on seasonally adjusted data.

SOURCE: "The Redefined Monetary Aggregates," table A1.

Although the average difference between the M1 and M1B measures is somewhat larger (0.51 percent), M1B has demonstrated a faster rate of growth over recent years relative to M1. This faster growth — 1.0 percent in 1978 and 2.5 percent in 1979 — results from

[9]Simpson, "The Redefined Monetary Aggregates," p. 102.

[10]The Eurodollar holdings included in this measure incorporate those that are not captured in overnight Eurodollars issued by Caribbean branches of member banks. Liquid Treasury obligations consist of those issues with 18 months or less remaining to maturity. See Simpson, "The Redefined Monetary Aggregates," p. 98.

It should also be noted that the new M2, M3, and L aggregates exclude the amounts held by depositary institutions, money market mutual funds, the federal government, the Federal Reserve, and foreign commercial banks and official institutions. See Simpson, "The Redefined Monetary Aggregates," pp. 98, 108.

Table 4
Rates of Growth for Old M2, Old M3, and New M2 Monetary Aggregates[1]

Year	Annual Rate of Growth Old M2	Old M3	New M2
1970	7.2%	7.2%	5.8%
1971	11.3	13.5	13.5
1972	11.2	13.3	12.9
1973	8.8	9.0	7.3
1974	7.7	7.1	6.0
1975	8.4	11.1	12.3
1976	10.9	12.7	13.7
1977	9.8	11.7	11.5
1978	8.7	9.5	8.4
1979	8.3	8.1	8.8

Quarter	Quarterly Rate of Growth Old M2	Old M3	New M2
I/1975	6.4%	8.2%	7.8%
II/1975	9.5	12.4	14.9
III/1975	10.0	12.8	14.6
IV/1975	6.8	9.4	9.9
I/1976	10.5	12.0	13.0
II/1976	10.0	11.9	12.7
III/1976	8.9	11.0	11.3
IV/1976	12.6	13.8	15.2
I/1977	10.9	12.4	13.7
II/1977	9.0	10.5	11.2
III/1977	10.1	11.8	9.6
IV/1977	7.9	10.1	9.7
I/1978	7.0	8.1	7.5
II/1978	8.4	8.4	7.5
III/1978	9.8	10.3	8.2
IV/1978	8.5	9.8	9.5
I/1979	2.8	5.3	6.3
II/1979	8.8	7.9	10.2
III/1979	11.9	10.5	10.3
IV/1979	8.9	7.8	7.2

[1]See footnotes accompanying table 3.

SOURCE: "The Redefined Monetary Aggregates," table A2.

the increased use of NOW and ATS accounts as demand deposit and other balances are shifted into these interest-earning checkable deposits.

Growth rates of the old and new M1 measures exhibit greater divergence on a quarter-to-quarter basis. Over the last five years, the average difference between the M1 and M1A quarterly growth rates was 0.80 percent; the average difference between M1 and M1B growth was 1.16 percent. The impact of NOW and ATS accounts again is demonstrated — during 1979, M1B grew 2.5 percent faster than either M1 or M1A. As these figures suggest, the extension of NOW accounts nationwide may temporarily produce wider divergencies between the M1A (and old M1) and M1B growth rates.

Annual and quarterly growth rates for the old M2, old M3, and new M2 measures are presented in table 4. As these figures show, growth rates of new M2 tend to be closer to those of the old M3 definition than to old M2. For instance, the average annual growth rate of old M2 was 9.2 percent over the last decade while the averages for old M3 and new M2 were 10.3 percent and 10.0 percent, respectively. An examination of the quarterly data reveals a similar relationship: From I/1975 to IV/1979, old M2 grew at an 8.9 percent average rate while the average growth rates for old M3 and new M2 were 10.2 and 10.5 percent, respectively. In addition, the proportion of new M2 that consists of money market certificates and money market mutual funds has increased sharply since 1978.[11]

Table 5 presents the annual and quarterly growth rates for the old M4 and M5 aggregates together with the new M3 and L definitions. As noted earlier, the new M3 aggregate is relatively closer in construction to the old M5 measure than to old M4. The difference between the average annual rate of growth of old M4 and new M3 is 1.2 percentage points; that between old M5 and new M3 is only 0.5 of a percentage point. On a quarter-to-quarter basis, movements in new M3 and old M5 are even more similar. For example, over the period I/1975-IV/1979, the average quarterly rate of growth of old M4 was 8.1 percent while that of old M5 and new M3 was 9.6 percent and 10.4 percent, respectively.

