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Changes in the structure of the U.S. financial industry over the last decade have raised questions about the reliability of M2 as the primary guide for monetary policy. Although the simple ratio of economic activity to M2 — that is, M2 velocity — indicates nothing unusual, the relationship between velocity and interest rates has been disrupted in recent years. This appears to be related to a breakdown in money demand in 1988, which could in turn be linked to the restructuring of depositories. The authors examine the velocities of two alternative monetary aggregates, but find that, like M2, these measures are not impervious to financial change.

The P-Star (P*) model forecasts inflation by exploiting the stability of M2 velocity and the tendency of the real economy to operate near its potential. For a given stock of M2, P* is the price level that would prevail if velocity were at its mean and real income equaled potential output. The ratio of the actual price level (P) to P* can be considered an indicator of how the current money stock will affect inflation over the next several years. Over shorter horizons, other factors may be expected to influence the inflation rate. This paper shows how the P* model can be modified to include information about the recent behavior of commodity prices. This modified model yields more accurate short-run inflation forecasts while still retaining the property that, over longer horizons, only money matters.

During the initial stages of the expansion of the 1980s, wage growth remained relatively subdued. Even as the economy picked up steam later in the decade, tight labor markets did not drive up wages to the extent that past experience would have suggested. In an effort to find out what was behind this unusual wage restraint, the Federal Reserve Bank of Cleveland held a two-day conference in October 1989 on the causes and consequences of structural changes in U.S. labor markets. This article provides an overview of those proceedings.

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Recent Behavior of Velocity: Alternative Measures of Money

by John B. Carlson and Susan M. Byrne

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Introduction

The unusual weakness of the M2 monetary aggregate over the past year or so has raised concerns about implications for the economy and has brought into question the reliability of this measure as a guide for policy. These concerns heightened last summer as initial reports indicated that M2 declined in the third quarter, leaving it around the lower bound of its target range. Historically, such sharp slowdowns in money growth have been associated with subsequent weakness in economic activity.[1]

By contrast, growth in the narrower M1 measure has been robust, having increased almost 9 percent in 1991. Growth in the monetary base has also been strong, driven to some extent by the transitory foreign demand for U.S. currency during the Gulf War. Moreover, Poole (1991) and Motley (1988) have proposed alternative measures of money that suggest monetary policy is not as stringent as it might appear.

From time to time, policymakers reexamine the potential usefulness of alternative measures of money as policy guides. Indeed, in the mid-1980s, the Federal Open Market Committee (FOMC) abandoned M1 as its primary policy target in favor of M2. One basis for forsaking M1 is most clearly evident in the marked change in the historical pattern of its velocity, defined as the ratio of nominal income to M1 (see figure 1).

Over much of the postwar period, M1 velocity increased steadily along a trend rate of 3 percent. In the early 1980s, however, this measure became substantially more variable with no clear trend. The disruption in the historical pattern was attributed largely to financial innovation in conjunction with deregulation and disinflation.[2]

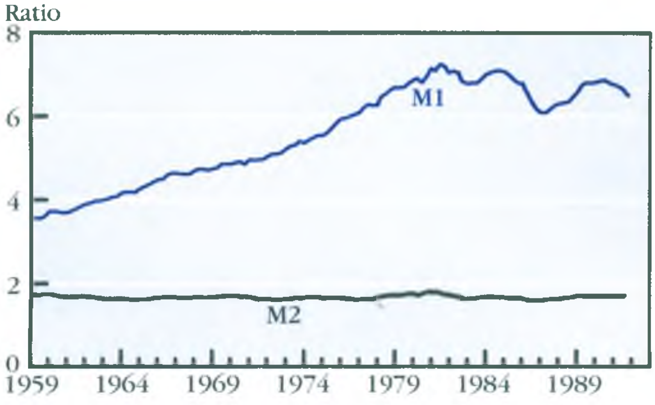
M2 velocity, on the other hand, appeared to be unaffected by these events. Although the measure has always varied systematically with interest rates, it is essentially trendless both before and after the early 1980s (see figure 1). In fact, since the founding of the Federal Reserve in 1913, M2

■ 1 Although revisions to the data revealed that initial reports understated M2 growth during the summer and for the year, the revised figures were still inexplicably sluggish. We recognize, however, that the association between money growth and economic activity does not imply causality. For a discussion of this issue, see Carlstrom and Gamber (1990).

■ 2 For a discussion of the breakdown of M1 velocity and its implications for monetary targeting, see Poole (1988). For a brief summary of the effects of financial innovation, deregulation, and disinflation on M1 and its velocity, see Judd and Scadding (1982) and Carlson (1989).

FIGURE 1

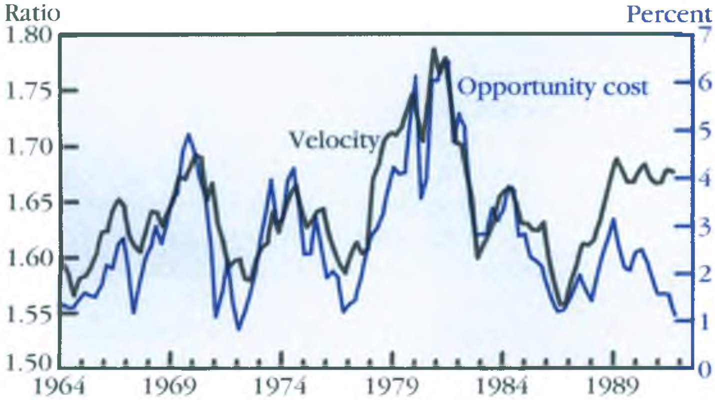
M1 and M2 Velocity



SOURCE: Board of Governors of the Federal Reserve System.

FIGURE 2

M2 Velocity and Opportunity Cost



SOURCE: Board of Governors of the Federal Reserve System.

and nominal income have grown at approximately the same rate, suggesting the existence of a relatively simple and enduring relationship between the two.

On the surface, there is little basis for believing that M2 velocity has behaved unusually over the past few years; after all, it is currently close to its *trendless* long-run average. What is unusual, however, is that around 1989, an apparent break occurred in the relationship between M2 velocity and the opportunity cost of the aggregate, defined as the difference between the market interest rate and the rates paid on M2 instruments (see figure 2).[3] Since then, M2 velocity has been trending up while its opportunity cost has been falling. Yet, history suggests that velocity should be declining, at least in the short run. Understanding this anomaly is, of course, important for interpreting the aggregate's recent weakness.

This article examines the factors that some analysts believe account for the unusual behavior of M2 and its velocity. We also discuss alternative measures of money recently proposed by Poole, and estimate a demand function for an expanded measure of M2. The analysis suggests that part of the anomalous behavior of M2 velocity is related to the ongoing restructuring of the savings and loan (thrift) industry. Although the implications for the long run are unclear, M2 velocity is likely to remain higher over the near term than one might otherwise expect given the level of its opportunity cost.

I. Velocity and the Demand for Money

The concept of velocity is central to discussions of monetary policy, largely because it affords the Federal Reserve a straightforward and relatively nontechnical language that Congress and the public can easily understand.[4] The fact that M2 velocity has been trendless makes it easy to convey to the public why the M2 aggregate might be viewed as a reliable guide over the long term. As the simple ratio of income to money, however, velocity embodies some complex structural relationships.

Economic explanations for the behavior of velocity have generally focused on the existence of a "stable" money demand function. The notion of stability typically implies that this function should have relatively few arguments, and that it should include some measure of spending or economic activity (see Friedman [1956]).[5] If the function were to require knowledge about a large number of variables in order to pin it down, the simple relationship between money and economic activity would be less predictable.

For many years, economists were confident that reasonably stable money demand specifications could be estimated for narrow definitions of money. Many specifications were based on the inventory-theoretic models of Baumol (1952)

3 More precisely, the interest rate paid on M2 instruments is the weighted average of the component rates, where the weights are relative shares. The market rate is the weighted average of yields on the three-month Treasury bill and the three-year Treasury note, with weights being shares of both the non–time deposit (zero-maturity) and small time deposit components of M2. For further discussion of this opportunity cost measure, see Carlson and Parrott (1991).

4 Since 1978, the FOMC has been required by law to report to Congress on its annual monetary objectives. The Committee's progress is reviewed at midyear and again at the beginning of the following year, when the next set of objectives is reported.

5 For a recent comprehensive survey of the empirical literature spawned by Friedman's restatement, see Judd and Scadding (1982).

and Tobin (1956). One theoretical result of such models was that the income elasticity of cash balances is less than one, implying that the velocity of money would rise secularly.

This seemed to square with estimates of income elasticity associated with conventional specifications of M1 demand. Estimates of interest elasticity, however, were much lower than the theoretical models predicted.[6] Although Hoffman and Rasche (1989) recently obtained more substantial estimates of the long-run interest elasticity of M1, it is doubtful that stable short-run specifications for M1 demand exist. The evidence suggests that changes in the structure of the financial industry have affected M1 demand in too many ways to pin down.[7]

Because M2 velocity appeared to be impervious to the financial changes of the 1970s and early 1980s, attention turned toward finding stable short-run specifications for M2 demand. One of the most promising was developed by Moore, Porter, and Small (1990), hereafter referred to as MPS. They applied econometric techniques that enabled them to take account of the stationarity of M2 velocity and found that a reasonably stable M2 demand specification could be estimated, at least through 1988. Since then, however, their model has overpredicted M2 growth, raising questions about whether M2 velocity has drifted upward.

MPS specified M2 demand in an error-correction framework, noting two advantages to this approach.[8] First, error-correction regressors — entered as first differences in the levels — are more likely to be stationary and are much less colinear than they would be as undifferenced regressors. Second, the long- and short-run money demand relationships are clearly distinguished.

The long-run money demand function is specified as

$$(1) \qquad m_t = \alpha + y_t + \beta s_t + e_t ,$$

where $m_t = \log(M2)$, $y_t = \log(\textit{nominal GNP})$, and $s = \log(\textit{opportunity cost})$. Note that the unitary coefficient on nominal GNP ensures that equation (1) also specifies a relationship in which long-run velocity varies only with opportunity cost.[9] Since one might expect M2 opportunity cost to be essentially trendless in the long run, M2 velocity would also be trendless. Thus, although equation (1) may specify a partial equilibrium for the level of M2, the implied long-run general equilibrium for its velocity is essentially a constant.

