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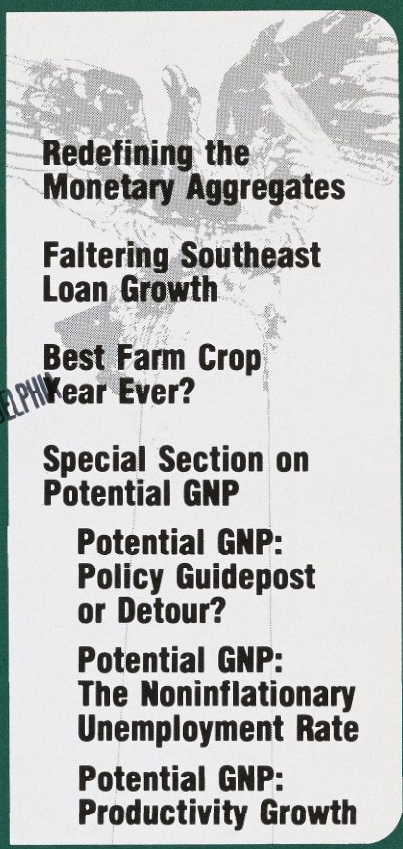

Redefining the Monetary Aggregates

Faltering Southeast Loan Growth

Best Farm Crop Year Ever?

Special Section on Potential GNP

- Potential GNP: Policy Guidepost or Detour?
- Potential GNP: The Noninflationary Unemployment Rate
- Potential GNP: Productivity Growth

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Because a higher proportion of our population has been working in recent years, more individuals with lower skills and experience are on the job. This fact, together with the shift in the mix of what we produce and consume away from high productivity sectors, largely accounts for the disappointing sluggishness in output per worker.

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REDEFINING THE MONETARY AGGREGATES

by Stuart G. Hoffman

Recent financial innovations and regulatory changes have eroded the usefulness of current monetary aggregate definitions as guides to monetary policy. New definitions, proposed by the staff of the Fed's Board of Governors, are designed to remedy some of the shortcomings of current money measures.

In an article in the January **Federal Reserve Bulletin,** *the Board of Governors staff proposed new definitions for the monetary aggregates. To promote better public awareness and understanding of this important issue, this article highlights those proposals and the factors necessitating a major overhaul of the current monetary measures.*

When a pathologist wants to examine an organism, he slices it open and peers knowingly, usually through a microscope, at the slices. In a way, economists do much the same when peering at the economy. Recently, however, one of their economic lenses has become a bit cloudy.

Since they were introduced in 1960, monetary aggregates have been effective viewing devices for economists examining monetary policy. Today's monetary aggregates, however, are becoming inadequate for clear viewing. New definitions and new aggregate arrangements are called for.

The Federal Reserve presently uses five monetary aggregates, including the familiar M_1 and M_2 that newspaper and television commentators sometimes refer to, to measure "money." Five different measurements are necessary because, to an economist, "money" exists in different forms.

WHAT IS MONEY? An asset must possess two essential qualities to be characterized as "money." First, the asset must serve as a medium of exchange, a generally acceptable means of settling transactions. If the asset qualifies in this regard, it is a transactions balance. Cash, bank checking accounts, and travelers checks all qualify as examples of transactions balances.

Some assets, while not themselves media of exchange, can be quickly and easily converted to transactions balances with almost no risk of capital loss. These highly liquid assets are referred to by economists as "near-monies." Passbook savings accounts and time deposits are examples of near-monies.

Money's second important quality is that it serves as a store of value. This is simply its purchasing power in future transactions. Obviously, this ability to store value is inversely related to the rate of inflation.

Measuring all forms of money and near-money is the function of the monetary aggregates.

THE MONETARY AGGREGATES. Economists have watched the movement of all forms of money by watching the five traditional monetary aggregates, M_1 through M_5. The different aggregates are simply convenient groupings of currency and deposits, which together make up the money stock of our economy.

The Federal Open Market Committee (FOMC) closely monitors the three most

important aggregates, M_1, M_2, and M_3. These are listed in Chart 1. The M_1 definition includes currency and demand deposit holdings of the public. ("Public" here means everyone and everything except banks and the Federal Government.) M_1 is the traditional measure of the amount of transactions balances held by the general public.

Since time and savings deposits are considered as near-monies, they are counted in the broader aggregate of M_2. The M_2 definition of money adds the public's time and savings deposits held at commercial banks to M_1.

The M_3 definition is a parallel of M_2. It adds the public's time and savings deposits at thrift institutions (savings and loans, mutual savings banks, and credit unions) to the M_2 definition.

WHY ARE THE MONETARY AGGREGATES IMPORTANT? Chart 2 illustrates a close historical relationship between the growth of M_1 and the subsequent rate of inflation in consumer prices.

The average M_1 growth in any year has its primary effect on the inflation rate up to *two years later*. In the meantime, that same M_1 growth affects production and employment, depending upon the amount of excess or idle capacity in the economy.

The FOMC has placed growing emphasis on the amount of money in the economy due to the knowledge that money growth has a heavy influence on price stability, unemployment, and sustained real economic growth. The monetary aggregates are essential for the FOMC to track the growth of money.

In 1970, first reference was made to the FOMC's plans for money growth. By 1974, the Committee had developed explicit numerical tolerance ranges for the growth of money over a two-month period. In May 1975, expected growth ranges for a longer period of four quarters ahead appeared as FOMC policy. Then, in February 1979, the Committee adopted monetary growth ranges for an entire

CHART 1

CURRENT MONEY DEFINITIONS

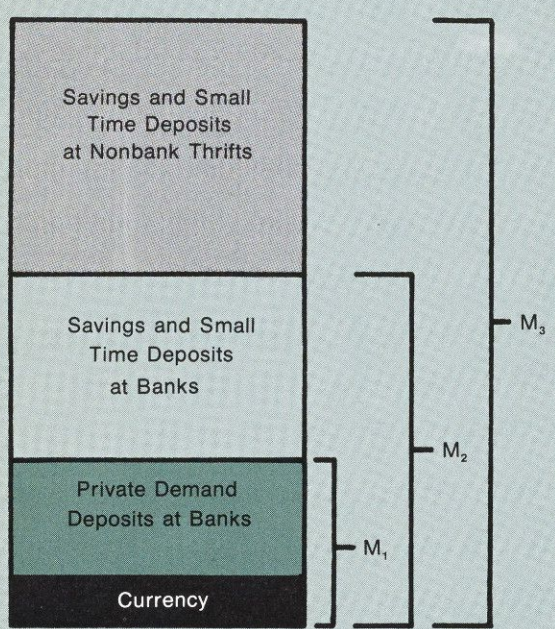


TABLE 1

REGULATORY CHANGES CREATING NEW TRANSACTIONS ACCOUNTS

Negotiable Order of Withdrawal Accounts (NOW)

- *New Hampshire and Massachusetts for mutual savings banks (1972) and commercial banks and S&Ls (1974)*
- *Connecticut, Maine, Rhode Island, and Vermont for depository institutions except CUs (1976)*
- *New York State for depository institutions except CUs (1978)*

