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Potential Output and the Recent Productivity Decline

JOHN A. TATOM

POTENTIAL output refers to the real gross national product (GNP) that is produced if the economy operates under high-employment conditions. Measures of potential output depend on measures of available resources, such as capital and labor, and reliable estimates of the relationship between national output and the employment of resources.

Since 1973, the growth of productivity (measured as output per unit of labor) has slowed substantially (see chart 1), raising doubt about the relationship of input to output and, therefore, the measurement of the nation's potential GNP. This issue is of considerable importance as it bears on the traditional concern over the degree of resource underutilization and the associated output losses in the economy. An accurate assessment of potential output is essential to determine the expected gain in output from a policy intended to achieve full employment. The relationship between resource supplies and potential output also is important in analyzing the output gain from supply-side policies to increase the supply of resources through increased work, saving and investment.

This Bank's measure of potential output differs from others in that it provides direct estimates of the effects of labor force growth, capital accumulation *and* changes in the relative cost of energy resources on productivity and economic capacity.[1] The stability of the input-output relationship on which this measure is based, and its ability to fully account for the unusual productivity developments during the last decade, provided support for the credibility of past estimates. Since energy costs have increased dramatically since 1978, it is important to verify that the earlier empirical results are consistent with recent productivity experience, as well as to assess the impact of this shock on potential GNP. Also, recent revisions of the GNP accounts incorporate new information on output and involve some conceptual changes that require revisions in potential GNP measures. In addition, since 1977 some modifications have occurred in the methods used by this Bank to measure potential output. The revisions and modifications are described below.

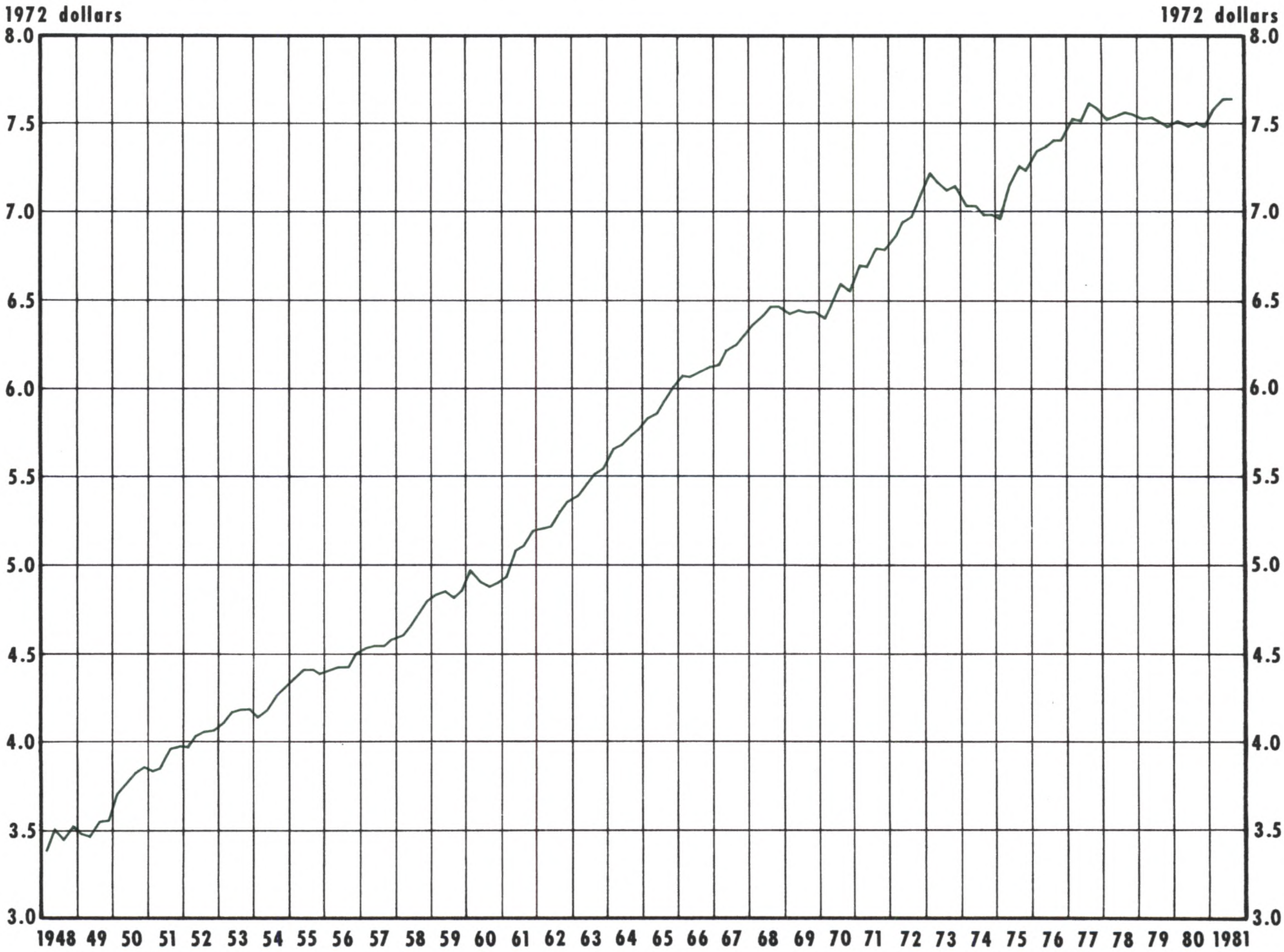
ENERGY PRICE SHOCKS AND PRODUCTIVITY

A sharp increase in the relative price of energy causes a reduction in the output (productivity) of existing labor and capital resources, or economic capacity. The particular channels through which this change occurs vary from firm to firm, but include changing production methods to reduce the use of higher-cost energy, the closing of plants rendered unprofitable, reduced optimal and actual use of existing facilities, and the diversion of labor and capital resources to uses that economize on higher-cost energy. These changes result in less output being produced despite an initially unchanged availability of domestic capital and labor resources. As a result, measures of productivity such as output per worker, per hour, or per unit of capital, decline. The rise in energy prices also induces a percentage increase in the nominal prices of output equal to the percentage decline in productivity or potential out-

[1]The original measures used by this Bank and the methods of their construction are explained in Robert H. Rasche and John A. Tatom, "Energy Resources and Potential GNP," this *Review* (June 1977), pp. 10-24. The theoretical basis for the energy price effect is developed in Robert H. Rasche and John A. Tatom, "The Effects of the New Energy Regime on Economic Capacity Production and Prices," this *Review* (May 1977), pp. 2-12. These hypotheses are further elaborated, and international evidence supporting them are presented in Rasche and Tatom, "Energy Price Shocks, Aggregate Supply and Monetary Policy: The Theory and International Evidence," in Karl Brunner and Allan H. Meltzer, eds., *Supply Shocks, Incentives and National Wealth*, Carnegie-Rochester Conference Series on Public Policy, Vol. 14 (1981), pp. 9-93.

Chart 1

Output per Hour (Private Business Sector)



Latest data plotted: 3rd quarter

Source: U.S. Department of Labor

put, since less output is producible for a given supply of money.