The second component of the MPS model is a dynamic equation based on an error-correction adjustment specification:

$$(2) \qquad \Delta m_t = a + b e_{t-1} + \sum_{i=1}^{u} c_i \Delta m_{t-i} + \sum_{i=0}^{v} d_i \Delta s_{t-i} + \sum_{i=0}^{w} f_i \Delta y_{t-i} + \sum_{i=1}^{q} \sum_{j=0}^{n} g_{ij} \Delta x_{i,t-j} + \varepsilon_t ,$$

where e_{t-1} is the deviation of money from its long-run equilibrium value (derived from equation [1]) and ε_t is white noise. Adjustment speed is determined by changes in the lagged values of M2 and in the current and lagged values of the opportunity cost and scale variable. The general form of the model allows other variables to affect adjustment speed (both current and lagged values). These variables, which need not affect long-run equilibrium money balances, include any factors that influence the adjustment process.[10]

Equation (2) essentially specifies the short-run convergence process of M2 to its equilibrium value. When the coefficient on the error-correction term is negative, convergence is ensured. Substituting (1) into (2) yields

$$(3) \qquad \Delta m_t = a - b\alpha - b\beta s_{t-1} + b(m_{t-1} - y_{t-1}) + \sum_{i=16}^{u} c_i \Delta m_{t-i} + \sum_{i=0}^{v} d_i \Delta s_{t-i} + \sum_{i=1}^{w} f_i \Delta y_{t-i} + \sum_{i=1}^{q} \sum_{j=0}^{n} g_{ij} \Delta x_{i,t-j} + \varepsilon_t$$

■ **6** For a possible explanation of this discrepancy, see Poole (1988).

■ **7** Although Hendry and Ericsson (1990) have found "stable" specifications, these generally include many explanatory variables and hence are not convincingly useful for predicting changes in the simple link between M1 and economic activity.

■ **8** Earlier advocates of this framework include Baba, Hendry, and Starr (1988).

■ **9** MPS include a time index as a regressor to estimate any drift in M2 velocity directly. Although they find the coefficient to be significant, the drift is negligible (around 0.03 percent per year).

■ **10** MPS also specify a set of error-correction models for determining interest rates paid on the components of M2. They find that many bank deposit rates adjust relatively slowly to changes in money market interest rates. However, because their specifications are not very durable, we will focus only on the demand for M2 given the opportunity cost, not on how the opportunity cost is determined.

BOX 1

CP Specification

The CP specification and estimated coefficients are

$$\Delta m_t = -.053 - .009 s_{t-1} - .138\,(m_{t-1} - y_{t-1})$$
$$\quad (4.44) \quad (4.60) \quad (5.13)$$

$$+ .245 \Delta m_{t-1} - .007 \Delta s_t - .007 \Delta s_{t-1}$$
$$(3.08) \quad (3.32) \quad (3.39)$$

$$+ .186 \Delta c_t + .241 \Delta x_{t-1} + .031 REGDUM + \varepsilon_t$$
$$(2.87) \quad (3.30) \quad (7.38)$$

Adj. R^2 = .74; SEE = .0040; est. period = 1964:IQ to 1986:IVQ,

where s is a measure of opportunity cost, c is personal consumption expenditures, x is thrift deposits (including other checkables, money market deposit accounts [MMDAs], savings deposits, small and large time deposits, and term repurchase agreements [RPs]), and *REGDUM* is a qualitative variable that equals zero in all quarters except 1983:IQ, when it equals one.[a] Because thrift restructuring has been ongoing since 1988, and because we seek to avoid high influence points given the substantial changes in the industry since that time, equation (4) is estimated before the thrift crisis (1964:IQ to 1986:IVQ) and simulated through 1990. All parameters are significant at the 5 percent level or better.

a. Following MPS, we present results that approximate log(s) using a first-order Taylor series expansion when the opportunity cost is less than 0.5. We also estimate the model using the simple log of opportunity cost. Although the simple measure improves the in-sample fit, out-of-sample simulations are less favorable. Nevertheless, the usefulness of the Taylog transformation remains an open issue, though beyond the scope of this study.

MPS estimate a version of equation (3) over the 1964:IQ to 1986:IIQ period. They find that their specification is relatively stable, despite the advent of both deregulation and, perhaps more significantly, disinflation. Beginning in 1988, however, it begins to overpredict M2 growth.

The implications of this overprediction for velocity depend on what parameters of the M2 demand function may be changing. If any of those in the long-run specification (equation [1]) have changed, then M2 velocity will likely fluctuate around a new, higher equilibrium level. If, on the other hand, the error-correction process is misspecified, the divergence between interest rates and velocity could be temporary.

II. The MPS Specification and Thrift Restructuring

Carlson and Parrott (1991), hereafter CP, propose a specification of equation (3) that includes the change in thrift deposits as a determinant in the error-correction equation (see box 1).[11] They argue that this change is a proxy for deposit-pricing effects that, though related to the thrift restructuring, are not adequately captured in the measure of opportunity cost. This implicitly assumes that the effects of restructuring influence the adjustment of M2 to its equilibrium level, but do not affect the equilibrium level itself.

These effects may arise when failing thrifts are liquidated and time deposit contracts are abrogated. Because many of these deposits were contracted at rates substantially higher than those paid in recent years, holders of these deposits realize a sharp drop in their returns when contracts are nullified. Since the historical series on time-deposit yields records only the rate paid on new contracts, it understates this recent decline. Thus, the measure of opportunity cost is inadequate. For holders of abrogated contracts, opportunity cost has increased; in contrast, measured opportunity cost has fallen in recent years.

The CP specification is estimated before 1988 to avoid high influence points given the collapse in thrift deposits thereafter. (Out-of-sample simulations after 1988 account for most of the shortfall evident in the MPS model.) The results are consistent both with the hypothesis that thrift restructuring has played a major role in the recent M2 weakness, and with the belief that this realignment will not significantly alter long-run velocity.

It is important to note that the CP specification does not examine the potential for effects on the equilibrium level of velocity. Unfortunately, the data are not of sufficient duration to discriminate convincingly between long- and short-run effects. Nevertheless, the depository restructuring hypothesis is consistent with previous anomalies in the relationship between interest rates and velocity.

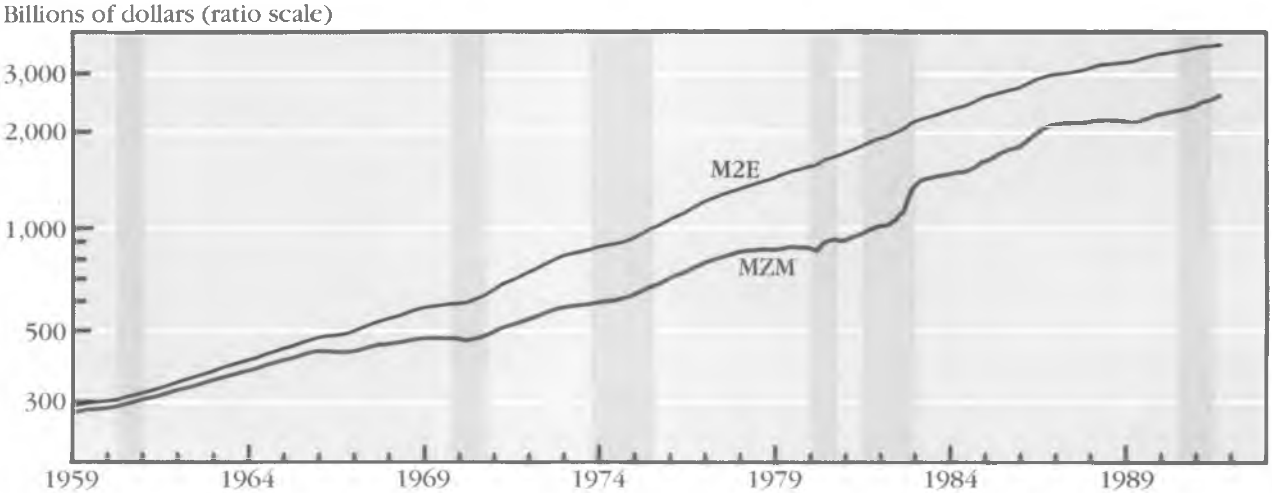
For example, M2 velocity appeared to be unusually low in the mid-1980s, given the level of its opportunity cost (see figure 2). Soon after the advent of deregulation, many analysts speculated that M2 velocity would shift downward.[12] It was believed that deregulation left the depositories in a better position to compete for funds to

11 For an alternative approach, see Duca (1991).

12 See Hallman, Porter, and Small (1989).

FIGURE 3

MZM and M2E



NOTE: M2E equals M2 plus institution-only MMMFs. MZM equals M2E minus small time deposits. Shaded areas represent recessions. Estimated trough date for 1990–91 recession is 1991:IIQ.
SOURCE: Board of Governors of the Federal Reserve System.

expand their market share of credit; hence, many argued that deposits included in M2 would increase as a share of the nation's portfolio. This in turn implied that M2 velocity would fall.

III. Alternative Measures of Money

Historically, when money demand specifications have broken down, analysts have found that the problem is often reflective of the particular definition of money being used. Over time, financial innovations occur, resulting in new instruments that have properties similar to more than one asset. For example, money market mutual funds (MMMFs), first offered in the early 1970s, have characteristics of both transactions deposits and mutual funds. Moreover, when regulations change, such as the elimination of Regulation Q, the range of assets for which deposits are substitutable can be substantially affected. Hence, financial innovation and deregulation can blur the functional distinctions between the monetary aggregates.

Poole (1991) recently identified three functional components of M2: 1) traditional transactions balances (currency plus checkable deposits) that are defined as M1, 2) savings balances that can be converted without notice into transactions balances (such as MMMFs and statement savings accounts at banks), and 3) small time deposits (defined as certificates of deposit denominated in amounts of less than $100,000) that can be converted into transactions balances (without penalty) only upon maturity.

Although M2 has served well until recently, Poole questions its longer-term durability as the appropriate measure of money. He proposes two alternative aggregates. The first, based on a principle advanced by Friedman and Schwartz (1970), views money as a "temporary abode of purchasing power." To satisfy this principle, Poole advocates including all instruments available with zero maturity. Thus, he would broaden M1 to include all savings balances that can be immediately converted into transactions balances (hereafter called MZM).[13]

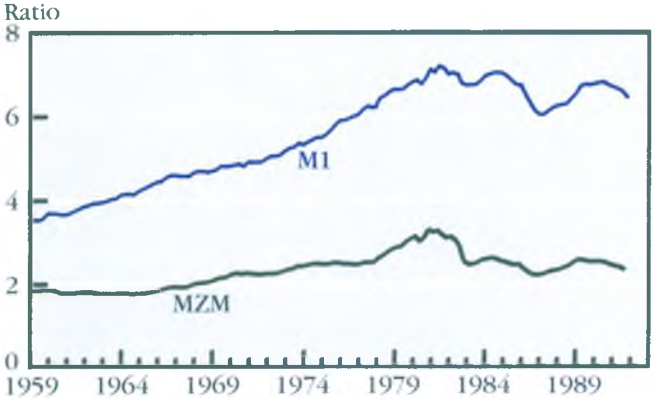
Poole also advocates expanding the M2 measure (M2E hereafter) to include MMMFs available to institutions only. He notes that these instruments allow institutions to earn interest on checkable accounts in the face of the long-standing and still-effective prohibition of interest payments on demand deposits. The time series of the two measures are illustrated in figure 3.