Credit Union (CU) Share Drafts

- *Federal CUs on experimental basis (1974) and permanent basis (1978)*

Demand Deposit Accounts at Thrifts

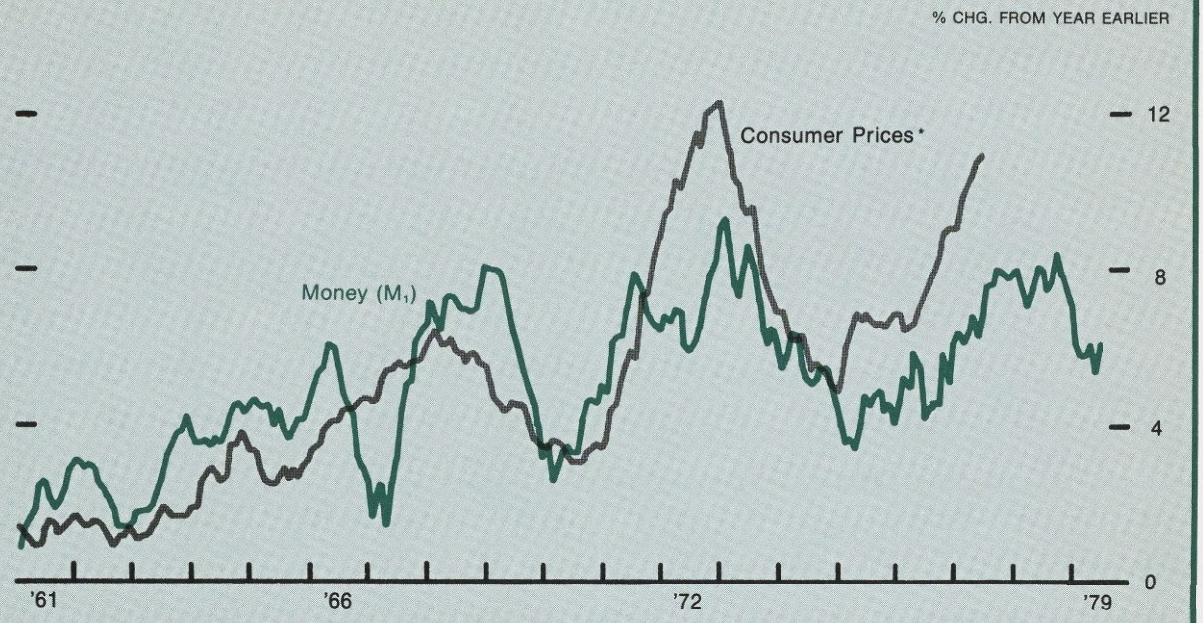
- *New York State for thrifts except CUs (1976)*
- *Nationwide for Federal-chartered S&Ls (proposed)*

Automatic Transfer Service Accounts (ATS)

- *Nationwide for commercial banks (1978)*

CHART 2

MONEY AND INFLATION



*Consumer Price Index lagged 24 months.

Note: Beginning November 1978, M_1 is adjusted for ATS and NOW accounts in New York State.

calendar year, with a midyear review in accordance with congressional legislation.

WHY CHANGE THE AGGREGATES? Since 1970, when the FOMC first began applying greater importance to the aggregates, the complexion of money and near-money has changed. In 1972, there began a series of regulatory changes and creations of new financial instruments that have reduced the accuracy of M_1 as a measure of the public's transactions balances. Additionally, certain assets have emerged as new near-monies that are not presently included in either M_2 or M_3, clouding the accuracy of those aggregates as well.

For convenience, the regulatory changes and financial innovations that have occurred in the past five years are grouped into three categories: (1) new M_1-type transactions accounts; (2) liquidity changes of existing near-monies; and (3) new near-monies.

NEW TRANSACTIONS ACCOUNTS. Table 1 lists four new transactions accounts authorized during the past several years: negotiable order of withdrawal (NOW) accounts, credit union share drafts, demand deposits at thrifts, and bank automatic savings-to-demand deposit transfer (ATS) accounts.

In April 1979, these accounts totaled $13 billion—$6.5 billion in ATS accounts, $5.0 billion in NOW accounts, $0.6 billion in share drafts, and $0.9 billion in demand deposits at thrifts.

All but the last pay interest, which explains their increasing popularity with the general public.

Unfortunately, the funds in these accounts are not included in our current definition of M_1. Thus, today's M_1 understates the public's ability to settle transactions by $13 billion, and the understatement will grow larger as these interest-yielding accounts win more and more public acceptance as substitutes for ordinary demand deposits.

To remedy the growing obsolescence of the current M_1 definition, the staff of the Board of Governors in an article in

the January **Federal Reserve Bulletin** has proposed a new M_1 definition. The proposed M_1 will include NOW and ATS accounts, share drafts, and demand deposits at thrifts, along with traditional commercial bank demand deposits and currency held by the public (see Table 2).[1]

TABLE 2

PROPOSED M_1

Currency
Demand Deposits at Commercial Banks } *Current M_1*

+ NOW Accounts
+ Share Drafts
+ Demand Deposits at Thrifts
+ ATS Accounts
– Demand Deposits of Certain Foreigners

Major Principle:
Include all domestic transactions accounts to remedy growing obsolescence of the current M_1 definition.

The growth rates of current and proposed M_1 were very similar until ATS accounts were introduced in November 1978 (see Chart 3). However, from October 1978 through June 1979, current M_1 grew at a 3.0-percent annual rate and the proposed M_1 at a 6-percent annual rate.[2] In either case, this represents a marked deceleration in "money" growth during the past nine months. Because the current M_1 is really an incomplete picture of transactions balances, it overstates the degree of slowdown. Empirical analyses suggest that the relationship between GNP and the growth of the proposed M_1 is marginally closer than the GNP's relationship with the current M_1. Therefore, the proposed definitional change should enhance the FOMC's knowledge of how its policy actions affect future economic activity.

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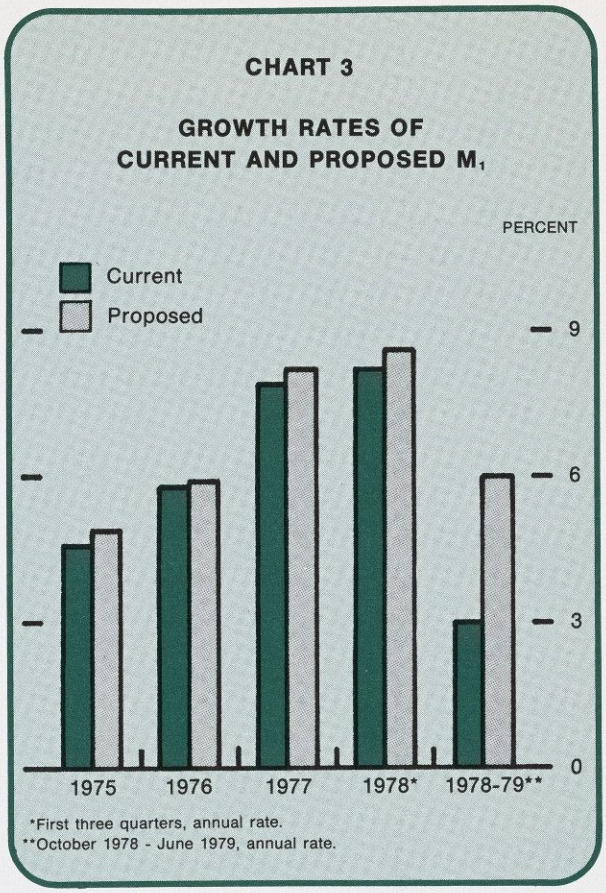
[1]The staff has also proposed to eliminate from M_1 certain demand deposits held by foreign commercial banks and official institutions, as recommended in 1976 by an outside advisory committee. See "Improving the Monetary Aggregates: Report of the Advisory Committee on Monetary Statistics" (Board of Governors, June 1976).

[2]Only a small part of this differential is due to the exclusion of certain foreign-owned demand deposits from proposed M_1.



LIQUIDITY CHANGES IN EXISTING NEAR-MONIES. The recent regulatory changes and financial innovations have combined to increase the liquidity of existing near-monies, particularly regular passbook savings accounts. Today's regulatory climate permits telephonic transfers from bank savings to bank checking accounts and nonnegotiable third-party payments from savings accounts at both commercial banks and S&Ls (see Table 3).

Apparently, the public is responding to these account freedoms. Evidence suggests that debits to savings accounts per dollar of deposit, a measure of their "transactions activity," have increased over the past several years.

As these permissive regulations have increased the liquidity of savings accounts, other rule changes were installed that reduced the liquidity of time deposits. These latter changes permit higher interest rates payable on four-, six-, and eight-year certificates and, despite a recent

TABLE 3

REGULATORY CHANGES INCREASE SAVINGS DEPOSIT LIQUIDITY AND REDUCE TIME DEPOSIT LIQUIDITY

Increase Savings Deposit Liquidity

- *Telephone transfers from savings to checking accounts at member banks (1975)*
- *Preauthorized nonnegotiable third-party payments from savings accounts at commercial banks and S&Ls (1975)*

Reduce Time Deposit Liquidity

- *Maximum interest rate raised on four-year (1973), six-year (1974), and eight-year (1978) certificates*
- *Substantial interest penalty for early withdrawal (1973)*
- *Liberalized interest penalty for early withdrawal (1979)*

liberalization, impose a stiff interest penalty on early withdrawals. Longer maturity and penalties mean a loss of liquidity in time deposits.