In addition, the decline in productivity shifts the demand for labor and capital resources down. In the short run, these shifts are reflected in a fall in the real wages of workers and a decline in the value of existing plant and equipment relative to its replacement cost. Over a longer period, the capital stock available per worker will decline from the level that would otherwise have occurred, so that the long-run decline in potential output, labor productivity and real wages is larger than the initial decline.

The effect of a rise in the relative price of energy on production is manifested in a production function approach through reductions in inputs (especially reduced energy usage), or through changes in productive efficiency or capacity that are "disembodied," that is, not associated with changes in the use of physical inputs such as labor, capital or energy. Earlier studies have provided an unbiased estimate of the effect of a rise in the relative price of energy on output that supports the energy price/economic capacity hypothesis.[2] Before re-examining

[2]An elaborate review of other analyses of energy price effects on the economy is presented in Rasche and Tatom, "Energy Price Shocks, Aggregate Supply," pp. 16-33. A more recent critique of the analysis here is Ernst R. Berndt, "Energy Price Increases and the Productivity Slowdown in United States Manufacturing," Federal Reserve Bank of Boston, *The Decline in Productivity Growth*, Conference Series No. 22 (June 1980), pp. 60-89.

Berndt finds no effect of higher energy prices on manufacturing productivity, in contrast to the evidence in John A. Tatom, the production function estimates, however, it is useful to review recent revisions in the data series used to estimate potential GNP.

THE RECENT GNP AND CAPITAL STOCK REVISIONS

From time to time, the U.S. Department of Commerce announces major revisions in the GNP accounts based on new source data, new estimating procedures and definitional or conceptual changes. The latest revision was published in December 1980.[3]

The basis of the recent revision was new information from the 1972 input-output tables, the 1977 economic censuses of various industries, and information from the 1973 and 1976 Taxpayer Compliance Measurement Program. In addition, GNP was redefined to include the reinvested earnings of incorporated foreign affiliates of U.S. direct investors and to exclude those of incorporated U.S. affiliates of foreign direct investors. The redefinition of GNP primarily affects the measure of income originating in the rest of the world, with little effect of the measurement of output from the nation's private sector.

Another important part of the revision was in gross private domestic investment. The revision of this measure was largely due to revised estimates of producer durable equipment investment. At the same time, a conceptual change occurred, shifting the output and investment in hotels and motels from the residential to the nonresidential sector. Except for the treatment of reinvested earnings abroad, however, the revisions of GNP primarily affect data beginning in 1968.

"The Productivity Problem," this *Review* (September 1979), pp. 13-14. Unfortunately, as Berndt notes, a major share of energy resources is classified as raw materials in his data set, and his analysis can be easily extended to show that most of the productivity decline he analyzes is due to an increase in the relative price of these "raw materials." Berndt also claims to show that an observed decline in the value of claims on existing physical capital relative to the replacement cost, as hypothesized above, is also not explained by energy price increases. His theoretical analysis is flawed by the omission of a significant output effect that substantially raises the magnitude of his estimate of the effect of higher energy prices on the value of existing capital.

[3]For a discussion of these revisions, see Keith M. Carlson, "Recent Revisions of GNP," this *Review* (March 1981), pp. 27-32; and "The National Income and Product Accounts of the United States: An Introduction to the Revised Estimates for 1929-80," *Survey of Current Business* (December 1980), pp. 1-26.

Table 1

Revisions in Real Net Capital Stock and Private Business Sector Output (selected years)[1]

Year	Upward revision of capital stock at beginning of year	Upward revision of private business sector output
1950	2.1%	0.3%
1955	2.0	0.6
1960	1.8	0.5
1965	2.9	0.2
1970	2.9	0.2
1975	4.9	2.8

[1]Figures are the percentage increase of 1980 revised data over data available in 1977.

The new source information affected measures of the nation's capital stock as well, especially after 1967. The reclassification of hotel and motel capital stocks is the primary source of changes in the measures prior to 1967. While the level of the nation's net nonresidential private capital stock (constant prices) was raised because of these changes, the growth rate was changed very little prior to 1973. For example, the revised data show a 4.2 percent annual rate of growth from 1948 to 1968, the same as earlier data. From 1968 to 1973, the revised data indicate growth of the net capital stock at a 4.4 percent rate, up from 4.0 percent in the earlier data. From 1973 to 1978, the revised capital stock shows that capital formation slowed to a 3.1 percent rate. Earlier data show the same extent of slowing in capital formation to a 2.7 percent rate from 1973 to 1978. As a result, the conclusion of earlier research that capital formation slowed subsequent to 1973, especially when measured relative to labor force growth, has been unaffected by the revisions. The rate of growth of the capital stock, however, has been somewhat faster since 1968 than earlier estimates showed; this could affect earlier estimates of input-output relationships.

Table 1 shows the extent of both the upward revision of the constant-dollar net stock of fixed nonresidential private capital at the beginning of the year and the private business sector output for data used in 1977 as compared with the recent revisions. The capital stock has been revised upward relatively more than output.

THE PRODUCTION FUNCTION

The basis of this Bank's potential output estimates is a production function for private business sector (PBS) output that relates output to hours of employment, the utilization of capital, and energy. Available measures of energy tend to be broken down by types of users, such as residential, commercial and industrial. No energy measures exist that are detailed by production vs. consumption use by households, or by producing sectors like the manufacturing and private business sector. Since energy measures compatible with existing data on sectoral output and employment of labor and capital do not exist, a "first-order condition" for energy employment is used to eliminate the quantity of energy from the production function, replacing it with the relative price of energy. Formally, the estimated equation is of the form,

$$(1)\ \ln X_t = \beta_0 + \beta_1 \ln h_t + \beta_2 \ln k_t + \beta_3 \ln (Pe/P)_t + \beta_4 \ln t,$$

where X_t is PBS output in period t, h_t is hours of all persons, k_t is the utilized net nonresidential capital stock (constant prices), the product of the Federal Reserve Board manufacturing capacity utilization rate and the capital stock in place at the end of period t-1, and Pe/P is the relative price of energy, found by deflating the producer price index for fuel, power and related products by the implicit price deflator for private business sector output. The t term is a time trend intended to capture the rate of technology change. When equation 1 is derived from a Cobb-Douglas production function, the βs in equation 1 are related to the output elasticities of the inputs, as shown in table 2.

Estimates of the annual production function using the revised data for the periods 1949-73, 1949-75 and 1949-80 are shown in table 3.[4] There are three noteworthy revisions in the estimates. First, the coefficient on the relative price of energy and estimate of the output elasticity of energy are smaller in absolute value, though not in a statistically significant sense, with the new measures of output and capital. In the earlier estimation for 1949-73 and 1949-75, $\hat{\gamma}$ is 11.7 percent (t = 1.92) and 12.0 percent (t = 5.66), respectively. Second, the autocorrelation adjustment, $\hat{\rho}$, is smaller than before (0.63 for the 1949-75 period). Finally, the estimates for the period 1949-73 are even closer to those for the longer sample periods than they are with the earlier estimates. In the earlier estimations, there are no significant differences in the coefficient estimates across periods, but $\hat{r}$ is 1.2 percent per year and $\hat{\alpha}$ is 58.9 percent in the 1949-73 sample period; these are 1.6 percent and 64.9 percent, respectively, in the earlier estimation for the 1949-75 sample period.