Prior to 1980, MZM velocity seemed to be trending up, although at a slower rate than that of M1. Since 1983, however, MZM's velocity has appeared to be the more stable of the two series

■ 13 Although Motley (1988) proposed a measure of zero-maturity instruments, the logical antecedent to this measure is Friedman and Schwartz's M2 aggregate, which consists of all commercial bank deposits (demand plus time and savings).

FIGURE 4

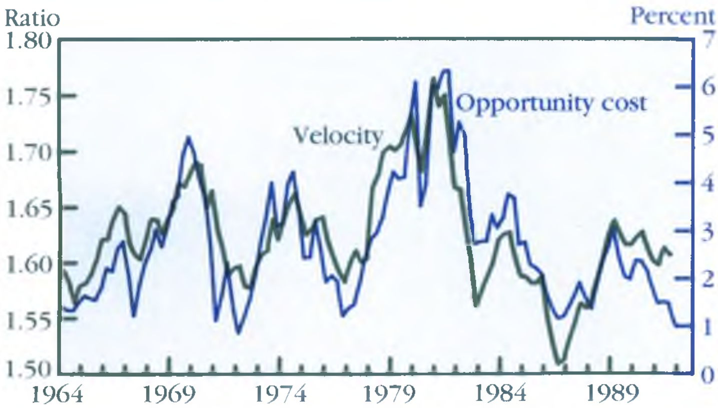
M1 and MZM Velocity



SOURCE: Board of Governors of the Federal Reserve System.

FIGURE 5

M2E Velocity and Opportunity Cost



SOURCE: Board of Governors of the Federal Reserve System.

(see figure 4).[14] Poole recognizes that the stability of MZM velocity (manifest only since deregulation) does not provide a sufficient empirical basis for choosing this aggregate over the broader alternatives. Nevertheless, he prefers it because, as a comprehensive measure of assets that serve as a temporary abode of purchasing power, MZM should be durably linked to spending. Moreover, he essentially argues that the trend in MZM velocity prior to 1980 was largely a consequence of Regulation Q, which distorted the competition between time deposits and nonregulated depository assets.

Without Regulation Q, banks have much less incentive for developing regulatory avoidance schemes, such as automatic transfer accounts, that distort the relationship between measured transactions deposits and spending.[15] Also, it seems reasonable to assume that without interest-rate regulation, banks will treat small time deposits much more like managed liabilities, enabling them to compete more directly in capital markets. Thus, the volume of small CDs will be more indicative of changes in the competitive positions of depositories than of monetary conditions.

It also seems less likely that nondepository competitors will have the same incentives to invest in financial innovations that seek to compete directly with depository savings instruments. For example, the explosive growth of MMMFs was due in large part to the inability of depositories to compete for funds on the same footing with liquid instruments offering market rates of return. In the absence of binding constraints, it is unlikely that we will see the same burst of financial innovation as occurred under Regulation Q; hence, one might expect a more stable link between zero-maturity instruments and economic activity. Since it remains to be seen whether the principle guiding the choice of MZM will lead to an empirically more robust measure of money, however, Poole recommends that M2 and MZM be given equal weight in policy deliberations.

The velocity of M2E appears to have characteristics that suggest its relationship to the economy is less disrupted by regulatory change than that of M2 (see figure 5). Indeed, M2E velocity has been falling in recent years roughly commensurate with the decline in opportunity cost. This more consistent pattern suggests that over the whole sample period, the demand for M2E has been relatively more stable than the demand for M2.

Nevertheless, before it returned to a more consistent relationship with interest rates, M2E velocity was still unusually low over most of the 1980s. As suggested above, this could reflect the unsustainable attempt by depositories to increase their market share once they were freed from the regulatory constraints that limited the types of loans they could make. Perhaps the best example of this was in the thrift industry.

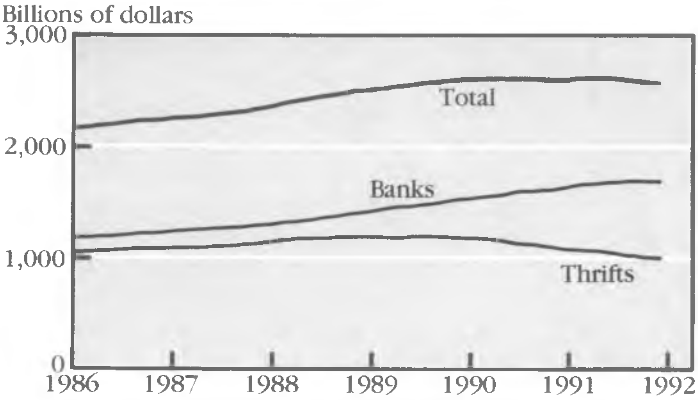
By the early 1980s, the rising cost of funds, reflecting accelerating inflation, had left many thrifts that were holding relatively low-yielding mortgages insolvent. Kane (1989, p. 4) argues that, with nothing to lose, these "zombie" institutions attempted "to grow out of their problems by undertaking long-shot lending and funding activities" that essentially renewed and ex-

14 Because there is no empirical basis for assuming that MZM velocity has been stable, we do not estimate a demand function below.

15 Although the existence of reserve requirements on transactions deposits leaves some incentive intact, the effects of most potential avoidance schemes would probably be internalized in zero-maturity assets.

FIGURE 6

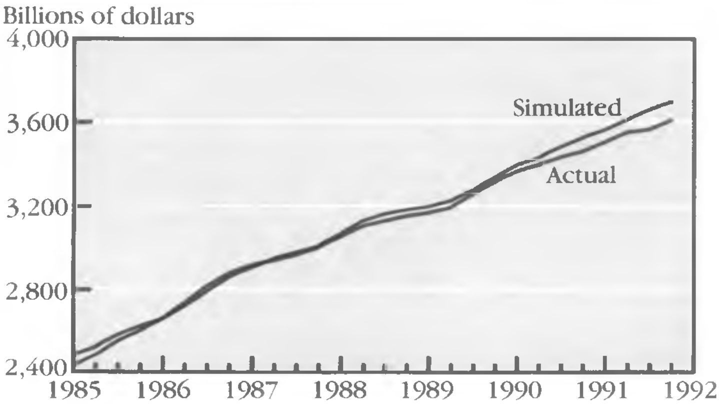
Nontransactions Deposits



SOURCE: Board of Governors of the Federal Reserve System.

FIGURE 7

Simulated and Actual M2E: Based on Equation (4)



SOURCE: Authors' calculations.

panded the lost bets of the past. To finance this expansion, thrifts offered a premium on deposits, leading to a sharp increase in the depository component of M2E (and M2) relative to income, thereby decreasing velocity.[16] With the understanding that such instruments were federally guaranteed, depositors were all too willing to provide the funds. As the decade unfolded, however, it became clear that this strategy was not sustainable.

Beginning in 1989, Congress and the Bush administration officially recognized the insolvency of both a large portion of the savings and loan industry and the thrift deposit insurance fund. In August of that year, they allocated funds as the first step in resolving the insurance crisis, and to close zombie thrifts. The weakness in deposit growth since 1988 is to some extent an unwinding of the unsustainable depository share of credit markets.

IV. The Demand for M2E

We estimate two variations of the velocity specification (equation [3]) using the M2E measure.[17] The first regression includes a temporary intercept shift variable embodying the hypothesis that the unsustainable expansion of depositories affected equilibrium velocity in the 1980s. It presumes that the overextension of depository intermediation was financed largely by time deposits, which are closer substitutes for capital market instruments than are money market securities. This hypothesis would explain why a large part of the runoff of nontransactions deposits at thrifts did not find its way back to other depositories, but was instead transferred to nondepository investment vehicles (see figure 6).

The first specification does not include the thrift-change variable proposed by CP. The estimated coefficients are

$$(4)\quad \underset{}{\Delta m_t} = \underset{(5.13)}{-.076} - \underset{(5.25)}{.012 s_{t-1}} - \underset{(5.62)}{.189(m_{t-1} - y_{t-1})}$$

$$+ \underset{(6.91)}{.421\Delta m_{t-1}} - \underset{(4.27)}{.008\Delta s_t} - \underset{(1.92)}{.005\Delta s_{t-1}}$$

$$+ \underset{(4.27)}{.292\Delta c_t} + \underset{(2.81)}{.005 DBUDUM_{t-1}}$$

$$+ \underset{(5.61)}{.024 REGDUM} + \varepsilon_t$$

Adj. R^2 = .72; SEE = .0043; est. period = 1964:IQ to 1989:IVQ,

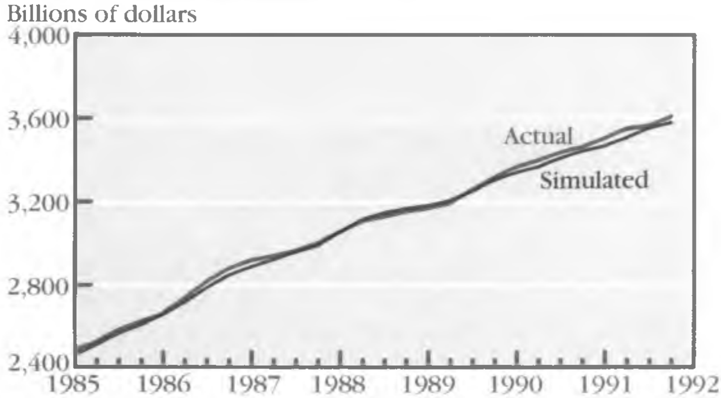
where s is a measure of M2E opportunity cost, c is personal consumption expenditures, *DBUDUM* is the temporary intercept shift variable, and *REGDUM* is a qualitative variable accounting

16 As CP note, such a premium is not adequately incorporated in measured yields. Thus, measured M2E opportunity cost probably overstates true opportunity cost. This would explain why M2 velocity appears to be low relative to its measured opportunity cost.

17 Although Hoffman and Rasche (1989) find a stable long-run relationship between real M1, interest rates, and real income, they question the existence of a stable short-run specification for M1 demand. Hendry and Ericsson (1990) do find stable short-run specifications for the narrow measure, but raise a number of issues that are beyond the scope of this paper. We focus on the short-run demand for M2E, which has the virtue of a trendless velocity over the past 30 years.

FIGURE 8

Simulated and Actual M2E: Based on Equation (5)



SOURCE: Authors' calculations.

for the introduction of nationwide NOW accounts. *DBUDUM* and *REGDUM* equal zero in all periods except 1981:IVQ – 1988:IIQ and 1983:IQ, respectively, when they equal one.