Here again, the rule changes have resulted in a surge of activity in these accounts by the general public. As of October 1978, commercial bank time deposits with *original* maturities of at least four years accounted for 46 percent of small-denomination (less than $100,000) time deposits, up from 4 percent in mid-1973.

At nonbank thrifts, the boom in time deposits has been even more pronounced. From almost none in mid-1973, four-year-and-over *original* maturity certificates rose to 67 percent of small time deposits by September 1978.

The current M_2 aggregate has been materially affected by the regulatory changes and the public's positive response to the new rules. Just a few years ago, passbook savings accounts and time deposits at commercial banks were sufficiently similar in liquidity that it made sense to group them in one monetary aggregate. This is no longer the case. Savings account deposits are more liquid today, while time deposits (except large negotiable CDs at large banks) are less liquid.

To correct the growing inaccuracy of M_2, the Board staff proposes to redefine M_2 to include the new M_1 plus savings deposits at all depository institutions (see Table 4). This new definition recognizes that similar deposits (like savings accounts) should be combined regardless of the depository institution where they are held.

TABLE 4

PROPOSED M_2

Proposed M_1

+ Savings Deposits at all Depository Institutions

Major Principles:

Separate increasingly liquid savings deposits from less liquid time deposits.

Group together similar types of deposits regardless of their depository institutional location.

NEW NEAR-MONIES. In the wake of all the new rules and innovations are new highly liquid assets that did not exist a few years ago. Also, the doors to existing near-monies have been opened to previously excluded groups.

Table 5 lists these new financial instruments: money market mutual funds, bank repurchase agreements, money market certificates, and commercial bank savings accounts for state and local governments and businesses.

TABLE 5

FINANCIAL INNOVATIONS CREATE NEW LIQUID ASSETS

New Highly Liquid Assets

- *Money market mutual funds (1974)*
- *Repurchase agreements between banks and their business customers*
- *Six-month money market certificates at depository institutions (1978)*

New Savings Account Authorizations

- *Commercial bank savings accounts authorized for state and local governments (1974) and partnerships and corporations (1975)*

Money Market Funds. Money market mutual funds originated in the high interest rate environment of 1974. These funds maintain a portfolio of high-yielding Treasury bills, commercial paper, and large CDs. Ownership shares in such funds are available at a lower minimum investment than required for direct purchases of these instruments.

Most money market funds offer an attractive checkwriting option (usually a $500 minimum) and same-day wire transfer service into a preauthorized demand deposit account. Consequently, these funds are highly liquid assets that could serve as a medium of exchange. However, survey evidence indicates that the turnover of such accounts is substantially lower than that of transactions accounts. About one-half of money market fund assets is held by institutional investors, about half of which is held as investments by trust accounts.

Part of the reason for excluding money market funds from the current and proposed aggregates is the lack of timely, reliable data verified by Federal Reserve reporting procedures. An interesting perspective, however, is available from an industry source that reports money market fund assets totaling $26 billion at the end of June 1979. Just a year earlier, they were $6 3/4 billion.[3]

Repurchase Agreements. Repurchase agreements (RPs) were originally created in the 1930s but have grown very rapidly in the past five years. A repurchase agreement is typically an overnight loan of immediately available funds secured by U. S. Treasury securities. On the following day, the funds are returned to the lender with interest. Large nonfinancial corporations have learned to minimize their end-of-day demand deposit holdings by arranging RPs with their commercial banks. RPs are a convenient and low cost cash management tool.

While an RP, itself, is not a medium of exchange, it is a highly liquid alternative to demand deposits. Yet, like money market funds, RPs will not be included in the Board's redefined monetary aggregates. Again, like money market funds, this is partly because of data limitations.

What RP data that are available show a burgeoning growth. Estimates of commercial bank RPs with the nonbank public are available back to late 1969.[4] At that time, outstanding RPs averaged about $4 1/2 billion. By the time of the record-high money market yields in mid-1974, the amount outstanding had grown to nearly $17 1/2 billion. At the end of May 1979, RPs outstanding at all commercial banks totaled over $47 billion.

In recognition of this growing use of RPs, the Board staff intends to publish a separate RP series as a companion to the redefined monetary aggregates.

Money Market Certificates. Money market certificates (MMCs) were authorized on June 1, 1978, for all depository institutions. (Credit unions received authority slightly later.) These are six-month certificates of deposit issued in minimum denominations of $10,000, with an initial yield tied to the weekly auction rate on six-month Treasury bills.

Like other time deposits, there is a substantial interest penalty for early withdrawal. This feature gives MMCs a lower degree of liquidity than passbook savings deposits. But the relatively short six-month maturity makes them more liquid than other time deposits. In the Board staff's proposed monetary aggregates, money market certificates will be included in M_3, which is defined as the new M_2 plus all time deposits at all depository institutions.

MMCs have been a big hit with the general public because of the high and rising yields they've offered since their introduction. When first offered in June 1978, MMCs yielded 7 3/4 percent at thrifts (one-fourth point higher than banks), including daily compounding of interest. In late July, these six-month certificates yielded about 9 1/4 percent, with daily compounding no longer allowed.

By the end of May 1979, MMCs stood at around $158 billion at all depository institutions, up from zero just one year earlier. They account for 13 1/2 percent

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[3]Donoghue's **Money Fund Report,** Holliston, Massachusetts, various issues.

[4]Estimates of all commercial bank RPs with the nonbank public are available from the Banking Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System.

and 17 1/4 percent of savings and small time deposits at commercial banks and thrifts, respectively.

New Accounts for Governments and Businesses. Two regulatory changes in the mid-1970s made commercial bank savings accounts available to state and local governments and partnerships and corporations.

Business savings accounts are limited to $150,000 per account. Because these savings accounts are linked by telephonic transfer to demand deposit accounts, they are highly liquid assets, estimated to have heavier activity than personal savings accounts. Like all other savings accounts, they are included in the proposed M_2 aggregate.

At first, business and government savings accounts grew rapidly as those groups took advantage of a new and attractive alternative to demand deposits. Recently, however, these accounts have stabilized at around $4 1/2 billion for state and local governments and $10 1/4 billion for businesses.

SUMMARY AND CONCLUSIONS. Recent financial innovations and regulatory changes have reduced the accuracy of the current M_1 as a measure of the public's transactions balances. At the same time, other developments have enhanced savings deposit liquidity while fostering growth of less liquid time deposits.

In recognition of these events, the Board staff has proposed new definitions of M_1, M_2, and M_3, restricted to liabilities of depository institutions. The new definitions are summarized in Table 6.

Proposed M_1 will presumably include all transactions balances, except to the extent that the public uses its money market funds as a means of payment. To those who view RPs as quasi-transactions balances, a separate series will be available to use at their discretion.

The proposed M_2 will incorporate the redefined M_1 plus all savings deposits regardless of their institutional location. There will be no mixing of time and savings deposits, which have recently become dissimilar in liquidity. Money market funds will not be included in any aggregate, although they appear to be as liquid as savings deposits.

Finally, the proposed M_3 will include the new M_2 plus time deposits (both large and small) at all depository institutions. It would be a mistake to add money market funds to the new M_3, since large CDs account for a large portion of the funds' portfolios and would involve "double counting." To avoid this problem, an M_2+ could be defined as proposed M_2 plus all *small*-denomination time deposits plus money market mutual funds.[5]

The new monetary aggregates should give the FOMC a clearer lens through which to view the behavior of "money" in determining monetary policy strategies. ■

TABLE 6

NEWLY PROPOSED MONETARY AGGREGATES

Proposed M_1
- *Current M_1*
- *+ NOW Accounts*
- *+ Share Drafts*
- *+ Demand Deposits at Thrifts*
- *+ ATS Accounts*
- *– Demand Deposits of Certain Foreigners*

Proposed M_2
- *Proposed M_1*
- *+ Savings Deposits at All Depository Institutions*

Proposed M_3
- *Proposed M_2*
- *+ Time Deposits (small and large) at All Depository Institutions*

[5]Separating small- and large-denomination time deposits would be advisable on its own merits, since they behave quite differently during periods of high and rising market interest rates. This occurs because large CDs are not subject to interest rate ceilings. See Timothy Cook, "The Impact of Large Time Deposits on the Growth Rate of M_2," **Economic Review,** Federal Reserve Bank of Richmond, March/April 1978.