Table 2

Indirect Least Squares Estimation of a Cobb-Douglas Production Function

Production Function: $X_t = A\, h_t^{\alpha}\, k_t^{\beta}\, E_t^{\gamma}\, e^{rt}$,

where X	=	output
h	=	hours of all persons
k	=	utilized capital stock
E	=	energy input
A	=	scale factor
α, β, γ	=	output elasticity of hours, capital, and energy, respectively
r	=	trend growth rate per year or per quarter
t	=	time period

First-Order Condition for Energy: $Pe/P = \gamma X/E$,

where Pe/P = the price of energy relative to the price of output

Linear model: $$\ln X_t = \ln A + \frac{\alpha}{1-\gamma} \ln h_t + \frac{\beta}{1-\gamma} \ln k_t + rt - \frac{\gamma}{1-\gamma} \ln (Pe/P)_t$$

An important hypothesis that was supported in earlier work is rejected using the revised data. A slowing in the time trend for technological change beginning in 1967 could not be rejected earlier. For all three sample periods in table 3, this hypothesis is rejected. A time-trend variable with a value of zero to 1966, then increased by one each year from 1966 on, was added to each equation estimated in table 3. The t-statistics for the slower trend variable are

[4]The ordinary least squares (OLS) estimates of the coefficients in table 3 are virtually identical but the Durbin-Watson statistics are 1.28, 1.35, and 1.37 for the 1949-73, 1949-75, and 1949-80 periods, respectively. To check whether this autocorrelated error pattern results from the omission of significant lagged input effects on output, one and two period lags on the input variables are added to the equations in table 3 and their OLS counterparts. When this is done, the coefficients are not significant, the Durbin-Watson statistic does not change and the estimate of ρ shown in table 3 is not reduced.

Table 3
Production Function Estimate for the U.S. Private Business Sector

	1949-73	1949-75	1949-80
β_0	1.3440	1.4663	1.4971
	(3.78)	(10.70)	(13.25)
β_1	0.6885	0.7302	0.7201
	(12.53)	(13.25)	(13.07)
β_2	0.3115	0.2698	0.2799
	(5.67)	(4.90)	(5.08)
β_3	−0.0704	−0.0875	−0.0953
	(−1.00)	(−3.96)	(−6.22)
β_4	0.0168	0.0182	0.0177
	(7.84)	(9.69)	(9.48)
$\hat{\alpha}$	0.6432	0.6715	0.6574
	(9.57)	(14.30)	(14.58)
$\hat{\beta}$	0.2910	0.2481	0.2555
	(5.27)	(4.64)	(5.31)
$\hat{\gamma}$	0.0658	0.0805	0.0870
	(1.07)	(3.96)	(6.81)
$\hat{r}$	0.0157	0.0167	0.0162
	(6.11)	(10.24)	(10.36)
$\bar{R}^2$	0.97	0.97	0.97
SE	0.0091	0.0099	0.0102
DW	2.03	1.93	1.93
$\hat{\rho}$	0.44	0.39	0.39

−1.67, −1.50, and −1.41, for the 1949-73, 1949-75, and 1949-80 periods, respectively. The slowing is not statistically significant at a 5 percent level in any of these periods.[5] In addition, a test for an optimal point for a trend break using a minimum standard error criterion fails to reveal a point superior to 1967. There is no evidence then for a slowdown in productivity growth due to disembodied factors influencing the trend.

The new estimates do not alter any of the other earlier conclusions. In particular, the status of a number of hypotheses tested earlier has been unchanged because of the changes in the private business sector concepts and the new measures. For example, tests of the Cobb-Douglas restriction yield the rejection of a translog specification of the production function.

[5]This result held before the recent revisions as well. See Rasche and Tatom, "Energy Price Shocks, Aggregate Supply," p. 25.

The output elasticity of hours during the three periods is not significantly different from the share of labor in total costs during each of the three periods. This is extremely important as the Cobb-Douglas production function implies a price elasticity for energy demand that may be biased upward. While this would not yield a bias in the estimated effect of energy prices on output, it would yield an upward-biased estimate of γ *and* a downward-biased estimate of α. There is no evidence of such a bias. The t-statistics for the equality of the $\hat{\alpha}$ estimate and the actual share of labor in each period are −0.22, 0.27, and −0.08, respectively, so that the hypothesis that $\hat{\alpha}$ is equal to the actual share of labor cannot be rejected.

Other factors that failed to add significantly to the productivity relationships estimated earlier continue to be insignificant. These include adjustments for pollution abatement capital and the changing proportions of young people (age 16-19) or women in the labor force.

Finally, it remains the case that pre-1974 production function estimates that omit energy developments break down after 1973. When the 1949-73 model is estimated without the relative price of energy, the standard error of the equation is identical to that shown in table 3. When the sample period is extended to 1975 and 1980, the standard error of the equation without energy rises to 1.24 percent and 1.37 percent, respectively. The Chow test indicates that a significant change in the structure of the production function occurs in each case when energy is omitted and the sample period is lengthened. As the stability of the standard errors in table 3 indicates, such structural changes can be rejected using the Chow test when energy prices are included.

An estimate of the production function using quarterly data from II/1948 to III/1981 is:

$$(2)\quad \ln X_t = \underset{(21.03)}{1.4688} + \underset{(23.81)}{0.7351} \ln h_t + \underset{(8.58)}{0.2649} \ln k_t - \underset{(-8.31)}{0.0893} \ln(Pe/P)_t + \underset{(16.94)}{0.0045}\, t$$

$\bar{R}^2 = 0.99$ $\quad$ SE = 0.0074 $\quad$ DW = 1.96 $\quad$ $\hat{\rho} = 0.76$

$\hat{\alpha} = 0.6748$ (26.09) $\quad$ $\hat{\beta} = 0.2432$ (10.22) $\quad$ $\hat{\gamma} = 0.0820$ (9.05) $\quad$ $\hat{r} = 0.0041$ (18.41)

The estimated coefficients are essentially the same as those in table 3. This quarterly production function is used below to derive the revised potential output series. The stability and all other properties discussed above for the annual equations in table 3 apply to the quarterly estimates as well.

The impact of a change in the relative price of energy on output, productivity, real wages, and the capital stock can be assessed using the production function estimate in equation 2. For a given employment of labor hours and capital services (the short-run effect), a 10 percent rise in the relative price of energy reduces PBS output (X_t) and productivity by 0.89 percent. The long-run elasticity of output, labor productivity, real wages, and the capital stock is $(-\gamma/\alpha)$, or 0.122 in this case.[6] Thus, a 10 percent rise in the relative price of energy leads to a long-run decline in output that is 36 percent larger than in the short run. In particular, a 10 percent increase reduces output, productivity and the capital-labor ratio by 1.22 percent. From the third quarter of 1973 to the third quarter of 1974, and, again from the first quarter of 1979 to the second quarter of 1980, the relative price of energy rose 40 percent.[7] Given the estimates above, each shock reduced productivity and potential output by 3.6 percent in the short run and 4.9 percent after adjustment of the market for capital goods.