The estimated coefficient on *DBUDUM* is positive and statistically significant. This is consistent with the hypothesis that equilibrium velocity was temporarily low in the 1980s. Though the model has reasonably good in-sample properties, out-of-sample simulations indicate that it overpredicts M2E growth in 1991 (see figure 7). The 1991:IIIQ drop in M2E (and the sharp rise in its velocity) is greater than two standard deviations of its predicted value based on in-sample experience.[18]

One explanation for the shortfall in M2 is that the savings and loan restructuring peaked in the summer months of 1991. Thus, the second regression extends equation (4) to include the change in thrift deposits as a regressor in the error-correction specification:

$$(5)\quad \Delta m_t = -.079 - .011 s_{t-1} - .194(m_{t-1} - y_{t-1})$$
$$\quad\quad (5.64)\quad (5.07)\quad\quad (6.10)$$

$$+ .271\Delta m_{t-1} - .008\Delta s_t - .006\Delta s_{t-1}$$
$$(3.77)\quad\quad (4.05)\quad (2.56)$$

$$+ .240\Delta c_t + .004 DBUDUM_{t-1}$$
$$(3.62)\quad (3.18)$$

$$+ .027 REGDUM + .180\Delta x_{t-1} + \varepsilon_t$$
$$(6.37)\quad\quad (3.31)$$

Adj. R^2 = .75; SEE = .0041; est. period = 1964:IQ to 1989:IVQ,

where x denotes thrift institution deposits (including other checkables, MMDAs, savings deposits, small and large time deposits, and term RPs). The coefficient on the thrift proxy is statistically significant, but somewhat smaller than in the CP specification. This suggests that depository restructuring is an important and continuing factor, at least in the short run. Out-of-sample simulations of M2E demand tend to underpredict M2E over most of the past three years, but the bias has been small (see figure 8). Thus, although not immune to the structural change, the measure would seem to warrant a closer look.

V. Conclusion

Changes in the structure of the U.S. financial industry have justifiably brought into question the reliability of M2 as a guide for monetary policy. The aggregate's appeal as an intermediate policy guide has been largely due to its relatively stable and simple relationship with income and interest rates. Over most of the past 30 years, this stability was manifest in the behavior of M2 velocity, which, though influenced by interest rates, ultimately reverted to a trendless mean.

Although M2 velocity, by itself, indicates nothing unusual, its relationship with interest rates has been disrupted in the last few years. This appears to be related to a breakdown in M2 demand after 1988, which probably reflects to some extent the restructuring of depositories.

We examine the velocities of two alternative measures of money: MZM and M2E. Of these, M2E holds the most promise, because its velocity appears to be least affected by the events of recent years. Moreover, velocity specifications of money demand seem to be more durable for the M2E measure than for M2.

Nonetheless, we must stress the tentative nature of any conclusions based on the analysis above. Unfortunately, money demand theory has not advanced to a state in which empirical hypotheses are sharply defined and testable. This perhaps reflects the tension arising from the idea that if money demand is to be useful for policy, it should have relatively few determinants.

On the other hand, as Judd and Scadding (1982) note, the fundamental source of the instability of money demand has been the excessive growth in money. They argue that the failure of

18 We recognize that statistical tests comparing M2 and M2E may not be very meaningful. However, from a monetary targeting point of view, it is much more persuasive if one can demonstrate an empirical basis for believing that the velocity of the targeted aggregate is relatively stationary.

monetary policy to restrain inflation led to the high market interest rates that, in combination with regulatory restraints, induced much of the financial innovation disrupting the relationship between M1 and the economy. Similarly, one might argue that rising inflation was the fundamental source of the unsustainable expansion — and ultimate collapse — of the thrift industry.

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Commodity Prices and P-Star

by Jeffrey J. Hallman and Edward J. Bryden

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Introduction

A recent article by Hallman, Porter, and Small (1991), henceforth referred to as HPS, presented the P-Star (P*) indicator of future inflation. The HPS models exploit the stability of two long-run relationships: that between M2 and nominal output, and that between actual and potential real output. Despite paying no attention to other possible influences on inflation, such as commodity prices or interest rates, the HPS models produced better forecasts of the GNP implicit price deflator over the 1970s and 1980s than did a number of alternatives, including both univariate ARIMA models and the published forecasts of several econometric consulting firms.

Most economists believe the quantity theory relationship that underlies the P* model holds only in the long run, if at all. In the short run, standard economic theory predicts that any factors affecting aggregate supply or aggregate demand may also affect the price level. Commodity prices may give early indications of shifts in either supply or demand; if so, augmenting the P* models to include information about the recent behavior of commodity prices may be expected to improve both fit and forecasting performance, particularly over short horizons. This paper shows that these results can indeed occur.

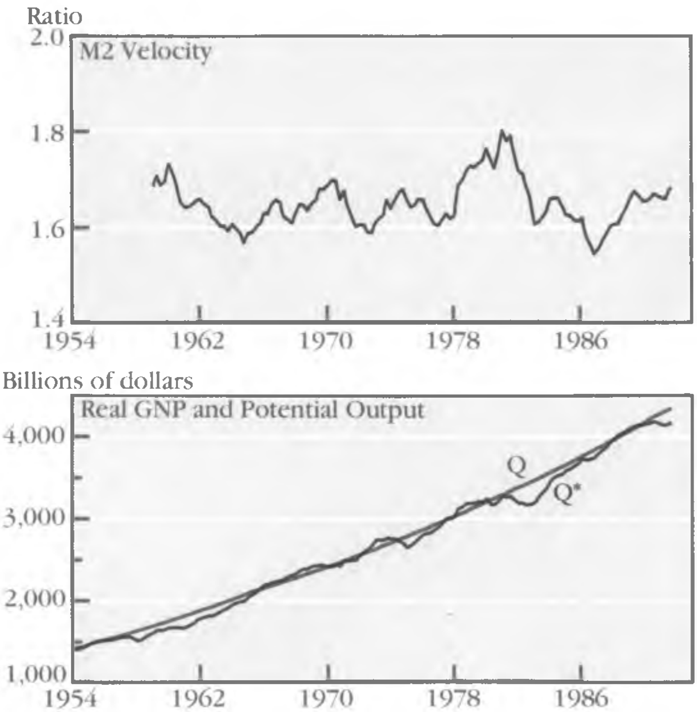
After briefly reviewing the P* idea, we show how the P* approach can be extended to incorporate commodity price data. Two notable results are obtained: First, the resulting models outperform the HPS models in fit and forecasting ability, although the improvement is not large. Second, the relative significance of the P* and commodity price terms depends on the sampling frequency of the data. The two terms are equally significant in explaining inflation at quarterly and annual frequencies, but inflation in the biennial version of the model depends exclusively on the monetary (P*) term. This accords well with the orthodox view that, while commodity market developments may significantly influence inflation in the short run, in the long run only money matters.

I. The P* Model

The HPS work was motivated by the observation that, rather than trending up or down over the past 35 years, V (the velocity of M2, defined as GNP divided by M2) has simply fluctuated around its average value of 1.65 (V*). During

FIGURE 1

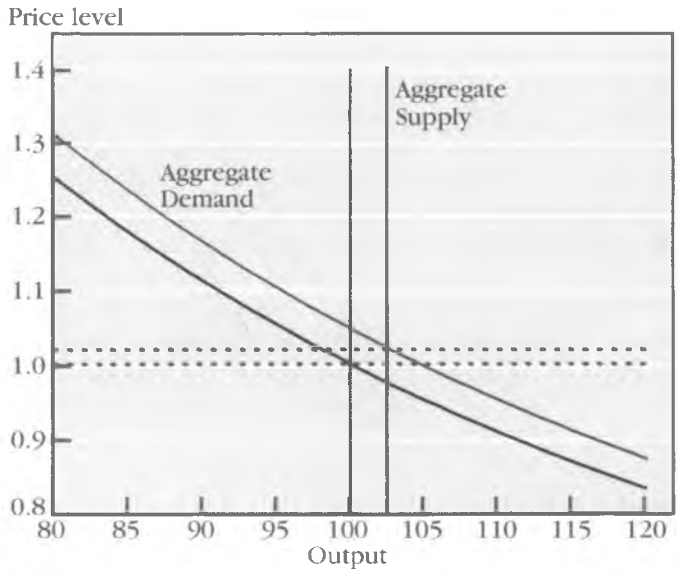
M2 Velocity, Real GNP, and Potential Output



SOURCE: Board of Governors of the Federal Reserve System.

FIGURE 2

Long-Run Aggregate Supply and Demand



SOURCE: Authors' calculations.

the same period, real GNP (Q) has usually been within 5 or 6 percent of potential output (Q*). Both of these regularities can be seen in figure 1. Using lower-case letters to denote natural logarithms, HPS found that they could not reject the hypothesis that the velocity gap $(v - v^*)$ and output gap $(q^* - q)$ are covariance stationary.[1] A stationary series has a mean to which it tends to return infinitely often. More important, as the forecasting horizon lengthens, the optimal forecast of a stationary series tends to approach the series mean.[2]

The relation between real output, the price level as measured by the implicit price deflator (P), money, and velocity is given by the quantity equation:

$$(1) \quad p + q = m2 + v.$$

As the velocity and output gaps are stationary, so too is the price gap $(p - p^*)$, where P* is defined as M2* x V* / Q*. The reason is that the price gap is simply the sum of the velocity and output gaps. Since V* is constant, the economic interpretation of stationarity of the price gap is that, given M2 and potential output, the price level that can be supported in the long run is P*.

Historically, inflation has usually accelerated when P* has exceeded P, and slowed when the reverse was true. Letting π denote the rate of change of the implicit price deflator, HPS used a quarterly model of the form

$$(2) \quad \Delta\pi_t = \alpha (p_{t-1} - p^*_{t-1}) + \sum_{j=1}^{4} \beta_j \Delta\pi_{t-j}$$

to exploit this regularity in forecasting inflation. The lagged $\Delta\pi$ terms in equation (2) reflect the fact that quarterly changes in the inflation rate are often partly reversed in subsequent quarters, perhaps due to measurement error. Lagged $\Delta\pi$ terms are unnecessary when the model is estimated using annual data. The model then becomes

$$(3) \quad \Delta\pi_t = \alpha (p_{t-1} - p^*_{t-1}),$$

where the subscript t is now an annual index (measured in every fourth quarter) rather than a quarterly index as in equation (2). Estimates of the models in equations (2) and (3), and a biennial version (one observation from the fourth

1 A series y_t is covariance stationary if, for all k and j, $E(y_{t+k}) = m$, and $cov(y_{t-j}, y_t) = cov(y_{t+k-j}, y_{t+k})$.

2 Optimal here means the forecast that minimizes the expected variance of the forecast error.

TABLE 1

Estimates of the Models

	Coefficients						Regression Statistics		
	α_1	α_2	β_1	β_2	β_3	β_4	$\bar{R}^2$	Standard Error	Durbin-Watson
Frequency				Price Gap Models					
Quarterly[a]	−.145 (−4.2)		−.64 (−7.4)	−.47 (−4.7)	−.27 (−2.7)	−.12 (−1.3)	.32	1.56	1.96
Annual[b]	−.214 (−4.2)						.38	1.19	2.36
Biennial[c]	−.31 (−5.6)						.70	.97	1.50
Frequency				Price Gap Models with Commodity Price Inflation					
Quarterly[a]	−.107 (−3.0)	−.039 (−2.9)	−.70 (−8.1)	−.55 (−5.5)	−.34 (−3.5)	−.15 (−1.8)	.36	1.51	1.97
Annual[b]	−.171 (−3.5)	−.061 (−3.5)	−.30 (−2.3)				.56	1.00	2.34
Biennial[c]	−.37 (−7.4)	−.015 (−1.8)					.84	.77	2.25

a. Estimated from 1960:IIQ to 1990:IIQ; 121 observations.
b. Estimated from 1961 to 1990; 30 observations.
c. Estimated from 1962 to 1990; 15 observations.
NOTE: T-statistics are indicated in parentheses.
SOURCE: Authors' calculations.

quarter of every other year) of equation (3) are given in table 1.