SIXTH DISTRICT BANKING NOTES

FALTERING SOUTHEAST LOAN GROWTH

District bank loan growth slowed significantly during early 1979. While this pattern usually occurs when economic activity slows, it is in marked contrast to the still strong performance noted in other parts of the country.

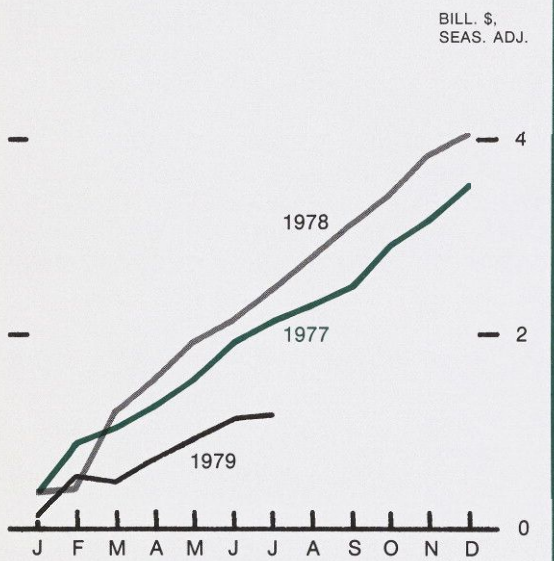
District bank loan growth faltered this year, trailing 1977 and 1978 rates by a wide margin. District banks maintained a 13-percent growth rate in each of the past two years. First-half growth for 1979 has slowed to 6 1/2 percent—$1.1 billion (see Chart 1). Growth for this period last year was $2.2 billion.

The slowdown is more striking when contrasted with stronger performance nationally. Bank loan expansion continued at nearly last year's pace throughout the rest of the country.

Clearly, District loan growth has diverged, both from past trends and from current national ones. Since developments in the financial area often parallel the underlying condition of the economy, this divergence is important. Financial data can give advance clues about the direction of the economy before other indicators are available.

CHART 1

CUMULATIVE CHANGE, SIXTH DISTRICT MEMBER BANK LOANS



Thus, a shift in an important financial indicator raises questions of a broader nature. What does the weaker loan growth say about the District's economy? Why has the loan growth slowed? Do reduced expansion rates reflect more cautious loan policies on the part of banks or reduced demand from borrowers?

The situation in the District is complex. It's somewhat perplexing as well. The slowdown is wide in breadth but not equally large in all categories. Some slowdowns have been relatively small, while others have been sharp. Further, some changes parallel national patterns while other changes don't.

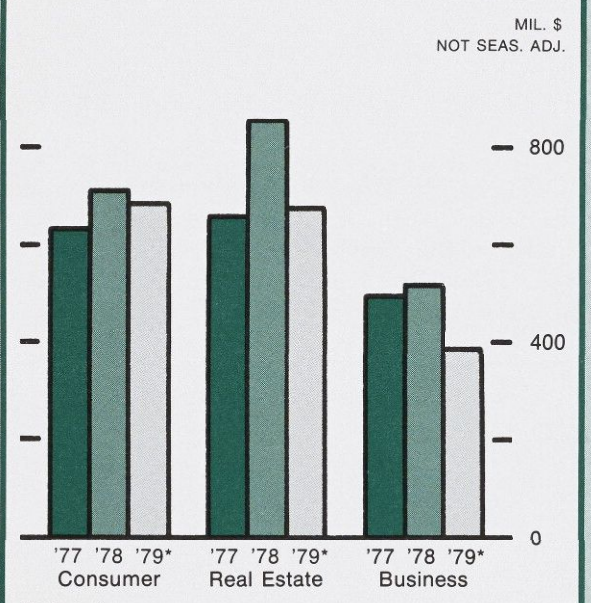
Consumer loan growth, both instalment and single payment, stayed stronger than expected, though not as strong as last year's (see Chart 2). Several factors encouraged a slowdown. Double-digit inflation threatened to price many large-ticket items out of reach as consumers spent more on necessities. Purchases of large cars became less attractive as gasoline shortages caused concern. Just as important, consumers already carried a heavy debt load. They had financed strong spending over the past three years with greater amounts of credit. Even with strong income gains, the ratio of debt to household income had reached historically high proportions.

Bankers shifted their lending in this area as well. They cut back on indirect financing of automobiles, though direct loans to finance companies continued to grow.

Real estate loans increased at four-fifths of last year's pace (see Chart 2). Slowed commercial expansion reflects the caution

CHART 2

FIRST HALF CHANGES IN DISTRICT MEMBER BANK LOANS



with which District banks are approaching these loans. Larger banks, in particular, are limiting their financing of multifamily properties, new residential projects, and commercial construction.

The weakness in loan expansion for residential housing stems from another source. Single-family housing loans, no longer subject to low usury ceilings in many District states, now offer competitive returns. As such, they are attractive to banks. But consumers are resisting the higher rates. Demand for the loans hasn't grown as rapidly as before.

District business loan growth slowed to three-quarters of last year's pace—a fact made more noteworthy by booming national growth (see Chart 2). Data on large bank lending show slowdowns in all major areas.

Manufacturing loans made no gains from last year. Reduced sales and employment caused textile and apparel manufacturers to curtail their use of bank credit. They borrowed less this year than last. Stronger borrowing in other industries balanced out the loss but did not overcome it.

Service-type firms, usually a strong growth area in the District, showed essentially no loan growth.

Loans to trade firms increased but not by as much as last year. Wholesalers, in particular, showed more restraint in their use of credit.

Loans to construction firms fell below last year's amounts as building slowed in the District.

Not all of the weakness is reflected in the categories above. Loans to other banks, both domestic and foreign, declined. Participation loans were especially weak, accounting for much of the decline of loans to domestic banks.

Loan growth in "all other" categories paralleled this slower pace. Expansion continued but not at last year's rate.

The slowdown in loan growth is broad, its causes complex, and its meaning clear. Those sectors of the economy most dependent on bank credit slowed in the District during the first six months of the year.

APPENDIX

A new statistical release on Sixth District member bank credit currently being developed was the source of the information for this Note. The information used to compile the release is taken from several reports that banks file with the Federal Reserve Bank of Atlanta. All member banks report weekly loans (net of Federal funds sales) and securities. The 15 largest banks (assets of $750 million as of December 1977) report very detailed information on their major balance sheet items. (This information is currently available on the "Weekly Condition Report of Fifteen Large Commercial Banks, Sixth Federal Reserve District.") In addition, a sample of other District member banks (as part of a national reporting panel) now reports weekly information on five loan categories and two securities categories, which is then used to estimate the changes in the corresponding categories for the other District member banks. District totals for each category are then obtained by combining the data from these three groups. This detailed information will be published in several months.

John M. Godfrey

BEST FARM CROP YEAR EVER?

by Gene D. Sullivan

Good rain, good prices, and large plantings have District farmers optimistic.

Sixth District farmers are optimistic this year. They're talking of "more"—more acreage planted; more money spent; more credit used; and, hopefully, more profits to be made.

Spurred by brisk price increases, farmers throughout the Southeast expanded their soybean plantings this spring. The increase was huge, especially in Georgia and Louisiana, where half the new plantings

TABLE 1

PLANTINGS: 1979 AND PRIOR YEARS

(000 acres)

	District States*			
	1977	1978	1979	Percentage Change 1978÷1979
Corn	4,939	3,870	3,663	95
Cotton	2,906	2,404	2,238	93
Hay	3,588	3,615	3,590	99
Oats	379	323	295	91
Peanuts	817	816	815	100
Rice (All)	592	810	770	95
Sorghum	285	290	288	99
Soybeans	12,054	13,491	15,060	112
Tobacco	146	142	128	90
Total Nine Crops	25,706	25,761	26,847	104
	United States			
Corn	83,568	79,719	79,751	100
Cotton	13,619	13,292	13,913	105
Hay	60,658	61,495	60,860	99
Oats	17,733	16,385	14,082	86
Peanuts	1,545	1,544	1,549	100
Rice (All)	2,261	3,080	3,070	100
Sorghum	16,993	16,483	15,574	94
Soybeans	58,760	64,044	71,654	112
Tobacco	958	949	870	92
Total Nine Crops	256,095	256,991	261,323	102

*Includes the sum of acreage in Alabama, Florida, Georgia, Louisiana, Mississippi, and Tennessee.