REVISED MEASURES OF POTENTIAL OUTPUT

To determine potential real GNP, measures of potential employment of labor and capital are used to construct potential private business sector output. Other components of real GNP that are not sensitive to cyclical movements in output and are independent of the employment of labor are then added to obtain potential GNP. The latter components are the output originating in the rest of the world, general government, households and non-profit institutions.

The deviation of actual from potential employment of the nation's capital stock is based on an observation that at peak periods in the past, the Federal Reserve Board capacity utilization rate measure has been about 87.5 percent. This benchmark is used in the private business sector production function for full employment.[8]

The potential input of hours of all persons employed in the private business sector is found by determining potential hours per worker and potential employment. In each case, actual measures are related to a measure of slack in the labor market. This slack measure (UN) is the unemployment rate of the civilian labor force (U), minus the full-employment unemployment rate of the civilian labor force (UF), which was prepared in 1977 for the Council of Economic Advisers (UN = U − UF).[9] Hours per worker in the private business sector are found from the regression of hours per worker on excess unemployment in the current and past quarter, a shift variable (D) to account for the unusually high levels of hours per worker from III/1961 to II/1967, and a time trend (t) to account for a secular decline in hours per worker. For the period II/1948 to III/1981, this equation is:

$$(3)\quad \ln HPW = \underset{(546.1)}{0.797} - \underset{(-6.06)}{0.496}\, UN_t + \underset{(2.16)}{0.177}\, UN_{t-1} - \underset{(-57.06)}{0.001}\, t + \underset{(7.29)}{0.014}\, D$$

$\bar{R}^2 = 0.99 \quad SE = 0.0032 \quad DW = 1.89 \quad \hat{\rho} = 0.62$

This equation has not been changed since 1977, except for the addition of the significant lagged slack

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[6]See John A. Tatom, "Energy Prices and Capital Formation: 1972-77," this *Review* (May 1979), pp. 2-11, for an explanation and derivation of this result.

[7]Note that percentage changes are measured by the change in the logarithm of the relative price of energy. The exact magnitudes over the two periods are 40.7 percent and 40.3 percent, which measured as actual percentage increases are 50.2 and 49.6 percent, respectively. The relative price of energy rose another 12 percent in the first half of 1981 due to the immediate effects of domestic crude oil decontrol, but subsequent adjustments in the world market due to decontrol took 2.8 percentage points off this in the third quarter of 1981 alone.

[8]It can be argued that, at these peaks, "normal" operating conditions for the nation's plant and equipment are not observed and that, if demand were sustained, firms would increase investment to lower operating rates to optimal levels. In this case an 87.5 percent rate for the FRB capacity utilization rate overstates the "natural rate" of capacity utilization. This argument has been made in John A. Tatom, "The Meaning and Measurement of Potential Output: A Comment on the Perloff and Wachter Results," in Karl Brunner and Allan H. Meltzer, eds., *Three Aspects of Policymaking: Knowledge, Data and Institutions*, Carnegie-Rochester Conference on Public Policy, volume 10 (1979), pp. 165-78. The benchmark is supported by comparative movements in "excess" unemployment of the civilian labor force and the capacity utilization rate. When the capacity utilization is regressed on the excess unemployment rate described in the text below over the period I/1955-II/1981, the constant is 86.2 percent with a standard error of 0.78 percentage points when a significant lagged unemployment rate is included.

[9]This data series and its development is described by Peter K. Clark, "Potential Output in the United States 1948-80," *U.S. Productive Capacity: Estimating the Utilization Gap* (Washington University: Center for the Study of American Business, December 1977), pp. 21-66.

term.[10] The sum of the slack terms, −0.32, is virtually identical to the single contemporaneous term in the earlier estimates, so that only the timing of the cyclical effect has been changed. Potential hours per worker is found from the predicted values of equation 3 with the slack variable set at zero in the current and past quarter.

Potential employment in the private business sector is found in a similar manner. In particular, the logarithm of private business sector employment ($\ln EM_t$) is regressed on a constant, a time trend (T), excess unemployment in the current and past quarter, and a trend shift variable (T2) to account for a shift in the trend rate of growth of the labor force after 1964. This particular break in trend was chosen on the basis of the lowest standard error of the equation. A break in trend is included to improve the efficiency of the estimation of the coefficients for the slack variables. The equation for the II/1948-III/1981 period is:

$$\text{(4)}\quad \ln EM = \underset{(371.63)}{3.94} + \underset{(7.21)}{0.002}\,T + \underset{(9.59)}{0.004}\,T2 - \underset{(-11.03)}{0.013}\,UN_t - \underset{(-2.63)}{0.003}\,UN_{t-1}$$

$$\bar{R}^2 = 0.91 \qquad SE = 0.0046 \qquad DW = 1.87 \qquad \hat{\rho} = 0.92$$

When this equation is differenced, the autoregressive disturbances disappear (the Durbin-Watson statistic without first-order autocorrelation adjustment is 1.89), and the coefficients for the trend, break in trend, and slack variables are virtually identical. To find potential employment in the private business sector, the actual level of employment is cyclically adjusted by ($0.13\ UN_t + 0.003\ UN_{t-1}$) percent, according to the level and first-difference equations.[11]

This method of determining potential employment differs from the one this Bank used earlier. Until recently, potential PBS employment was found by subtracting the level of current employment outside the private business sector from potential civilian employment [$(1 - U_F)$ times the civilian labor force]. The former was equated to the difference in actual civilian employment and PBS employment. This method had two minor shortcomings. First, periodic census revisions and changes in sampling and estimation methods alter the civilian labor force and employment data, slightly affecting a measure such as the above and an accompanying measure of potential output. Second, this employment measure was somewhat cyclical, despite the absence of any permanent cyclical effects on the civilian labor force measure. The reason for this appears to be that PBS employment and civilian employment data are estimated by different methods, and their difference is cyclical.[12]

Revised quarterly estimates of potential real GNP are presented in the appendix to this article. These data as well as actual real GNP are shown in chart 2. The growth rate of this revised potential output series has been unchanged for past periods. The average growth rate of potential output was 3.7 percent from 1949 to 1973, the same as in the original estimates. This rate has varied somewhat in the past, however, largely reflecting differences in the growth rate of the labor force. For example, from 1951 to 1963, potential output grew at a 3.3 percent rate while the civilian labor force grew at only a 1.2 percent rate. Potential output growth accelerated to a 4.0 percent rate from 1963 to 1973, as labor force growth accelerated to a 2.1 percent rate.