The growth rates of L — total liquid assets — have been closer to new M3 than to the other monetary aggregates. While the average quarterly growth rates of L and new M3 have been roughly similar over the past five years (11.1 percent and 10.4 percent, respectively), there has been a growing divergence between these measures in more recent years. This is explained by the rapid growth of liquid assets issued by non-

[11]Simpson, "The Redefined Monetary Aggregates," p. 105.

depositary institutions which form the distinction between new M3 and L.[12]

MEASURING THE NEW AGGREGATES: TECHNICAL CONSIDERATIONS

Several technical problems arise in the measurement of the new monetary aggregates: Certain deposits held by depositary institutions must be consolidated to avoid double counting, the series used in calculating the new aggregates must be seasonally adjusted, and the data needed to construct the new aggregates must be gathered.

In calculating the old M1 aggregate, the problem of double counting deposits was resolved by netting out cash items in the process of collection, interbank deposits, and Federal Reserve float from total commercial bank demand deposits.[13] A similar procedure is followed in measuring the new M1A. At the M1B and M2 levels, however, it is assumed that thrift institutions hold demand deposits at commercial banks to service their checkable deposits and ordinary savings deposits. Thus, in calculating M1B, the estimated proportion of demand deposits owned by thrift institutions used to service their checkable deposits will be removed;[14] for new M2, total demand deposits owned by thrift institutions are currently netted out.

At the new M2 and M3 levels, further consolidation measures are employed. For instance, in the calculation of new M2, savings and time deposits owned by all depositary institutions are netted out, and money market mutual funds' holdings of RPs are deducted from the public's holdings of overnight RPs. In addition, CDs held by these funds are also netted out of large time deposits in calculating new M3. Both of these latter items are netted out in the derivation of the total liquid assets aggregate (L).

Table 5

Rates of Growth for Old M4, Old M5, New M3, and L Monetary Aggregates[1]

	Annual Rate of Growth			
Year	Old M4	Old M5	New M3	L
1970	10.2%	9.2%	8.9%	6.5%
1971	12.8	14.3	14.8	10.4
1972	12.3	13.9	14.0	12.9
1973	12.0	11.0	11.7	12.3
1974	10.7	9.0	8.7	9.6
1975	6.6	9.7	9.4	9.8
1976	7.1	10.2	11.4	11.0
1977	10.1	11.7	12.6	12.6
1978	10.6	10.6	11.3	12.3
1979	7.5	7.6	9.5	N.A.

	Quarterly Rate of Growth			
Quarter	Old M4	Old M5	New M3	L
I/1975	7.6%	8.9%	7.2%	7.1%
II/1975	5.5	9.5	9.4	9.5
III/1975	6.2	10.1	10.7	10.5
IV/1975	6.2	8.8	9.1	10.7
I/1976	6.0	9.0	9.9	10.1
II/1976	6.0	9.4	11.3	11.1
III/1976	6.3	9.2	10.3	10.0
IV/1976	9.5	11.8	12.1	10.8
I/1977	10.1	11.8	12.4	11.5
II/1977	8.3	10.0	11.4	11.8
III/1977	10.0	11.7	11.7	12.2
IV/1977	10.4	11.5	12.5	12.8
I/1978	10.2	10.0	10.5	11.2
II/1978	10.6	9.8	11.1	12.4
III/1978	9.9	10.4	10.3	11.3
IV/1978	10.1	10.7	11.5	12.2
I/1979	5.4	6.8	7.9	10.4
II/1979	3.7	4.9	8.8	13.1
III/1979	9.2	8.9	10.3	11.7
IV/1979	11.0	9.1	9.8	N.A.

[1]See footnotes accompanying table 3.

SOURCE: "The Redefined Monetary Aggregates," table A3.

Derivation of seasonally adjusted aggregates follows past procedures wherein the individual components of the series are seasonally adjusted first, then aggregated to the desired level.[15] At this time, how-

[12]For example, the percentage increase in dollar amounts between January 1978 and December 1979 for these items, using seasonally adjusted data, are:

Bankers acceptances	+120%
Commercial paper	+ 48
Short-term Treasury securities	+ 39
U.S. savings bonds	+ 4

and, based on seasonally unadjusted data, +136% for term Eurodollars.