Source: **Prospective Plantings,** Crop Reporting Board, Economics, Statistics, and Cooperatives Service, U. S. Department of Agriculture, June 1979.

TABLE 2

CHANGE IN PLANTINGS, 1978 TO 1979

(000 acres)

	Ala.	Fla.	Ga.	La.	Miss.	Tenn.	District States	U. S.
Corn	- 70	- 4	- 30	- 8	- 25	- 70	-207	32
Cotton	0	- 1	0	- 35	-130	0	-166	621
Hay	- 20	-10	- 10	15	0	0	- 25	- 635
Oats	- 2	--	- 5	--	--	- 21	- 28	-2,303
Peanuts	- 2	1	0	--	0	--	- 1	5
Rice	--	--	--	- 30	- 10	--	- 40	- 10
Sorghum	- 7	--	0	0	5	0	- 2	- 909
Soybeans	300	49	400	350	300	170	1,569	7,610
Tobacco	0	0	- 8	0	--	- 6	- 14	- 79
Total Nine Crops	199	35	347	292	140	73	1,086	4,332

Source: **Acreage,** Crop Reporting Board, Economics, Statistics, and Cooperatives Service, U. S. Department of Agriculture, June 1979.

were made. Total expansion reached 1.6 million acres, up 12 percent from last year (see Table 1). Soybean production had already occupied more land than all other row crops combined.

Not all planned expansions took place. District farmers had hoped to plant more cotton, as did their national counterparts. But the weather posed problems, and it couldn't be done. Heavy spring floods kept District farmers out of their fields, idling 166,000 acres. Mississippi, hit hardest, lost 130,000 acres; Louisiana lost 35,000. District production will fall below last year's, while national production should rise 5 percent (see Table 2).

The added soybean plantings offset other cutbacks as well. Farmers made large reductions in corn acreage this spring and smaller ones in rice, oats, and tobacco. Their plantings of peanuts, sorghum, and hay stayed stable. Still, overall prospects look good. Planted acreage rose 4 percent, 2 percent more than the national average (see Table 1).

Spending has risen as well. This year's production tab will rise by $422 million as a result of two major factors. Increased plantings will mean increased expenses. Farmers will spend $224 million on soybean expansion alone (see Table 3).

Spending will also increase just because prices have risen. Inflation will add more than $200 million to this year's farm bill as costs rise where production stays stable. Hay plantings, for instance, are level with last year's. But big hikes in the price of fuel and fertilizer will cost farmers an added $37 million. These same hikes will raise the cost of corn production by $90 million, though plantings were reduced (see Table 3). Farmers, like their countrymen, are "pedaling harder" just to keep pace.

Even so, the greater farm spending will aid the economy. Enough real growth occurred to benefit farm supply firms. Sales volumes should move up for such items as herbicides, insecticides, and farm equipment as farmers cultivate added land.

Farm lenders will gain as well. Farmers will finance their spending through increased reliance on credit. Data on PCA loans show borrowing is up about 12 percent over last year.

The mood of the farmers is seen in these figures. Confidence is growing that good weather will hold and prices stay high. Rain, in short supply for the past two years, continues to fall as it should. Farm commodities keep going up, and news of the Russian grain shortage has put fears

TABLE 3

PROJECTED VARIABLE EXPENDITURES FOR CROP PRODUCTION IN 1979

District States

	Intended Acreage Planted (000)	Variable Cost Per Acre ($)	Total Variable Expenditure (mil. $)	Change from 1978* (mil. $)
Corn	3,663	124	454.2	89.6
Cotton	2,238	226	505.8	18.1
Hay	3,590	83	298.0	37.1
Oats	295	58	17.1	3.0
Peanuts	815	280	228.2	31.1
Rice	770	269	207.1	19.6
Sorghum	288	69	19.9	7.3
Soybeans	15,060	76	1,144.6	223.6
Tobacco	128	1,101	140.9	- 6.6
Total Nine Crops	26,847	--	3,015.8	422.8

*Expenditure changes reflect acreage variations as well as inflation in production cost per acre since 1978.

Sources: **Acreage,** *op. cit.*, and projections from costs prepared by the Economics, Statistics, and Cooperatives Service, U. S. Department of Agriculture, and by agricultural economists at various land grant universities.

TABLE 4

EXPECTED RETURNS OVER VARIABLE COSTS MAJOR DISTRICT CROPS, 1979

	3-Year Average Yield[1] (per acre)	3-Month Average Price[2] ($ per unit)	Anticipated Revenue[3] ($ per acre)	Projected Variable Cost ($ per acre)	Expected Net Return Over Variable Cost ($ per acre)	Total[4] (mil. $)
Corn	54.1 bu.	2.71	$ 147	$ 124	$ 23	$ 84.2
Cotton	465 lbs.	.587	273	226	47	105.2
Hay	1.72 tons	55.80	96	83	13	46.7
Oats	47.3 bu.	1.28	61	58	3	0.9
Peanuts	2,911 lbs.	.213	620	280	340	277.1
Rice	38.9 cwt.	8.37	326	269	57	43.9
Sorghum	20.79 cwt.	3.61	75	69	6	1.7
Soybeans	22.8 bu.	7.19	164	76	88	1,325.3
Tobacco	2,022 lbs.	1.139	2,303	1,101	1,202	153.9
Total Nine Crops						$2,038.9

[1]Weighted average of state yields for each crop from 1976-78.

[2]Average of March, April, and May 1979 prices.

[3]The average price times the three-year average yield.

[4]The net over variable cost per acre times all acres planted.

of glut to rest. Barring unpleasant surprises, Sixth District production should be greater than ever before. Just as important, it will bring high prices. Soybeans should net $1.3 billion over variable costs, about $88 per acre. For the combined commodities, that net should be over $2 billion, nearly $250 million above 1978's level. It's no wonder that farmers are optimistic. ■

SPECIAL SECTION ON POTENTIAL GNP

The following three articles deal with the slippery but important concept of potential GNP. How big an economic pie can we produce in this country without worsening inflation? How much can that pie grow from year to year without worsening inflation? These are important questions. This figurative economic pie is the limit on our economic living standard nationally. The pie is what we divide into our individual standards of living. The bigger the pie and the faster its growth, the more we can divide, so long as the gains are real and not inflationary. The answers matter to all of us.

This same notion of potential GNP serves as a guide to economic policy makers: Will additional stimulus push the economy closer to its real potential or beyond it into worsening inflation? Explicitly or implicitly, whether or not the people making these decisions have ever heard of potential GNP, the concept provides an important test against which to judge the results.

The answers come harder than the questions. Jake Haulk has been grappling with potential GNP questions for some time and wants to share with our readers some of what he has uncovered. In his first article, he emphasizes how much potential GNP depends on the noninflationary rate of unemployment (now higher than "full" employment) and on the productivity of our work force. His second and third articles probe more deeply into the measurement and problems of each. Two more articles on the same general subject will appear in a future ***Economic Review.***

POTENTIAL GNP: POLICY GUIDEPOST OR DETOUR?

by Charles J. Haulk
and Robert E. Goudreau

Potential GNP, the most we can produce without pushing up the inflation rate, is closely related to productivity and unemployment. Earlier estimates of potential GNP growth were too optimistic.

Part of the reason inflation has been getting worse has to do with inaccurate measurements used to determine the potential Gross National Product—the highest output of goods and services possible without increasing inflation. Since potential GNP provides a standard for measuring the way the economy actually performs, it is a key factor in the formulation of national monetary and fiscal policy. Recent estimates, we believe, have been too high because of faulty measurements, resulting in overstimulative policies that have made inflation worse.

Three main elements figure in the calculation of potential output: labor force, productivity, and the nonaccelerating inflation rate of unemployment, which we abbreviate as NAIRU.

The NAIRU rate is different from the actual rate and is the lowest rate of unemployment the economy can support without making inflation worse. Four percent was used as the noninflationary rate in the '50s and '60s but by 1979, the Council of Economic Advisers had raised it to 5.1 percent—a rate we believe is too low and has pushed potential GNP estimates up too high.