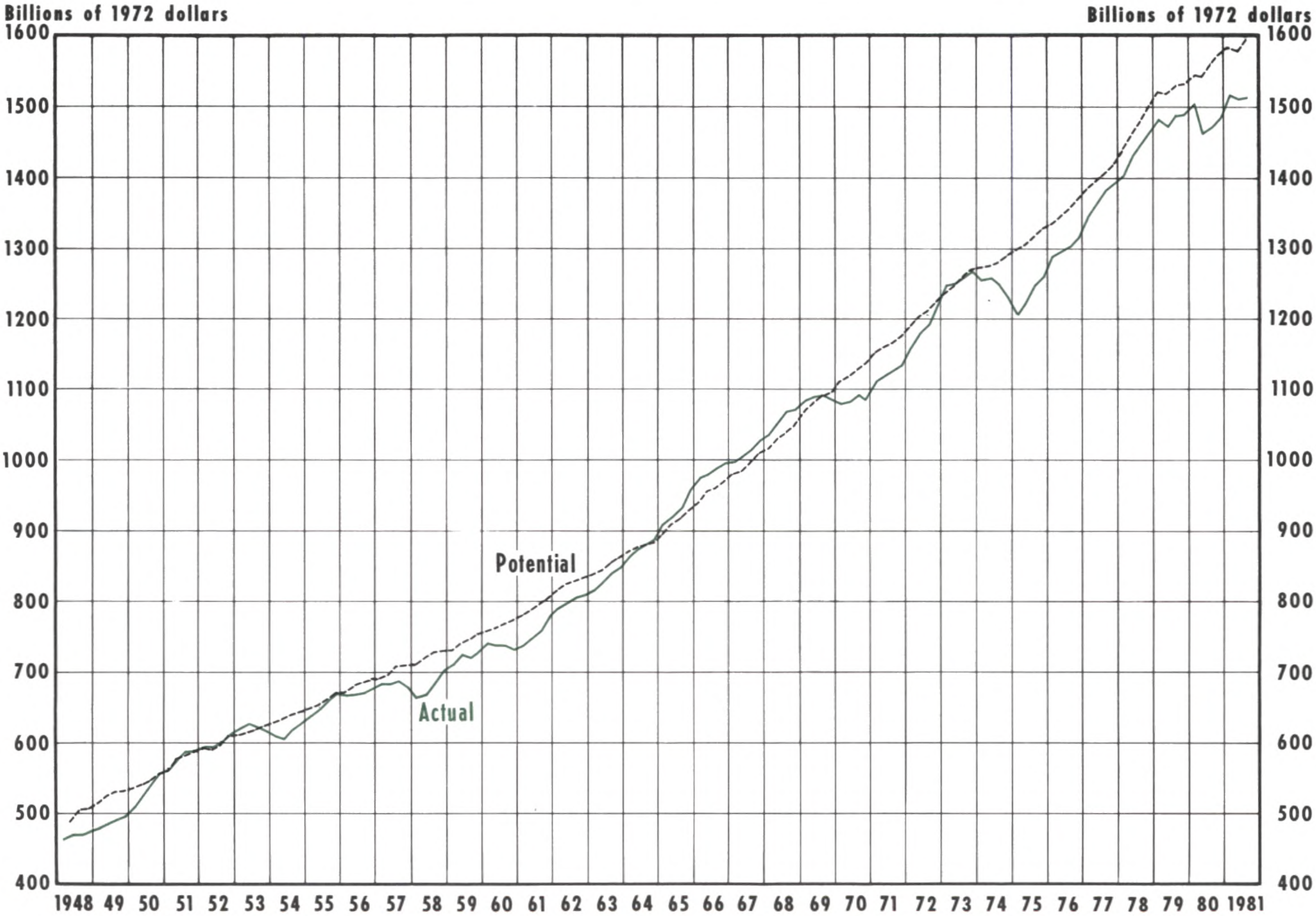
Since 1973, the potential growth rate has averaged 3.1 percent despite a labor force growth of 2.4 percent. The potential output growth rate has been as high as 5.0 percent in 1977-78. The annual growth rate of potential output in 1974 and 1980 was only 2.0 percent; in 1975, this growth rate was only 2.6 percent. These relatively slow rates reflect the impact

[10]This equation was explained in Robert H. Rasche and John A. Tatom, "Potential Output and Its Growth Rate — the Dominance of Higher Energy Cost in the 1970's," *U.S. Productive Capacity: Estimating the Utilization Gap* (Washington University: Center for the Study of American Business, December 1977), pp. 76-77. The unusual shift in hours per worker in the '60s has also been noted by George L. Perry, "Potential Output and Productivity," *Brookings Papers on Economic Activity* (1:1977), pp. 11-47. Tests of additional lagged values of the excess unemployment rate found them to be insignificant.

[11]The effect of a one percent rise in the excess unemployment rate on PBS employment should be roughly a percent decline equal to the ratio of the civilian labor force to PBS unemployment. This may be derived from the relation that PBS employment is (1 — U) LF — NE, where U is the unemployment rate of the civilian labor force (LF), and NE is non-PBS employment, measured by the difference in civilian employment and PBS employment. The actual ratio of the labor force to PBS employment in the sample period has a mean of 1.26. The remainder is due to cyclical variation in non-PBS employment that does not affect non-PBS output.

[12]The difference between establisment-based payroll measures of employment and households-sampling-based civilian employment measures is procyclical so that the old method resulted in a measure of potential PBS employment that was inversely related to excess unemployment. This cyclical difference is discussed by Alexander Korns, "Cyclical Fluctuations in the Difference Between Payroll and Household Measures of Employment," *Survey of Current Business* (May 1979), pp. 14-44.

Chart 2
Real GNP



Latest data plotted: 3rd quarter

Source: U.S. Department of Commerce

of sharp increases in the relative price of energy resources.

Table 4 shows the annual averages of recent levels of potential GNP together with recent estimates by the Council of Economic Advisers (CEA).[13] The CEA estimates range from 1.4 percent below to 1.0 percent above those presented here. The percentage difference between the two measures is virtually the same in 1973 as reported earlier, but the 1977 CEA estimates for the period 1974-76 rose from 1.1 percent larger to almost 3 percent larger than this Bank's estimates. The two estimates are now extremely close, largely due to major revisions in the CEA estimates reported in the *Economic Report of the President* in 1977 and 1978. These revisions pushed the 1973 level below that estimated by this Bank, but then assumed a roughly constant growth rate that was faster in 1974-76, then slower in 1976-79, than that estimated here. The CEA reported in 1981 that potential output was expected to grow at a 2.9 percent rate in 1979 and 1980, then return to a 3.0 percent rate.[14]

[13]See Council of Economic Advisers, *Economic Report of the President*, 1981.