[13]For a discussion of this problem, see *Report,* pp. 12-14; Darwin Beck, "Sources of Data and Methods of Construction of the Monetary Aggregates," *Staff Papers,* pp. 117-33; and Simpson, "The Redefined Monetary Aggregates," pp. 107-10.

[14]At the present time, the amount of such holdings is negligible and, therefore, is not omitted from M1B.

[15]See Simpson, "The Redefined Monetary Aggregates," pp. 110-11. For a general treatment of the seasonal adjustment

Table 6
New and Proposed Data Sources

Institution	Component Collected	Coverage/Frequency
Member banks	Term RPs	125 large member banks/weekly
	Overnight RPs	125 large member banks/weekly
	NOW and ATS accounts	all member banks/weekly
	Overnight Eurodollars at Caribbean branches	approximately all/weekly
Nonmember banks	Demand deposits	sample/weekly
	NOW and ATS accounts	sample/weekly
	Savings and small-denomination time deposits	sample/weekly
	Large-denomination time deposits	sample/weekly
Mutual savings banks	NOW accounts and demand deposits	sample/weekly (Wednesday)
	Savings and small-denomination time deposits	sample/weekly (Wednesday)
	Large-denomination time deposits	sample/weekly (Wednesday)
Savings and loan associations	NOW accounts	sample/thrice-monthly
	Savings and small-denomination time deposits	sample/thrice-monthly
	Large-denomination time deposits	sample/thrice-monthly
Credit unions[1]	Share drafts	sample/weekly (Wednesday)
	Savings and small-denomination time deposits	sample/weekly (Wednesday)

[1]The weekly sample (scheduled to begin in March 1980) will consist of 70 of the nation's largest credit unions, plus a sample of smaller credit unions to be collected once a month.

SOURCE: "The Redefined Monetary Aggregates."

ever, several of the components used to calculate some of the new aggregates are not seasonally adjusted because of data insufficiencies or technical difficulties. The individual series that have not been seasonally adjusted include NOW accounts, ATS accounts, credit union share drafts, demand deposits at thrift institutions, overnight RPs and Eurodollars, money market mutual fund shares, term RPs at commercial banks and savings and loan associations, and term Eurodollars held by U.S. nonbank residents.

A much wider diversity of financial institutions now participates in the data reporting and collection process (see table 6). Financial institutions that have not been active participants in the previous derivation of the monetary aggregates will play an important role. For example, the Federal Home Loan Bank Board now collects data on NOW accounts held at savings and loan associations; beginning in the spring of 1980, a sample of large credit unions will provide data on credit union share drafts and related items; the Investment Company Institute provides a weekly survey of money market mutual fund shares; and a daily survey of 125 large member banks forms the basis for the RP series. As this incomplete listing suggests, the comprehensiveness of the new monetary aggregates is greater than the previous measures.

problem, see *Report,* pp. 37-40 and, for a technical discussion, David A. Pierce, Neva Van Peski, and Edward R. Fry, "Seasonal Adjustment of the Monetary Aggregates," *Staff Papers,* pp. 71-90.

CONCLUSION

The Federal Reserve Board recently has redefined the monetary aggregates to provide better measures of financial assets held by the public. The new basic transaction measure, called M1A, is equal to the former M1 minus demand deposits held at commercial banks due to foreign commercial banks and official institutions. Large discrepancies between the growth rates of M1 and M1A are not anticipated.

In addition, a broader transactions measure — M1B — has been introduced. This aggregate combines those deposits that are held, for the most part, both for check-writing purposes and as savings accounts. M1B, therefore, equals MIA plus NOW accounts, savings accounts subject to automatic transfer (ATS accounts), credit union share drafts, and demand deposits at mutual savings banks (non-interest-bearing). The growth of NOW and ATS accounts has contributed to faster growth of M1B relative to M1 or M1A. Consequently, if NOW accounts are legalized nationwide, more rapid growth in M1B relative to M1A is expected.

The Board also has redefined M2 and M3 and has introduced a new aggregate, L, which is intended to measure total liquid assets held by the public. These redefinitions represent a consolidation of the former M2, M3, M4, and M5 measures, For instance, the new M2 is similar in definition to the old M3; the new M3 is similar to the old M5. The new L aggregate, unlike any previous measure, includes such items as term Eurodollars held by U.S. nonbank residents, bankers acceptances, commercial paper, U.S. savings bonds, and other liquid Treasury obligations. This broad measure of liquid financial assets is believed to provide a useful measure of credit in the economy which arises either through the banking sector or through other financial channels.