Additionally, two factors that go into measuring productivity have not received sufficient attention. One is the assumption of labor force homogeneity—the idea that all members of a particular age, sex, or racial group will perform the same way on the job. The other is the changing composition of industrial output that comes about as more workers move from jobs in manufacturing and agriculture to work in government and service industries.

The concept of a potential GNP assumes that all economic resources are efficiently utilized but are affected by several diverse factors, including restrictions put on the economy by government agencies and financial and other institutions; society's attitudes about work and its desire to consume; the state of technological development; the market structure of the various industries; types and quantities of natural resources; the existing stock of capital equipment; and the structure necessary for the distribution of goods and services produced. Economists make certain assumptions about these factors to make it possible to assign values to them so the potential output can be calculated. The more of

these we try to take into consideration, the more complex the calculation becomes and, in general, the smaller the estimates of the potential GNP.

One of the earliest and simplest calculations of potential GNP relied primarily on the unemployment rate. Economist Arthur Okun,[1] writing in 1962, proposed that potential output be the actual output produced when 4 percent of the labor force is out of work. He said the difference between the potential GNP and the actual GNP depends on the difference between the actual unemployment rate and the 4-percent noninflationary unemployment rate. He assumed that the unemployment rate is influenced by the number of people working, the average number of hours worked, and productivity.[2] He found that the potential GNP grew 3.5 percent a year between 1953 and 1961.

Later calculations became more complex. In the 70s, George Perry[3,4] recognized that the estimated growth rates of the labor force and productivity would be essential in projecting potential GNP, so he proposed a method that took them into account. He also refined the concept to include an estimate of the changes that were taking place in the demographic make-up of the work force, and he raised the noninflationary unemployment rate to 4.9 percent. This approach incorporates a productivity growth rate and figures the number of man-hours available at the noninflationary unemployment rate.

Peter Clark[5] refined the concept of potential GNP by considering capital stock—or existing business equipment and structures—to take into account the slowing of productivity growth that occurs when the number of people working grows faster than capital equipment and the result is a smaller ratio of capital to labor. Robert Rasche and John Tatom[6] used capital, labor, and energy prices to determine what potential output had been in the past, and they found a significant break in the growth of the GNP after the 1973 Arab oil embargo and the quadrupling of oil prices. Richard Sheehan and Frank Zahn[7] set up an econometric model to determine the supply and demand for both capital and labor at the noninflationary unemployment rate.

Both labor force and productivity have a long list of determining factors, many of them hard to assign precise values. The size of the labor force depends on the number of people of working age, society's attitudes about women and teen-agers working, whether people are working because they have to or because they want to, and whether job availability encourages people to look for work. All of these things determine how many people in a particular age, sex, or racial group are employed, although recent labor force behavior has pretty much defied prediction.

The quality of labor is determined by such things as age distribution, skill levels, and mental and physical well-being. The productivity of the labor force depends on the condition and amount of capital stock, the state of technological development, quality and attitudes of the labor force, and the composition of the goods and services produced. It is also necessary to make adjustments for cyclical fluctuations in some industries' production.

The recent sluggishness of the growth in productivity has received a lot of attention. Perry[8] made adjustments for the age, sex, and racial make-up of the labor force; other economists have considered things like capital and energy prices. But other key factors need to be considered, such as technological development, changes in the quality of the labor force besides demographic ones, and changes

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[1]Arthur Okun, "Potential GNP: Its Measurement and Significance," **Proceedings of the American Statistical Association, Business and Economics Statistics Section,** 1962, pp. 98-104.

[2]Okun, *op. cit.,* p. 99.

[3]George L. Perry, "Labor Force Structure, Potential Output, and Productivity," **Brookings Papers on Economic Activity,** Vol. 3, 1971.

[4]George L. Perry, "Potential Output and Productivity," **Brookings Papers on Economic Activity,** Vol. 1, 1977.

[5]Peter K. Clark, "Potential GNP in the United States, 1948-1980," Council of Economic Advisers, May 1977, mimeo.

[6]R. H. Rasche and J. A. Tatom, "Potential Output and Its Growth Rate—The Dominance of Higher Energy Costs in the 1970s," October 1977, mimeo.

[7]Richard G. Sheehan and Frank Zahn, "Investment, Potential Output, and Okun's Law," paper presented at Western Economics Association meetings, Las Vegas, June 19-21, 1979.

[8]Perry, *op. cit.,* 1977.

in the composition of the goods and services produced.

Most writers assume that technological improvements are quickly absorbed by industry and so will show up in the growth of capital equipment. John Kendrick[9] attempts to assign a value to the effect that funds spent for research and development have on productivity. He and others have noted that productivity is reduced when large amounts of capital and labor are used for environmental protection because clean air and water don't show up in the GNP. Edward Denison[10] tries to assess the impact of higher crime rates and employee dishonesty on productivity.

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[9]John Kendrick, "Reaching a Higher Standard of Living," Office of Economic Research, The New York Stock Exchange, 1979.

[10]Edward F. Denison, "The Shift to Services and the Rate of Productivity Change," **Survey of Current Business,** October 1973.

Many writers recognize the changing characteristics of the work force and have taken demographic factors into consideration but fall into the trap of assuming that all workers within a particular age, sex, or racial group are homogeneous, when that obviously is not true. We believe that this assumption of homogeneity and the effect it has had on estimates of productivity has not been sufficiently studied; nor has the particular composition of the goods and services produced by the labor force. Several studies have looked at the effect of changes in this composition on the level of productivity, but none that we know of have looked at the effect on how fast productivity is growing.

Other sections of this report will address the problem of productivity and the question of the noninflationary unemployment rate. ■

POTENTIAL GNP: THE NONINFLATIONARY UNEMPLOYMENT RATE

by Charles J. Haulk and Robert E. Goudreau

Current evidence suggests that the inflation rate worsens when unemployment falls below 6 percent and manufacturing capacity utilization exceeds about 84 percent.

We believe that inflation has gotten worse because of fiscal and monetary policies that resulted from erroneously high estimates of potential GNP and that these estimates were off because the noninflationary unemployment rate, or full employment rate, used in the calculations has been too low. To the extent that policy makers continue to use the 5.1-percent rate, policy will continue to be overly expansionary.

For the '50s, the noninflationary unemployment rate was set at 4 percent, which was appropriate for the time. By 1979, it was up to 5.1 percent. Now, many economists, ourselves included, propose that it be raised to a point somewhere between 5.5 and 6 percent, since the labor force is changing and the inflation rate is increasing.

Early in 1978, the actual unemployment rate had dropped to 6 percent; from then through the second quarter of 1979, the rate dropped only 0.3 percent to 5.7 percent, while the inflation rate increased from around 6 percent beyond 10 percent. By definition, the NAIRU rate is the lowest rate possible without worsening inflation; so if inflation does get worse, that indicates that the actual unemployment rate has dropped below the NAIRU. Thus, the recent acceleration in the rate of inflation suggests the current noninflationary unemployment rate is in the 6-percent range.

To calculate potential GNP, it is necessary to find the optimal rate of utilization of labor and capital. These utilization rates are the highest possible without causing an increase in inflation. Once utilization rates reach a certain level, demand grows faster than supply because the additionally used resources are pushed to their limits. For labor, the utilization rate has traditionally been measured by the unemployment rate; as the unemployment rate goes down, the utilization rate goes up.

For capital, the rate is called the capacity utilization rate, the actual rate of output divided by the maximum sustainable output possible under normal conditions. Capacity utilization rate data have been collected for several years for manufacturing industries, but rates for other industries are difficult to come up with. Because of differences in their production methods, it is hard to find measurements of their capacity. So the manufacturing capacity utilization rate is used as a substitute for an overall rate. The relationship of capacity utilization in manufacturing to unemployment and inflation shows that the nonaccelerating inflation rate of unemployment is increasing.

This is proved indirectly by the work of economist Rose McElhatton,* who has

*Rose McElhatton, "Estimating a Stable-Inflation Capacity-Utilization Rate," **Economic Review**, Federal Reserve Bank of San Francisco, fall 1978.

proposed 80 to 83.5 percent as the "equilibrium range" of capacity utilization that won't increase or decrease inflation. Inflation increases when the utilization rises above 83.5 percent and decreases when it falls below 80 percent. These findings differ considerably from those of many economists who believe the 87- to 88-percent utilization level of 1973, which they consider the peak period, is the best yardstick for measuring full use of the nation's productive resources.