[14]The CEA estimate is apparently based upon the expectation that the labor force will grow at a 1.75 percent rate, hours per worker will decline at a secular rate of 0.5 percent and that potential productivity (output per hour) will rise at about a 1.75 percent rate. See *Economic Report*, 1980, pp. 89-90 and *Economic Report*, 1981, pp. 180-81. Such a rate of productivity advance may appear optimistic in light of the experience since 1978 or in 1973-75. It should be noted, however, that potential

Table 4

Recent Measures of Potential GNP (billions of 1972 dollars)

	Potential GNP	CEA estimate	Ratio
1973	$1,254.8	$1,234.9	98.3%
1974	1,279.7	1,277.5	99.8
1975	1,313.0	1,320.6	100.6
1976	1,351.8	1,365.1	101.0
1977	1,400.6	1,411.4	100.8
1978	1,470.0	1,459.3	99.3
1979	1,526.2	1,504.6	98.6
1980	1,556.2	1,548.5	99.5

The primary difference shown in table 4 is that the CEA growth rate of potential output of 3.4 percent in 1973-76 exceeds the 2.5 percent rate estimated here, while its growth rate for 1976-79 of 3.3 percent is less than the 4.1 percent rate estimated here. It appears that, in recent years, the CEA has smoothed its potential output series to capture the sharp supply shock effects on potential output by lowering the growth rate of potential output over several years. As a result, the levels of potential output have not differed substantially. This difference is to an extent intentional, as the CEA has always employed a given growth rate for long periods. This tendency has been tempered in recent years, as can be seen by the slight variability in the CEA annual growth rate shown in table 4. It may be that the 1980-81 productivity losses that result from energy shocks will be largely reflected in the CEA's use of too slow a rate of potential growth for the early 1980s.

RECENT ACTUAL AND POTENTIAL PRODUCTIVITY DEVELOPMENTS

The sharp drops in potential output growth in 1974-75 and 1980 reflect the effect of major energy price changes on actual and potential productivity.

Table 5

Recent Productivity Developments (compound annual rates)

	IV/1948-IV/1973	IV/1973-IV/1980	Difference
Growth of output/hour	2.87%	0.67%	2.20
Potential growth rate	2.82	0.94	1.88
Cyclical factors	0.09	−0.20	0.29
Residual factors	−0.04	−0.07	0.03
Contribution to potential growth rate of:			
Capital accumulation	0.92	0.28	0.64
(Growth in high-employment capital-labor ratio)	(3.52)	(1.04)	(2.48)
Energy price changes	0.07	−1.13	1.20

Since 1973, productivity's abysmal performance has been a major concern for policymakers. Thus, it is useful to detail the factors influencing such growth over the last seven years.[15]

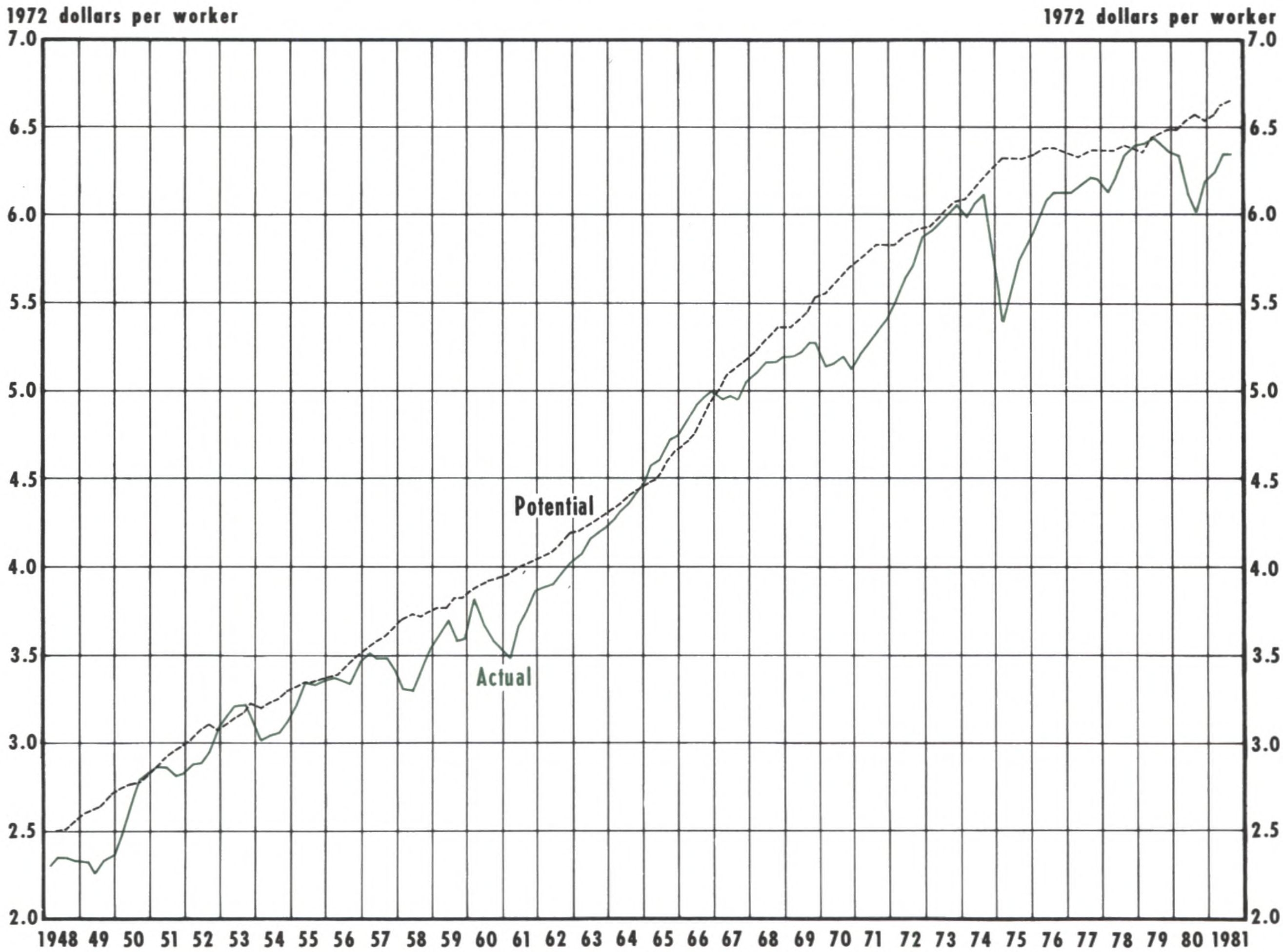
An analysis of the actual and potential productivity decline for the private business sector appears in table 5, where growth rates and the contribution of various factors are compared for two periods: 1948 to the end of 1973, and 1973 to the end of 1980. Output per hour grew at a 2.87 percent rate from IV/1948 to IV/1973, then slowed to a 0.67 percent rate over the next seven years. This growth can be analyzed in two ways. The first is to look at the contribution of the factors entering equation 2: the actual changes in the growth of employed capital relative to labor, the relative price of energy, the pace of technological change, and residuals due to random errors of fitting the equation at the end points of the period. The second, shown in the top panel of table 5, is to break down actual productivity growth in each period into changes due to the growth of potential productivity, changes due to cyclical variations in the employment of capital and labor at the beginning and end periods, and differences in the residual or random error component of equation 2.

output per hour, discussed in the next section, rose over five-year periods at no less than a 2.5 percent rate from 1948-73. Following the implementation of accelerated depreciation and corporate tax cuts, the pace of capital formation rose sharply so that it surged to the post-World War II peak rate of 3.2 percent from 1963 to mid-1970. Even during 1978 potential productivity growth had risen to over a 2 percent rate as the adjustment to the prior energy shock was apparently approaching completion. A repeat of that pattern and recent supply-side policies suggest a more rapid pace of productivity growth from 1982-85 than that projected by the CEA.