The economic intuition underlying the P* model can be illustrated using the long-run aggregate supply and long-run aggregate demand diagram in figure 2. Stationarity of the velocity and output gaps indicates the shape of the curves. The stationarity of velocity means that V is constant at V* along the long-run aggregate demand curve. But because money is also held fixed along the curve, long-run aggregate demand is represented as the hyperbola formed by the locus of points where P x Q = M x V*. The stationarity of the output gap means that the long-run aggregate supply curve is vertical at Q*.

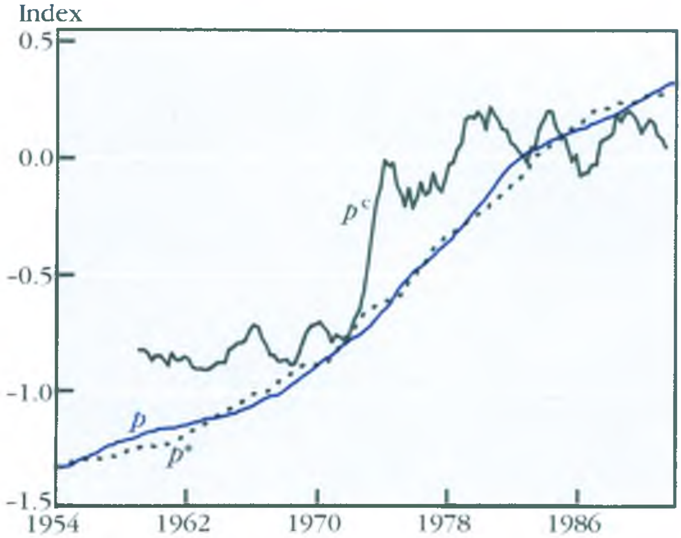
Changes in the money stock shift the long-run aggregate demand curve by proportionate amounts. A 4.5 percent increase in M2, for example, shifts the demand curve up (or equivalently, to the right) by 4.5 percent. That is, the shifted curve is the locus of (P, Q) pairs whose product is now 4.5 percent greater than before the shift. Changes in potential output are drawn as shifts in aggregate supply to the left or right. A 2.5 percent increase in Q* shifts the vertical line 2.5 percent to the right. In the example shown, the result of both shifts taken together is a 2 percent rise in prices accompanied by a 2.5 percent increase in real output.

Although the above analysis shows how money and potential output determine prices in the long run, it may have less application in the short run. The velocity and output gaps are stationary, but they are not identically zero at all times. Short-run aggregate demand may not be a hyperbola, and short-run aggregate supply may not be vertical. Furthermore, in constructing a measure of potential output, it is customary to restrict it to grow smoothly over time. The best that can be hoped for such a measure is that it will correctly capture the trend in potential output.

This catalog of short-run omissions and inadequacies is reason to hope that the P* model can be enhanced. The inclusion of variables that reflect information about the location or movements of the short-run aggregate supply and demand curves may improve the model's performance. One such candidate for inclusion is a measure of commodity prices.

FIGURE 3

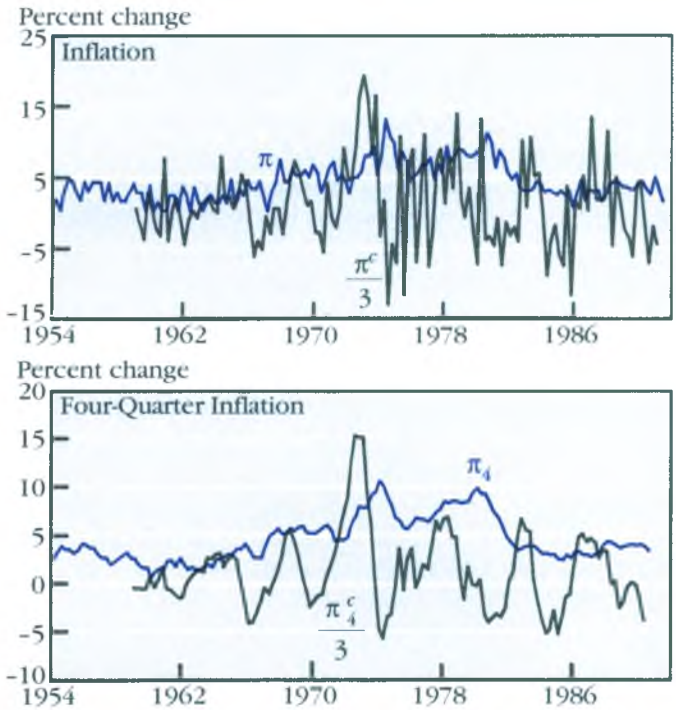
Implicit Price Deflator, P*, and the Commodity Price Index



SOURCES: Board of Governors of the Federal Reserve System, and the Commodity Research Bureau.

FIGURE 4

Inflation Rates for the Implicit Price Deflator and the Commodity Price Index



SOURCES: Board of Governors of the Federal Reserve System, and the Commodity Research Bureau.

II. Commodity Prices and the Deflator

Figure 3 plots the logarithms of P, P*, and the Commodity Research Bureau's (CRB) spot market price index for 22 commodities, labeled p^c in the figure. While both p and p^c have increased over the years, a simple long-run relationship between their levels is not apparent. Rather, there has been a decline in $(p^c - p)$, the log of real commodities prices.

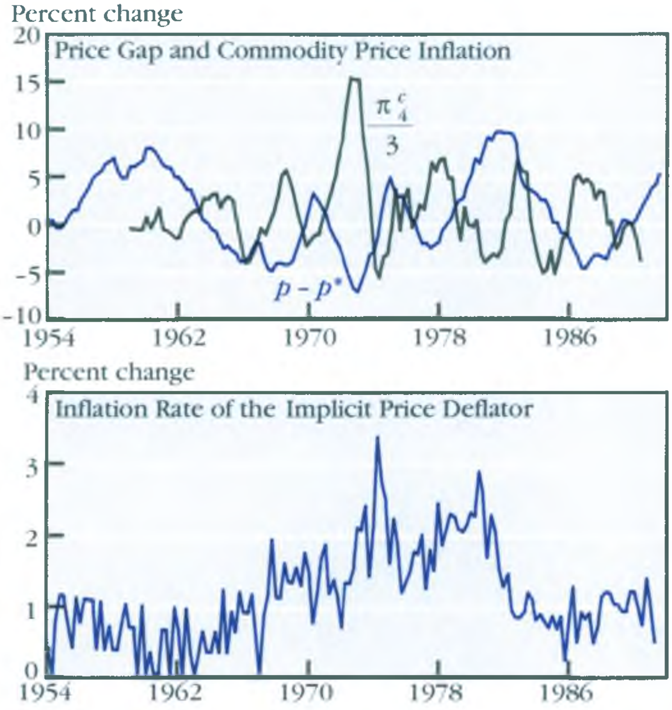
There is no reason to expect a simple relationship to hold between the levels of a commodity price index and the implicit price deflator. The deflator is meant to measure the price of all of the economy's outputs, while most of the 22 CRB commodities are primarily used as inputs to various production processes. Even if firms price on a pure markup basis, output prices can diverge from commodity prices if the relative prices of other, noncommodity inputs change. One can easily imagine that continuing technological progress in agriculture, for example, will result in a downward trend in the price of wheat relative to the price of labor. Trends in the real prices of commodities are simply trends in the prices of commodities relative to the prices of other goods, so we should not be surprised to find them in the data.

While it is easy to see how a trend in $(p^c - p)$ might arise from such forces as technological progress, it is much harder to imagine a scenario in which the inflation rates π and π^c would trend apart indefinitely. Not only would this imply a trend in the real price of commodities, but it would require a trend in the trend, resulting in explosive real commodity prices. That kind of relative behavior is not evident in the data, so there is an implied long-run relationship between the inflation rates of prices in general and commodity prices.

The top panel of figure 4 plots quarterly inflation rates for the GNP deflator and the commodity price index. The commodity inflation index is divided by three to put it on the same scale in the plot. The relationship between the two indices is clearer in the lower panel, where inflation rates are calculated over four quarters, resulting in a smoother plot. Notice that in keeping with the downward trend in real commodity prices evident in figure 3, the arithmetic mean of the commodity inflation index is lower than the arithmetic mean of GNP inflation. Finally, figure 5 shows that both $(p - p^*)$ and π_4^c (the change in p^c over four quarters) foreshadow subsequent changes in the inflation rate.

FIGURE 5

Inflation Predictions by the Price Gap and by Commodity Price Changes



SOURCES: Board of Governors of the Federal Reserve System, and the Commodity Research Bureau.

TABLE 2

Significance of the Error-Correction Terms

Frequency	T-statistics $(p - p^*)$	$(\pi - \pi^c)$
Quarterly	–3.0	–2.9
Annual	–3.5	–3.5
Biennial	–7.4	–1.8

SOURCE: Authors' calculations.

III. P* with Commodity Prices

The figures argue for a specification of the dynamic relationship between p and p^c that preserves a long-run relationship in which the commodity inflation rate is less than GNP deflator inflation. Just as the term $(p_{t-1} - p^*_{t-1})$ in equations (2) and (3) enforces a long-run relationship between p and p^*, the introduction of a term $(\pi_{4,t-1} - \pi^c_{4,t-1} - m)$ with a negative coefficient will enforce a similar relationship between the inflation rates for P and P^c. Here, m denotes the mean difference of the two inflation rates, so that the real commodity inflation rate $(\pi_4 - \pi^c_4)$ enters as a deviation about its mean. The resulting equation for the quarterly model is

$$(4) \quad \Delta\pi_t = \alpha_1 (p_{t-1} - p^*_{t-1}) + \alpha_2(\pi_{4,t-1} - \pi^c_{4,t-1} - m) + \sum_{j=1}^{4} \beta_j \Delta\pi_{t-j},$$

and the implied equilibrium has both $p = p^*$ and a trend of $-m$ in the real price of commodities. The annual and biennial versions of this model take the form

$$(5) \quad \Delta\pi_t = \alpha_1 (p_{t-1} - p^*_{t-1}) + \alpha_2(\Delta_4 p_{t-1} - \Delta_4 p^c_{t-1} - m) + \beta_1 \Delta\pi_{t-1}.$$

The biennial version does not require the lagged $\Delta\pi$ term. Estimates for all three versions may be found in table 1.