This relationship between inflation and capacity utilization examined by McElhatton is closely associated with manufacturing, which accounts for 30 percent of national output. Her calculations probably don't show the effects on inflation of agricultural or import industries, so a rise or fall in inflation can occur, even though the capacity utilization rate is within the 80- to 83.5-percent range. But she says if capacity utilization rates continue above 83.5 percent, we can expect additional inflation in the domestic nonfarm business sector of the economy.

Over a long period, inflation in manufacturing should be closely tied to general inflation. Price fluctuations for finished manufactured goods are likely to be less frequent and smaller than those of other industries, so they are probably a better indicator of inflation trends than fluctuations in other sectors.

To see whether there has been a change in the noninflationary unemployment rate, we obtain indirect evidence by examining the relationship between the unemployment rate and the capacity utilization rate for two periods—1965-71 and 1972-78—and found that the unemployment rate did drop as utilization rates rose. Calculations are shown in the following box.

Separate regressions for unemployment as a function of capacity utilization rates were performed for the two periods. Both variables were entered in logarithmic form.

For the first period:

Q1/1965-Q4/1971
Log UR = 12.970 - 2.593 Log CAPUR
(6.7048)(-5.9607)
R^2 = 0.5774
t-value in parentheses

For the second period:

Q1/1972-Q4/1978
Log UR = 15.101 - 3.0073 Log CAPUR
(10.204)(-8.9571)
R^2 = 0.7552
t-value in parentheses

Using the results shown in the box, we found that for the first period, the noninflationary unemployment rate was 4.5 percent; and that for the second period, the rate had risen to 6.0 percent, an increase of 1.5 percentage points. We don't claim that these results are absolutely accurate, but the rise is large enough to allow for a sizable measurement error.

Neither do we pretend to deal with all the problems of choosing the appropriate unemployment rate to use in calculating potential GNP, but we do believe our analysis and evidence provided by the economy itself show that previous estimates of potential GNP have been too high because 5.1 percent was used as the noninflationary unemployment rate. ■

POTENTIAL GNP: PRODUCTIVITY GROWTH

by Charles J. Haulk and Robert E. Goudreau

Because a higher proportion of our population has been working in recent years, more individuals with lower skills and experience are on the job. This fact, together with the shift in the mix of what we produce and consume away from high productivity sectors, largely accounts for the disappointing sluggishness in output per worker.

The productivity of the labor force—the output per man-hour worked—is determined by technology, capital stock, the quality of the labor force, and the composition of the goods and services produced by the labor force. The rate at which productivity grows is strongly influenced by technology. Productivity growth slows when capital and labor are used to produce goods and services in industries where few technical improvements are possible, but it grows faster as capital and labor are used in industries where a large number of technical improvements are possible. Productivity growth will be faster in an industry with strong technical improvements as that industry increases its size.

John Kendrick[1] estimates that substituting capital for labor, by giving workers more equipment, caused an 0.7-percent annual increase in the rate of productivity growth in the period 1973-77. That increase accounted for half of all labor's productivity growth during the period. Other writers argue that there has been a decline in the rate of capital growth in relation to labor, but Kendrick also says a decline in technical progress has caused a slower growth in productivity. Expenditures for research and development dropped from the mid-'60s to 1977 from 3 percent of the actual GNP to 2.2 percent. The slower growth of capital stock—equipment and structures—means the average age of the stock went up, so it took longer for industry to be able to incorporate technical improvements. But Kendrick also says that productivity growth that did occur from 1973-77 was helped by better labor quality, in the form of more on-the-job experience, fewer young people starting to work, and higher levels of education.

Our evidence, which follows, suggests that the improvement in the quality of the labor force may be lower than Kendrick and others assume and that the idea of a homogeneous labor force, too, is invalid, especially in periods of sharp change.

First of all, there is reason to question the use of years of education as a measure of improvement in labor force quality, since achievement test scores for high school graduates have been declining for several years. College textbooks and military training manuals are written at lower reading levels because students cannot otherwise comprehend them. Although it is difficult to measure this decline objectively, we cannot accept the claim that more schooling automatically improves labor force quality.

Edward Denison[2] points out that employee dishonesty has increased substantially in recent years, indicating a real

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[1]John Kendrick, "Reaching a Higher Standard of Living," Office of Economic Research, The New York Stock Exchange, 1979.

[2]E.F. Denison, "The Shift to Services and the Rate of Productivity," **Survey of Current Business,** October 1973.

decline in the motivation and diligence that characterized earlier generations of workers. Employee punctuality and attentiveness have suffered too, and absenteeism has increased.

Perhaps a more reliable sign of a change in the quality of the labor force is a change in the employment ratio, which is the number of workers holding jobs divided by the working age (or over 16) population. We believe that, other things being equal, productivity will drop as the employment ratio increases because an increase in the employment ratio will bring a disproportionate number of unskilled or more poorly motivated workers into the labor force. Other factors being equal, productivity will increase if the employment ratio drops and jobs are lost because the least desirable workers will be the first to go and the more productive ones will be retained. Periods of rapid growth in employment are times of slower growth or even declines in labor force quality and in productivity. A jump in the number of people working will add some marginally qualified workers to the labor force. This will reduce the overall capital-to-labor ratio and ultimately reduce productivity.

To test our hypothesis, we performed two sets of stepwise regressions, as shown in Appendix I. The results strongly support our contention that changes in the employment ratio affect productivity growth and suggest that labor force quality is not homogeneous among age, sex, and racial groups.

Since it isn't possible to predict changes in the employment ratio with much confidence, we can only project productivity or potential GNP with a wide range of possible outcomes. In most cases, the estimation procedures have yielded results that are apparently too high. Potential GNP cannot be determined by using only technology, capital stock, and working population; it also depends on society's attitudes toward work for its members and on labor supply responses to economic conditions. The same argument applies to capital. Savings and investment decisions and expenditures for research and development are determined, to a large extent, by actual inflation and expectations of what inflation will be.

As a final issue, we will look at the problem of the changing mix of goods and services produced by the labor force to see how the changes help determine productivity and productivity growth. The movement of man-hours worked from one sector of the economy to another, say from agriculture to government, affects this composition of output. But the shifting of man-hours from industries with a low productivity to those with a high productivity has not had as much of an effect on overall productivity in recent years as it did earlier.

A simple notion of measuring compositional effects on productivity involves a procedure used by the Council on Wage Price Stability[3] and Denison.[4] We can estimate the effects of changes in productivity in individual sectors of the economy, changes in the number of man-hours belonging to each sector, and the way these changes affect each other, called the interaction effect. The box below illustrates this.

$$\Delta qt = \left[\Sigma(li \cdot \Delta qi)\right] + \left[\Sigma(qi \cdot \Delta li)\right] + \left[\Sigma(\Delta qi \cdot \Delta li)\right]$$

qt = overall labor productivity = total real output divided by total man-hours;
li = ith sector share of total man-hours;
qi = ith sector productivity;
Δli, Δqi = changes in man-hour share and productivity in sector i; and
i = 1, - - - n, where n = the number of sectors.

1st bracket — effect of productivity changes within sectors

2nd bracket — effect of change in man-hour shares of sectors

3rd bracket — interaction effect

The change in overall productivity is the sum of the changes in all of the sectors weighted by their share of man-hours. The change in the effect of the changing man-hour shares is the sum of the share changes weighted by the productivity of their particular sectors. Finally, the interaction effect is the sum of the products of the changes.

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[3]Council on Wage Price Stability—Special Release on Inflationary Developments—CWPS-289, October 4, 1978.

[4]E.F. Denison, "The Shift to Services and the Rate of Productivity Change," **Survey of Current Business,** October 1973, p. 20.

From 1950-67, some 0.15 of the average annual rate of productivity growth was due to man-hours shifting from one industry to another: The productivity growth factor was 2.36 and the interaction effect was -0.13. For the period 1967-77, the man-hour shift was 0.03, the growth factor was 1.60, and the interaction effect was -0.10. This demonstrates the decreasing effect that man-hours moving from one industry to another has on productivity.