[15]In contrast to Edward F. Denison, "Explanations of Declining Productivity Growth," *Survey of Current Business*, (August 1979, part 2), pp. 1-24, the analysis here of post-1973 productivity developments fully explains the productivity "puzzle," while other explanations do not. See Tatom, "The Productivity Problem" or especially Denison's paper for a discussion of these other factors. The puzzle is presumably all the more challenging to other analysts due to the post-1978 cessation of productivity growth.

Chart 3

Capital Labor Ratio (Private Business Sector)



Sources: U.S. Department of Labor, and Board of Governors of the Federal Reserve System

The potential ratio is the capital stock adjusted for an 87.5% capacity utilization rate divided by potential hours of employment in the private business sector. The actual ratio uses the actual capacity utilization rate and hours of employment in the private business sector.

Latest data plotted: 3rd quarter

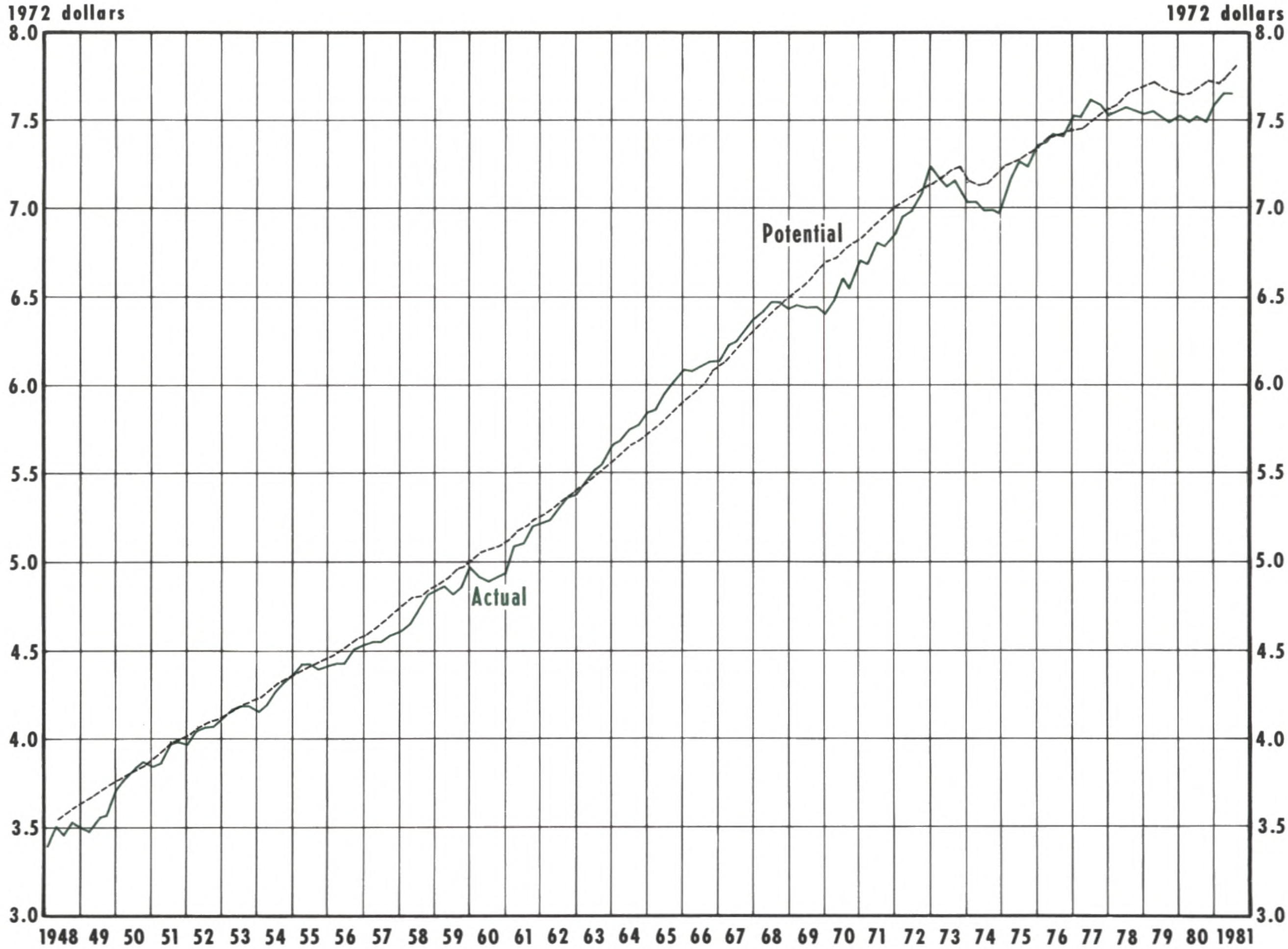
The contribution of cyclical factors accounts for the difference between the productivity effect of the growth of the potential PBS capital-labor ratio (the contribution of the capital-labor ratio to potential growth) and the effect of the actual growth in the utilization of capital per hour. The discrepancy between the two arises from the cyclical variability of the capital-labor ratio shown in chart 3. The sum of the "cyclical factor" and the contribution of "capital accumulation" to potential productivity growth indicates the estimate of the actual impact of movements in the observed ratio of utilized capital to labor hours on the observed productivity growth.

Most of the 2.2 percentage-point decline in productivity growth over the last seven years has been due to factors that slowed potential productivity growth. For the particular comparison shown, cyclical differences between productivity movements in the two periods or residual errors account for only 0.3 percentage points of the observed slowing.

In the lower part of the table, the factors contributing to the potential productivity growth slowdown are shown. What is omitted in the lower part of the table is the trend growth of total factor productivity which contributed 1.82 percentage points to the rate

Chart 4

Potential and Actual Output per Hour (Private Business Sector)