In all of the estimated models, both α coefficients are significantly less than zero, and the equations using the price gap model with commodity price inflation fit better than those that do not use the commodity price term.

Table 2 shows an interesting comparison of the error-correction t-statistics taken from table 1. The quarterly model predicts inflation over the coming quarter, the annual model over the coming year, and the biennial model over two years. At the lowest frequency, the explanatory power of the commodity inflation term is minor; nearly all of the explanatory power of the model comes from the price gap term. This result confirms that while supply shocks reflected in $(\pi - \pi^c)$ affect inflation in the short run, over longer horizons money (reflected in $[p - p^*]$) is more important. If both velocity and real output eventually return to their long-run values, supply shocks not accommodated

TABLE 3

Year-Ahead Forecasting Performance

Year	Actual	Quarterly ($p - p^*$) Predicted	Quarterly ($p - p^*$) Error	Annual ($p - p^*$) Predicted	Annual ($p - p^*$) Error	Annual ($p - p^*$) and ($\pi - \pi^c$) Predicted	Annual ($p - p^*$) and ($\pi - \pi^c$) Error
1970	5.17	5.41	−0.24	5.52	−0.35	7.14	−1.97
1971	6.09	4.94	1.15	4.99	1.10	5.39	0.70
1972	4.42	6.39	−1.97	6.38	−1.96	6.49	−2.08
1973	8.25	5.42	2.82	5.05	3.19	7.45	0.79
1974	9.96	8.88	1.09	8.94	1.02	8.10	−1.86
1975	8.35	9.69	−1.34	9.25	−0.91	9.14	−0.80
1976	5.74	7.97	−2.23	7.75	−2.01	7.81	−2.07
1977	6.82	6.73	0.09	6.08	0.75	7.52	−0.70
1978	7.98	7.30	0.69	7.47	0.51	6.98	1.00
1979	8.87	7.82	1.05	7.95	0.92	8.57	0.30
1980	9.88	7.49	2.39	7.90	1.98	8.10	1.78
1981	8.76	8.49	0.27	8.17	0.59	8.00	0.76
1982	5.06	6.92	−1.85	6.73	−1.67	6.27	−1.20
1983	3.64	3.70	−0.06	3.02	0.62	4.28	−0.64
1984	3.42	3.29	0.13	2.94	0.48	5.13	−1.71
1985	2.94	3.31	−0.38	3.12	−0.18	3.11	−0.17
1986	2.58	3.44	−0.86	3.26	−0.68	2.60	−0.02
1987	2.96	3.79	−0.83	3.75	−0.80	3.69	−0.74
1988	4.14	3.46	0.68	3.76	0.37	4.44	−0.30
1989	3.73	4.39	−0.66	4.59	−0.86	4.68	−0.96
1990	3.98	3.74	0.25	3.80	0.19	3.57	0.41
1991		3.03		3.80		3.57	
Mean forecast error			0.01		0.11		−0.27
Mean absolute forecast error			1.001		1.006		0.999
Root mean squared forecast error			1.28		1.24		1.15

NOTE: Entries represent the annual growth rate of the GNP implicit price deflator over fourth-quarter to fourth-quarter periods ending in the indicated year.
SOURCE: Authors' calculations.

by the monetary authority will have no long-run effect on the overall price level. In the short run, they can influence the rate at which P converges to P*, but the fit of the biennial equation indicates that the effect dissipates within two years.

Table 3 compares the out-of-sample forecasting performance of some of these models. The first three columns show the performance of the model in equation (1), while the remaining columns are for the annual models in equations (3) and (5). The forecasts reported in the table are not truly out of sample for two reasons. First, the estimates of v^* and q^* used in constructing the p^* series are actually based on the full sample of observations. However, all of the models use this p^* series, so none of them has an unfair advantage. This "cheating" would be important if we were comparing the performance of P* models with other models, as was done in HPS.[3] Second, the year-ahead forecasts made from the quarterly model cheat in the sense that we assume the values taken by p^* over the intervening three quarters were known. This is not true of the year-ahead forecasts for the annual models making up the rest of the table, since all of their right-hand-side variables are lagged at least once.

The root mean squared forecast error for the annual price gap model (equation [3]) is slightly smaller than for the quarterly version, showing that the short-run dynamics modeled by the lagged $\Delta\pi$ terms in the quarterly model are not

3 In their paper, HPS did try estimates of q^* and v^* based only on information that would have been available to a forecaster operating in real time and found that it made little difference to the forecasting performance of their models.

TABLE 4

Encompassing Tests

Independent Variable (right-hand side)	Dependent Variable (left-hand side)	T-statistic
$e^q - e^{p^*}$	e^q	1.08
	e^{p^*}	0.01
$e^q - e^{cp}$	e^q	2.23
	e^{cp}	1.18
$e^{p^*} - e^{cp}$	e^{p^*}	2.24
	e^{cp}	1.63

SOURCE: Authors' calculations.

important for forecasting a year ahead. The results for the annual models (equations [3] and [5]) show that adding the commodity price term yields smaller forecast errors. Another way to compare competing forecasts is to ask whether the forecast error from a given model can be explained (encompassed) by the forecast of another model, as elucidated in Chong and Hendry (1986). To make this comparison, let e_t^1 and e_t^2 represent the forecast errors made by models 1 and 2. Then examine the t-statistics for the coefficients α^1 and α^2 in the regressions

$$e_t^1 = \alpha^1(e_t^1 - e_t^2), \quad e_t^2 = \alpha^2(e_t^2 - e_t^1).$$

If α^1 is significantly different from zero, model 2 encompasses model 1, as it contains useful information (for forecasting purposes) that is not in model 1. If α^1 is significant but α^2 is not, the encompassing is one-way; that is, model 1 is encompassed (by model 2) but is not encompassing. Model 2 is then clearly better on statistical grounds. The statistics in table 4 show that the annual model (equation [5]) with commodity prices holds just such a relationship with the quarterly and annual price gap models, while neither of the latter encompasses the other.

Although the comparisons in tables 3 and 4 show that commodity price information can improve the forecasting performance of the price gap model, the t-statistic comparison in table 2 indicates that the improvement will be less at longer horizons. Commodity prices themselves are notoriously difficult to forecast (as implied by efficient markets theory), so it is probably impractical to make multistep forecasts from models like equations (4) and (5) to predict at longer horizons.

For 1991, the quarterly and annual price gap models predict inflation rates of 3.1 and 3.8 percent, respectively. Augmenting the annual model with the commodity price term yields a somewhat lower prediction of 3.6 percent. The low prediction of the quarterly model reflects the unusually slow money growth in the first three quarters of this year. If we assume that P, P*, and P^c all grew at a 2 percent annual rate for the fourth quarter of 1991, the inflation rate for all of 1991 would be 3.2 percent. Both annual models (equations [3] and [5]) would then forecast 1992 inflation at 2.1 percent.

IV. Conclusion

The P* approach to forecasting inflation exploits the long-run tendencies of output to return to potential and velocity to return to its mean. However, other factors may also influence the inflation rate over shorter horizons. Incorporating such influences into the HPS model can be accomplished simply by including additional terms that measure the lagged discrepancy between the actual inflation rate and the rate that would be predicted based on the relationship between inflation and the new factor.

The commodity inflation data used here are only one of many possible augmentations. Inflation as measured by a wholesale price index, for example, would be one reasonable addition; another might be an expectations measure derived from the yield curve. So long as these additional factors are related to the inflation rate, rather than to the price level, the latter will continue to be determined only by money and potential output. If potential output is taken to be exogenous, then ultimately, only money matters.

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The Causes and Consequences of Structural Changes in U.S. Labor Markets: A Review

by Randall W. Eberts and Erica L. Groshen

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Introduction

Despite apparently tight labor markets, wage inflation in the late 1980s was much lower than most observers anticipated. *The Wall Street Journal* quoted one noted economist as saying, "The most interesting phenomenon in the United States today is the existence of enormous labor shortages in some areas accompanied by no upward pressure on wages."[1] The article went on to state that the reasons for this phenomenon challenge the assumptions about the relationship between wage changes and general price changes that we formed during the 1960s and 1970s.

Several explanations were offered at that time for the slow nominal wage growth seen during the second half of the decade. Chief among the factors cited by labor-market analysts and the media was a reversal in labor–management psychology about wage increases, brought on in part by slow productivity growth, a severe economic downturn, and increased foreign competition. The common perception was that during the 1970s, workers, with the consent of management, felt entitled to automatic wage increases that were at least in line with inflation. The demand for "3 percent plus cost of living" was a common refrain around many negotiating tables. This mind-set evaporated as workers suffered massive job losses during the twin recessions of the early 1980s, and as managers faced mounting foreign competition that eroded U.S. firms' market share and placed downward pressure on domestic prices. Instead of focusing on wage increases, negotiations became centered on wage concessions in exchange for job security.

In addition to a change in the psychology of wage-setting behavior, institutional changes were also cited as possible causes of sluggish wage growth. Mitchell (1989), in comparing the wage pressures of the 1980s with those of the 1960s, concludes that recent changes in labor-market institutions have pushed wage-setting in a more competitive direction. With the declines in the proportion of workers in the union sector and in big firms, jobs are less likely to be cushioned from labor-market forces by union contracts and bureaucratic personnel practices.

Changes in demographics, particularly the greater participation of women in the labor force, were also said to figure into the moderate wage growth witnessed during the 1980s. To the extent that women are less attached to the labor force than are men, they may provide a

1 See Uchitelle (1987).

TABLE 1

Economic Conditions in Previous Decades

	1960s	1970s		1980s	
Condition	Expansion Quarters[a]	Recession Quarters[b]	Expansion Quarters	Recession Quarters[c]	Expansion Quarters
Average annual percentage change in:					
Average hourly earnings, private business sector	5.21	6.93	7.38	7.66	3.39
Compensation per hour index	6.36	9.01	8.35	9.10	4.26
Consumer Price Index	3.41	8.45	6.94	10.04	3.68
Output per hour, private business sector	2.41	−0.38	1.82	0.18	1.70
Real GNP, 1982 dollars	4.21	−0.18	3.47	−0.25	3.65
Average level of:					
Unemployment rate	4.06	5.37	6.42	8.17	7.02
Unemployment rate, male, age 25 and up	2.31	2.99	3.78	5.81	5.39
Capacity utilization	87.80	80.99	80.78	75.93	79.99

a. 1961:IQ to 1969:IVQ.
b. 1970:IQ to 1970:IVQ and 1973:IVQ to 1975:IQ.
c. 1980:IQ to 1980:IIQ and 1981:IIQ to 1982:IVQ.
SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis; U.S. Department of Labor, Bureau of Labor Statistics; and Board of Governors of the Federal Reserve System.

buffer by filling vacancies during tight labor markets and by leaving the labor force during slack periods.