There is a problem with the use of the composition shift measurement in this procedure because the industrial output must be converted to dollar values to have meaning. Over time, changes in the output of goods and services produced in each sector and in the whole economy must be determined by adjusting for price changes. Yet this adjustment artificially forces all years to reflect the relative prices during the year selected as the base year. In effect, productivity is limited to the notion of physical units of output. As long as relative prices do not change appreciably, the comparison of physical units of output between years is a satisfactory way to estimate changes in the value of what is produced. But if the relative prices change substantially, then this method of comparison could seriously distort the measurement of true productivity.

For example, if we calculate the productivity growth for nonfarm industries from 1947 to 1957 using 1957 prices, the increase is 30 percent. If we calculate the increase for the same period using 1967 prices, the increase is 28 percent. This problem presented itself during a period of slow overall price growth, although there were substantial changes in the composition of the output. Of course, the farther from the base year, the more likely a relative price shift would have occurred. Since 1967, the manufacturing sector has been losing ground, experiencing a decline in its share of output and man-hours. If a comparable shift in prices has occurred, then the estimates of real output and productivity could be understating true productivity.

Another point should be made regarding the use of labor productivity growth for estimating potential GNP. Most economists who have examined the problem usually look at how fast productivity has been growing and assume it will behave the same way in the future. But it is necessary to look at recent rates of productivity growth as well as the level of productivity. Appendix II illustrates this, and Appendix III shows how future productivity growth can be more accurately predicted by looking at factors that contribute to the changing growth rate of productivity.

Our calculations indicate that the changing mix of industrial output may be more important in determining the rate of growth of productivity than the estimates of earlier writers would lead us to believe. The total effect amounts to a reduction in the rate of productivity growth of 0.7 percent per year from 1960-64 to 1970-74. Of this reduction, 63 percent is due to slowing productivity growth within individual sectors and 35 percent is due to changes in growth of man-hour shares and output shares. The two industries that showed the most change in man-hour shares were services and manufacturing.

If we assume that productivity growth slowed at a steady rate over the ten-year period, that would mean it decelerated at a rate of 0.07 percent per year. If that same deceleration held for the next five years, then productivity growth would fall by 0.35 percent from the 1970-74 pace. To complete the analysis, we would need to calculate the differences in the rate of change in the productivity growth rate to see if the yearly percent reduction is itself changing. Because of unavailability of data, that calculation has not been performed. ■

APPENDIX I

The first regression equation sets the rate of productivity growth as a function of real output growth and employment ratio growth. Stepwise regressions are run to test for independence in the independent variables. Quarterly data for productivity, output, and the employment ratio were converted to percentage annual rates of growth. The regression results are shown in Table Ia. Results for the first step indicate that output growth is strongly correlated with productivity growth. The regression coefficient is significant at the one-percent confidence level, and the R^2 is 0.391. In the second step, the employment ratio term was added to the regression, and the results explain the growth of the employment ratio. The R^2 increased to 0.596, and both regression coefficients are strongly significant, indicating multicollinearity is not a problem. As expected, the output effect is positive and the employment ratio effect is negative.

Regression Results: Table 1a

Q2/1948-Q1/1979 Rates of Growth

Step 1

PRODG = 0.00566 + 0.54825ROUTG
(8.8592)**

R^2 = 0.3915 D. W.= 1.8702

Step 2

PRODG = -0.00150 + 0.80299ROUTG - 0.89811EMRG
(13.346)** (-7.8319)**

R^2 = 0.5962 D. W.= 2.2330

Correlation Matrix

	1	2	3
1 ROUTG	1.0000		
2 EMRG	0.5406	1.0000	
3 PRODG	0.6257	-0.0424	1.0000

PRODG = rate of productivity growth;
ROUTG = rate of real output growth; and
EMRG = rate of employment ratio growth.

t-statistics in parentheses
**Significant at the one-percent confidence level.

In the second regression, the variables were entered in the form of deviations from trend rates of growth. Trend rates were determined by use of a smoothing procedure. Deviations were obtained by subtracting the trend value from the actual value. Results of the stepwise regressions are shown in Table 1b. In the second step, the employment variable is significant and the R^2 increased to 0.563. Both coefficients are significant and have the expected sign. Again, multicollinearity is not a significant problem.

Regression Results: Table 1b

Q4/1948-Q1/1979 Deviations from Trend

Step 1

$$DTPRODG = 0.00116 + \underset{(11.008)^{**}}{0.95823}DTROUTG$$

$R^2 = 0.5024$ D. W. = 1.9284

Step 2

$$DTPRODG = 0.00111 + \underset{(12.202)^{**}}{1.1378}DTROUTG - \underset{(-4.040)^{**}}{1.2574}DTEMRG$$

$R^2 = 0.5625$ D. W. = 1.9510

Correlation Matrix

	1	2	3
1 DTROUTG	1.0000		
2 DTEMRG	0.4766	1.0000	
3 DTPRODG	0.7088	0.1224	1.0000

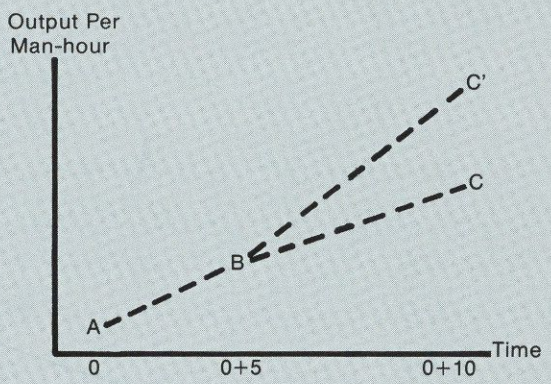
DTROUTG = deviation from trend rate of output growth;
DTEMRG = deviation from trend rate of employment rate growth; and
DTPRODG = deviation from trend rate of productivity growth.

t-statistics in parentheses
**Significant at the one-percent confidence level.

APPENDIX II

The figure to the right shows a hypothetical (output per man-hour) trend. Points A, B, and C represent measured levels of productivity in three different years taken at five-year intervals.

Suppose that in year 0 + 5 we know productivity for that year and for year 0, then we could estimate a constant trend rate of growth which would have increased productivity from point A to point B along the dashed line AB. By assuming that this particular rate of productivity growth will hold into the future, we could predict productivity at year 0 + 10 to be C′. But when year 0 + 10 arrives, we measure productivity to be at C, a substantially lower value than C′. What happened? Clearly, the projection of the recent trend rate was in error.



APPENDIX III

$$\frac{\Delta qt'}{qt} = \left[\Sigma\left(\frac{qi'}{qi} + \frac{li'}{li}\right)\Delta\frac{Qi}{Qt}\right] + \left[\Sigma\frac{Qi}{Qt}\Delta\frac{qi'}{qi}\right] + \left[\Sigma\frac{Qi}{Qt}\cdot\Delta\frac{li'}{li}\right] + \left[\Sigma\Delta\frac{qi}{qi}\cdot\Delta\left(\frac{qi'}{qi} + \frac{li'}{li}\right)\right].$$

$\frac{qt'}{qt}$ = growth rate of total productivity;

$\frac{qi'}{qi}, \frac{li'}{li}$ = growth rate of productivity and man-hour shares of sector i; and

$\frac{Qi}{Qt}$ = ith sector share of total real output.

1st bracket - change in output share effect
2nd bracket - change in productivity growth effect
3rd bracket - change in man-hour share growth effect
4th bracket - interaction effect

The change in the growth rate is in four parts: the effect of changing composition of output, determined by weighting the composition changes by the sum of the initial productivity and man-hour share growths; the effect of changing productivity, which uses initial sector output shares as weights; the man-hour share of growth change effect, which also uses sector shares of total output as weights; and, finally, the interaction effect, the sum of the products of the changes.

We have estimated the change in productivity growth from 1960-64 to 1970-74, dividing the economy into seven sectors: mining and construction; manufacturing; agriculture; transportation and utilities; services; wholesale and retail trade; and government. The results are shown below.

Sources of Change		Percent Share of Total Change
Effect of changing productivity growth within sectors	-.436	63.28
Effect of changing growth of man-hour shares within sectors	-.247	34.69
Effect of changing output shares	+.008	
Interaction effect	-.014	2.03
Total change in percentage rate of growth	-.689	

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