The questions facing policymakers and analysts during this period were twofold: What was really behind the apparent change in wage behavior, and was the shift permanent or temporary? In October 1989, the Federal Reserve Bank of Cleveland sponsored a conference on the causes and consequences of structural changes in U.S. labor markets. Several prominent labor economists were asked to provide a careful and comprehensive analysis of some of the important developments that took place during the 1980s. The research focuses on a range of labor-market behaviors and industrial relations practices that could explain the macroeconomic relationship between unemployment and wages, and also on the effects of this relationship on output and employment stability. Four of the six papers deal with alternative compensation practices (fringe benefits and lump-sum and profit-sharing payments) and the structure of union contracts. The remaining studies examine how changing labor-force demographics and increased pressure from international competition have affected wages.

I. Comparisons across the Last Three Decades

Was wage behavior different during the 1980s than in the preceding two decades? This brief section argues that this may indeed have been the case. Many analysts have noted that nominal wage growth during the expansions of the 1980s fell far short of that experienced during the upturns of the 1970s and even of the 1960s (table 1). And the same relatively low growth rates are also evident for the broader measure of compensation per hour, which includes fringe benefits, a growing component of employee compensation.

This sluggish response alone might tempt one to conclude that fundamental changes in the structure of wage determination and worker compensation during the 1980s dampened the upward pressure on wages. However, leaping to that conclusion ignores differences in economic conditions across the past three decades. Although observers in the 1980s generally perceived labor markets to be extremely tight (particularly during 1988 and early 1989), typical measures of labor-market tightness do not support this view. In fact, the minimum unemployment rate during the expansions of the 1980s

TABLE 2

Explaining Annual Percentage Changes in Nominal Average Hourly Earnings

	1960s	1970s	1980s
Intercept	0.465	6.022	0.473
	(0.63)	(7.43)	(2.11)
Consumer Price Index[a]	0.887	0.082	0.325
	(2.07)	(1.18)	(5.70)
Unemployment rate[b]	−0.018	0.027	0.051
	(−1.74)	(1.84)	(6.09)
Capacity utilization rate[b]	0.045	0.150	0.142
	(0.63)	(2.66)	(6.19)
Labor productivity[b]	0.286	−0.221	0.002
	(2.07)	(−2.70)	(0.03)
GNP implicit price deflator[b]	0.271	0.138	0.498
	(0.77)	(1.12)	(5.60)
Recession[c]	−0.387	−0.674	−0.138
	(−1.10)	(−1.80)	(−0.43)
R^2	0.89	0.52	0.99

a. Year-over-year change, lagged one quarter.
b. Year-over-year change.
c. Variable equals one for quarters marked by recession.
NOTE: Observations are quarterly, and percentage changes are year over year. Separate regressions were run for each decade. T-statistics are in parentheses.
SOURCE: Authors' calculations.

(5.2 percent) was *higher* than that of the upturns of the previous two decades (3.4 percent during the 1960s and 4.8 percent during the 1970s). Moreover, the maximum rate of capacity utilization was lower in the 1980s expansions (84.4 percent) than during those of the 1960s and 1970s (91.6 percent and 87.3 percent, respectively). Thus, it is not clear whether the slow wage growth of the 1980s stemmed from structural changes in wage-setting practices or simply from differences in business conditions.

One way to partially disentangle these effects is to ask the conceptual question, What would have happened to wages if the expansions of all three decades had shared the same economic conditions and differed only in the relationship between wages and changes in the economic environment? We use a simple econometric technique to estimate the wage behavior separately for each of the last three decades. These estimates, which summarize the link between wages and economic conditions in each decade, are then used to simulate the net nominal wage change that would have taken place if wages had responded to similar conditions.

We follow a variant of the wage-change model used recently by Wachter and Carter (1989) and earlier by Gordon (1982).[2] Annual changes in average hourly nominal earnings are explained econometrically by annual changes in the unemployment rate, capacity utilization, labor productivity (measured by output per hour), the GNP implicit price deflator, and the Consumer Price Index (CPI, all items for urban workers).

Other specifications of the wage-change model are possible, and many have been posited. Our simple five-variable specification is based on the premise that wages reflect both pressures in the labor market and inflation expectations. We use the CPI to measure expected price inflation. Changes in the unemployment and capacity utilization rates are assumed to proxy for shifts in the tightness of labor and product markets. Labor productivity changes measure workers' contribution to production and, consequently, employers' ability to grant higher wages. And finally, the GNP implicit price deflator captures shifts in producer prices, which also reflect employers' ability to pay higher wages.

We estimate these relationships separately for each decade using quarterly observations. We also include a variable that takes the value of one during quarters marked by national recessions to account for business-cycle effects.

Because our main purpose is to demonstrate wage behavior under similar economic conditions, we do not dwell on the estimates of individual coefficients. Nevertheless, we note that most of the variables in table 2 appear to have the expected effect on nominal wage changes: Higher nominal wage increases are generally associated with stepped-up inflation expectations, increased capacity utilization, labor productivity gains, and higher producer prices. Although the positive relationship between changes in nominal wages and unemployment rates in the 1970s and 1980s is perhaps surprising, it is consistent both with periods of stagflation during the earlier decade and with the long, gradual recovery of the 1980s, when wage and price increases moderated and unemployment fell.

The net effects of these differences in the relationship between nominal wage changes and changes in economic conditions are shown

2 We present this specification simply as an illustration of the changes sensed by analysts and practitioners during the 1980s. Individual coefficient estimates from this exercise should be interpreted cautiously because of the short time periods involved.

TABLE 3

Simulations of Annual Nominal Hourly Earnings Changes

Explanatory variables (economic conditions)	Structure (relationship between conditions and wages)		
	1960s	1970s	1980s
1960s	5.41	6.17	3.65
1970s	9.52	7.51	6.97
1980s	6.43	6.65	4.24

NOTE: The values are the average annual percentage changes in nominal hourly earnings during the decade. Simulations were performed by multiplying the explanatory variables for a given decade by the coefficients for the appropriate decade. The values on the diagonal (that is, for the same decade) are identical to the actual annual wage changes.
SOURCE: Authors' calculations using estimates from table 2.

in table 3. The bottom row is of primary interest. The first entry in that row is the average annual nominal wage change that would have taken place in the 1980s if labor had had the same relationship to economic conditions then as in the 1960s. In this hypothetical case, wages would have increased an average of 6.43 percent annually in the 1980s. Subjecting the wage behavior that prevailed during the 1970s expansions to 1980s economic conditions yields a slightly higher annual growth rate of 6.65 percent. Both of these figures substantially exceed the 4.24 percent average annual increase that actually took place during the 1980s.

It is also interesting to note that if wages had had the same relationship to economic conditions during the 1960s as they did in the 1980s, wage growth would have been considerably lower in the earlier decade than it actually was (3.65 percent versus 5.41 percent). The same holds true for the 1970s. The actual annual wage increase was 7.51 percent, compared with 6.97 percent when the 1980 wage structure is used.

This simple analysis suggests that something dampened the relationship between wages and economic conditions during the 1980s, such as changes in unemployment rates and in price levels. The papers summarized below explore the various shifts that have taken place and consider their implications for both wage behavior and the performance of the U.S. economy.

II. Why the Slow Wage Growth in the 1980s?

The explanations explored at this conference for the slow wage growth of the 1980s can be grouped around three phenomena: increased international competition, changes in wage-setting practices, and demographic shifts.

Increased International Competition

The first category considers increased competition within product markets, particularly that resulting from greater penetration of foreign imports into U.S. domestic markets. Under this scenario, pressures to keep prices in line with those of foreign competitors would moderate wage increases.

Susan Vroman and Wayne Vroman address this issue in "International Trade and Money Wage Growth in the 1980s." Their focus on international trade as a significant contributor to sluggish wage growth is well supported by the events of the 1980s. The U.S. economy has become increasingly open to foreign trade with respect to both imports and exports. As imports further penetrate our product markets, one would also expect labor markets to become more competitive, constraining domestic nominal wage growth.

The authors present two sets of estimates to test this hypothesis. The first is based on a time-series analysis of a modified Phillips curve, which shows the trade-off between nominal wage growth and unemployment. The second is based on a longitudinal study of more than 2,000 collective bargaining agreements in the manufacturing sector between 1959 and 1984. Both sets of estimates show that developments in international trade in the 1980s contributed to the slowdown in money-wage inflation, with nonpetroleum import prices and real nonpetroleum import share registering the most significant effects. The authors are quick to point out, however, that international trade accounted for only a small part of the slowdown, at most 18 percent in selected years. This contribution would have been even less significant for the private business sector as a whole, since international trade should have the largest impact on manufacturing, a sector that directly involves only one-fifth of U.S. workers.

Vroman and Vroman place the estimated trade effect into perspective by exploring other possible explanations for the modest wage growth of the 1980s. Most important among these are inflationary expectations and the composition of unemployment. The authors conclude that, of the factors considered, the reduction in inflationary expectations during the latter half of the decade was the primary factor in the slower nominal wage growth. The unusually high rate of unemployment among prime-age males was also found to exert a restraining effect on money-wage growth, equaling the impact of international trade.

Changes in Wage-Setting Practices

The second class of explanations relates to institutional changes in wage-setting practices. These include alternative forms of compensation, such as lump-sum payments, profit sharing, and fringe benefits. Also covered are changes in the structure of labor union contracts, such as contract duration, cost-of-living indexation, and the emphasis on job security over wage growth.

As documented below, workers have increasingly received compensation in forms other than cash wages. For instance, the percentage of workers receiving lump-sum or profit-sharing payments has risen over the last decade. Fringe benefits as a share of total compensation has also increased, although a slightly smaller proportion of workers are now covered by pensions and health care benefits—the two largest components of this form of payment. Moreover, the prevalence of cost-of-living indexation fell during the 1980s, while contract length grew. A theme shared by all four papers summarized in this section is that developments in wage-setting processes may have reduced the trade-off between wage inflation and unemployment.

Lump-Sum Payments. In "Lump-Sum Payments and Wage Moderation in the Union Sector," Linda Bell and David Neumark examine the growth of lump-sum payments in union firms in an effort to determine whether the spread of this alternative compensation arrangement contributed to the decline in wage growth during the past decade. Lump-sum payments can reduce wage inflation in at least three ways. First, they may signal a change in the labor–management environment toward either a strengthened management stance or a worker preference for that form of payment. Second, they may simply reflect an accounting change as certain labor costs are shifted out of wages and salaries and into other forms of compensation. Third, they may increase labor-market flexibility by tying compensation more directly to worker productivity and to firm profits. Profit sharing provides employers with a method for responding to shocks in the product market beyond simply adjusting employment. Since profit-sharing payments are not counted as part of an employee's base salary, adjustments in either direction can be made quickly in response to changing business conditions. This increased flexibility has led some economists, including Weitzman (1986), to advocate profit sharing as a means of stabilizing employment and output.

To analyze these effects, Bell and Neumark examine more than 5,000 contracts negotiated in 1,200 private-sector establishments between 1975 and 1988. Within this sample, they find a dramatic jump in the number of contracts with lump-sum payment provisions. Indeed, between 1983 and 1984, the proportion of workers signing such contracts skyrocketed from 5.9 percent to 69.5 percent! The authors present evidence that this surge resulted from unions' preference for this alternative form of compensation.

Applying the Phillips-curve framework to the trade-off between nominal wage increases and unemployment, Bell and Neumark find that the prevalence of lump-sum payments is associated with reduced wage growth. They estimate that a 10-percentage-point rise in the share of workers covered by lump-sum contracts pushes the annual rate of wage inflation down 0.3 to 0.4 percentage point. The authors then reject all but one of the aforementioned explanations for this dampening effect. They dismiss the accounting explanation of a shift from base wages by showing that lump-sum payments also reduce the percentage increase in firms' total labor costs. Likewise, they find little support for the flexibility explanation. In fact, their estimates are inconsistent with the hypothesis: Firms offering lump-sum payments exhibit *less* labor-cost flexibility in response to changes in demand for their products. The authors conclude that the labor–management environment must have changed during the 1980s.

Profit Sharing. Douglas Kruse explores the effect of a second form of nonwage payment—profit sharing—on wage growth. In "Profit Sharing in the 1980s: Disguised Wages or a Fundamentally Different Form of Compensation?" he points out that even this somewhat narrow type of compensation takes several different forms, including profit-related bonuses, deferred pension plans, or some combination of the two. Results of his study show a steady growth in deferred profit sharing, as the percentage of the private wage and salary work force with such coverage rose from 13.3 percent in 1980 to 18.4 percent in 1986. Although this still represents a relatively small share of the total labor force, the covered workers appear to be concentrated in industries that have historically demonstrated downwardly rigid wage behavior, such as manufacturing.

Kruse concentrates on increased labor flexibility to explain the negative relationship between profit sharing and wage growth—a relationship that is similar to the one between lump sums and wages described by Bell and Neumark. He reviews the empirical literature on the connection between profit sharing and employment stability and finds little agreement among the studies.

Kruse also pursues his own empirical test using deferred pension plans as a measure of profit sharing. His analysis yields some support for the position that firms do not view profit-sharing payments as part of the short-run cost of labor, but rather as a distribution of profits to labor after other costs (including base labor costs) have been taken into account. In this way, a company's employment decisions are not influenced by profit-sharing payments, since these are not considered part of base wages. For 586 publicly traded U.S. companies, Kruse notes little trade-off between higher profit-sharing payments and employment. On the other hand, he does find the expected trade-off between base wages and employment. The author concludes that profit sharing is not simply "disguised wages," but a more flexible form of employee compensation.

Fringe Benefit Coverage. In "The Decline of Fringe-Benefit Coverage in the 1980s," Stephen Woodbury and Douglas Bettinger suggest that compensation became more flexible during the last decade because a lower percentage of workers received employer-based health insurance coverage and pension plans. The share of workers included in employer-provided pension plans dropped from 60 percent in 1979 to 55 percent in 1988. During the same period, the percentage of workers covered by employer-provided group health insurance plans shrank slightly, from 74 percent to 72 percent. As a result, the ratio of employer costs for these two fringe benefit packages to wages and salaries edged down. These statistics suggest that the moderate wage growth in the 1980s was not necessarily due to large offsetting increases in benefit coverage. However, the reduced coverage may have led to more flexible compensation.

Woodbury and Bettinger's primary purpose is to provide a detailed analysis of the determinants of fringe benefit coverage. They conclude that the decline in coverage during the 1980s resulted both from the decrease in marginal tax rates on personal income during the middle of the decade and from the steady drop in union representation throughout the decade. Dwindling manufacturing employment, shifts in occupational mix, and aging of the work force had little to do with the decrease in coverage, according to the authors.

The most significant determinant was the lowering of marginal tax rates in 1986, which induced workers to trade fringe benefits for increased wages. However, their willingness to substitute wages for fringes was not uniform across all types of voluntary benefits. Woodbury and Bettinger estimate that workers were more willing to trade wages for employer-provided pensions than for employer-provided health coverage. The authors interpret the decline in benefit coverage as a tendency for a reduction in the fixed component of worker compensation, which can be seen as a move toward a more "spot market" type of pay.

Union Contracts. Wage moderation in the 1980s was disproportionately concentrated in the union sector, which experienced lower wage growth in the latter half of the decade (14.2 percent) than did the nonunion sector (23.9 percent). In contrast, in every year between 1976 (when data first became available) and 1982, union wage hikes outpaced nonunion wage changes. After 1982, when the economy began to recover from the high unemployment brought on by the twin recessions that inaugurated the decade, many unions placed job security above wage growth as the top priority in their bargaining rounds. This reordering is certainly evident in unions' nominal wage increases.

In "Indexation and Contract Length in Unionized U.S. Manufacturing," Mark Bils examines two changes in the structure of labor contracts that could have led to slower wage growth in the union sector: reductions in indexation and shorter contract length. For all union contracts settled in the private sector, the proportion of workers with inflation escalator clauses fell from an average of 55.2 percent between 1980 and 1983 to 36.8 percent between 1984 and 1988. However, the length of contracts remained the same over the decade, averaging slightly more than 31 months.

An extensive body of theoretical literature supports the view that the length of contracts and the inclusion of indexation reflect the degree of uncertainty facing workers and employers. To explore this proposition, Bils examines a detailed longitudinal set of major collective bargaining agreements reached between 1955 and 1985 in the manufacturing sector. His results contradict the generally accepted prediction that increased uncertainty will shorten contracts. Rather, he finds that contracts are *longer* in industries that face more uncertainty (durable goods, for example). Bils suggests that these results are consistent with the notion that longer contracts are written in order to reduce strikes.

With respect to indexing, he finds that the percentage of contracts with cost-of-living escalator clauses is positively related to increases in both inflation and inflation uncertainty. This is consistent with the generally accepted view that escalator clauses protect workers from unanticipated price-level changes. Consequently, consumers' lower inflation expectations during the latter half of the 1980s could explain the lower nominal wage growth at that time. This finding is in accord with Vroman and Vroman's results.

Demographic Shifts

In "Gender Differences in Cyclical Unemployment," Sanders Korenman and Barbara Okun consider the effect of female participation in the work force on cyclical unemployment. It may be that women provide a pool of workers who move freely into and out of the labor force (depending on the stage of the business cycle), since they are historically less attached to it than are men. Such a procyclical participation pattern of a large group of workers would weaken the effectiveness of unemployment rates as a measure of labor-market tightness. Consequently, fluctuations in wages and in standard measures of unemployment rates associated with business cycles would be dampened.

The major issue that Korenman and Okun explore, therefore, is whether women are indeed less attached to the labor force than are men. Their analysis shows that although women are still less attached, their connection grew during the 1980s.

These results might suggest that cyclical unemployment should rise in response to increased labor-force attachment among women, but further analysis shows no association between these two factors. The authors attribute this to the disparate distribution of the sexes across industries and occupations. Women's employment is disproportionately concentrated in growth industries that demonstrate little cyclical fluctuation, while men are concentrated in industries with the opposite characteristic. Thus, although Korenman and Okun do not rule out the possibility that the increase in female labor supply during the 1980s reduced wage growth by lowering labor-market tightness, their findings suggest little, if any, change in the long-run cyclical behavior of the economy as a result of this phenomenon.

III. Implications for Macroeconomics

Two prominent macroeconomists, Olivier Blanchard and Finn Kydland, were invited to the conference to comment on whether the findings of the papers summarized above alter the way in which labor markets figure into their view of the workings of the macroeconomy. In particular, we were interested in whether the trend toward more flexibility and risk sharing in wage-setting practices would alter their theories and policy recommendations.

Blanchard's remarks focus primarily on the macroeconomic implications of lump-sum bonuses and profit sharing. He sees both schemes as ways of lowering the risk of bankruptcy among firms, and notes an interesting tension between the implications of increased risk sharing in labor contracts and of recently introduced financial arrangements, such as high-yield junk bonds. The former generally provides greater stability by reducing the likelihood of bankruptcy, while the latter raises the chances of a firm going under.

Blanchard argues that the reduction in bankruptcy risks has had three macroeconomic effects: 1) stabilization of employment in the short run, 2) alteration of the factors determining labor mobility, and 3) modification of the Phillips-curve specification. The first effect results from the simple fact that firms will not be as likely to close their doors during downturns and, through wage adjustments, will be able to retain workers longer. This should reduce employment swings during business cycles. The second effect is related to labor adjustments that follow sectoral shocks. If wages are rigid, then declining employment is the only signal that leads workers to leave hard-hit sectors. However, if wages vary, then both they and job security enter into a worker's decision. Finally, an increase in wage flexibility breaks the link between tightness in the labor markets (as measured by unemployment rates) and price inflation.

Kydland frames his remarks in terms of implications for business-cycle theory. He notes that many researchers interested in this line of inquiry have changed their methodology from the system-of-equations approach popular in the 1960s to one based on the neoclassical growth model. Under the former framework, models are constructed around equations that describe aggregate economic behavior, such as wage rates, unemployment rates, household consumption, and business investment. In contrast, the approach based on the neoclassical growth model stresses the use of empirical knowledge to obtain parameter estimates for technology, preferences, and institutional arrangements. These parameter estimates provide realistic calibrations for simulation models intended to mimic, and thus explain, macroeconomic phenomena. Consequently, this transition to the use of the neoclassical growth model as the basis of macroeconomic analysis is important in determining how questions are posed and data are organized.

Kydland finds that research presented in this volume is, for the most part, organized around the former methodology—that is, based on estimates of aggregate behavioral equations. He stresses that in order to bridge the gap, questions posed in the business-cycle framework will have to be translated into the behavioral-equation framework, and vice versa. Therefore, business-cycle researchers may have to ask slightly different questions or else organize the information presented at this conference in a different way if they are to incorporate these findings into their research.

IV. Conclusion

The research presented at this conference underscores the thinking of many observers and market analysts who, during the latter half of the 1980s, perceived that developments were taking place in labor markets that altered certain basic relationships between wage behavior and economic performance. These essays suggest that the increased adoption of more-flexible pay schemes during the latter half of the decade led to lower labor costs, perhaps to more flexibility for firms in their employment decisions, and, in general, to more stability in employment (at least in the short run). Thus, evidence indicates that these more flexible pay schemes might be able to accommodate relatively lower unemployment rates without igniting serious wage inflation.

Although some observers argue that this increased flexibility, which stemmed from the adoption of lump-sum payments and profit-sharing arrangements, is simply a way to obscure wage concessions, the research presented here finds little support for this view. The fairly widespread acceptance of these alternative compensation practices by both workers and managers suggests that the shift in the relationship between labor markets, unemployment, and price inflation observed in the 1980s may extend well into the 1990s. This structural change, along with other changes noted at the conference, may be welcomed by policymakers attempting to contain inflation while simultaneously stabilizing output.

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