Latest data plotted: 3rd quarter

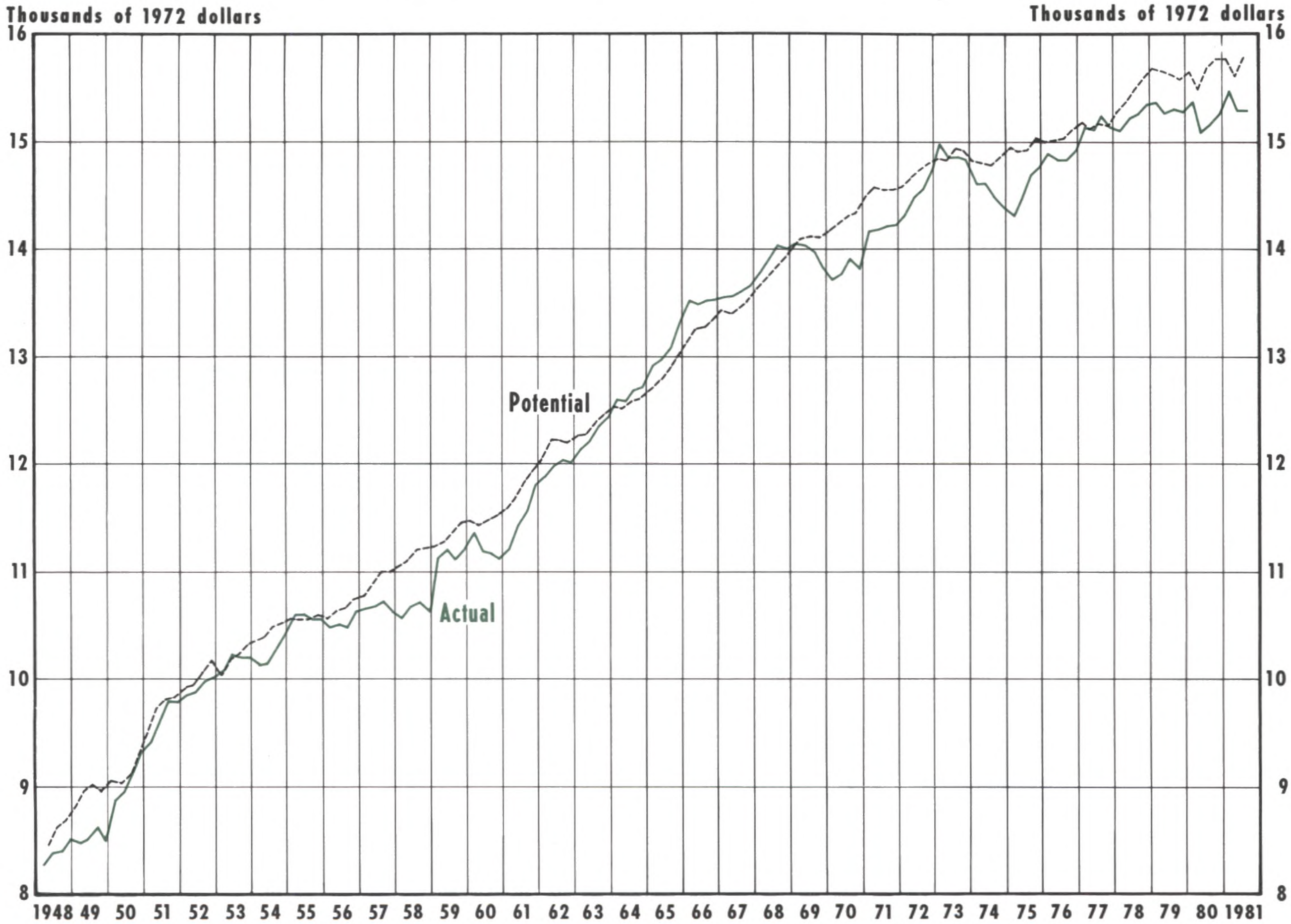
Source: U.S. Department of Labor

of productivity growth in both periods. The direct effect of energy price shocks over the last seven years has been to reverse the slight positive contribution of energy price declines over the prior 25 years, so that 1.20 percentage points of the 1.88 percentage-point-per-year decline in potential productivity growth has been due to this factor. The remainder has been due to a slowing in capital formation.

As noted in parentheses, the growth rate of the capital stock relative to potential hours of employment was 3.52 percent over the 25 years ending in 1973; subsequently, this growth slowed to about one percent. This slowing reduced the contribution of capital formation from a 0.92 percent rate to a 0.28 percent rate over the last seven years. When this result is combined with the effect on productivity growth of cyclical movements in the capital-labor ratio, the result is that capital formation, which added 1.01 percentage points (0.92 + 0.09) to the actual pace of productivity growth from the end of 1948 to the end of 1973, only contributed 0.08 percentage points to the actual rate of productivity growth from the end of 1973 to the end of 1980. Implicitly, cyclical differences between the end of 1973 and 1980 offset the effect of growth in capital per hour, so there was virtually no change in the actual employment ratio.

The small changes in table 4 become quite large when compounded over the seven-year period. For example, the slowing in the potential growth rate over the seven-year period reduces private sector

Chart 5
Real GNP per Civilian Worker



Latest data plotted: 3rd quarter

Sources: U.S. Department of Labor and U.S. Department of Commerce

output by 13.8 percent by the end of 1980. The direct impact of energy price increases alone over these seven years reduces output by 8.3 percent.

Moreover, a large share of the reduction in capital formation since 1973 has been due to energy price developments. The inclusion of the energy price-induced slowing in the desired capital-labor ratio leads to an 11.5 percent loss in output. The remaining loss in potential productivity is associated with a non-energy-related slowing in capital formation.[16]

Finally, it should be noted that table 5 presents a summary view of the effect of energy price changes on actual and potential productivity that does not reflect the actual pattern of events. In particular, the "slowdown" described in table 5 is not continuous. Associated with each energy shock is a once-and-for-all decline in both measures of productivity, with

[16]Factors responsible for the cessation of growth in the utilized capital-labor ratio besides the decline in the productivity of capital due to energy price changes and minor cyclical influences, include such factors as higher expected inflation, inflation uncertainty, and riskier returns due to an increased probability of governmental intervention through regulatory initiatives. See Tatom, "The Productivity Problem." Patric H. Hendershott, "The Decline in Aggregate Share Values, Taxation, Valuation Errors, Risk, and Profitability," *American Economic Review* (December 1981), pp. 909-22, discusses these and other factors that contribute to the slowdown in capital formation and argues that inflation alone has had little impact on the decline in share values and, implicitly, capital formation. Instead he claims that a change in risk premiums (attributed to increased uncertainty about price and regulatory changes) in equity and bond yields and reduced pretax profitability have been the reason for about half the decline in share values. Hendershott does not assess the role of a higher relative price of energy in reducing the pretax real profitability of the corporate capital stock.

temporarily slower growth as the capital-labor ratio is adjusted toward a lower desired level. This pattern is more clearly apparent in chart 4, which shows potential and actual measures of private business sector output per hour. Deviations in the two are predominantly due to the business cycle. The pattern of potential productivity developments in chart 4 shows virtually no growth from mid-1973 to mid-1975 and relatively slow expansion from mid-1975 to mid-1977. Following the second energy shock, potential productivity fell, then was virtually unchanged until the end of 1980. The second phase of a relatively slow pace of potential productivity expansion is apparent in the first three quarters of 1981.

Chart 5 shows an alternative measure of productivity, real GNP per civilian worker, again measured on both an actual and a high-employment basis.[17] The primary difference from chart 4 is the secular rate of decline in hours per worker. Both actual and potential real GNP per worker have flattened out twice relative to the prior trend growth, with a resumption of growth from early 1977 until early 1979. At the end of 1980, potential real GNP per worker stood only 5.7 percent higher than at the end of 1973, so that five years worth of the prior trend growth (2.2 percent rate) has been lost during the past seven-year period.

SUMMARY

Recent revisions in the measures of the nation's output and capital stock, as well as minor changes in procedures, have altered this Bank's measures of potential output. The major conclusions of earlier Bank studies, however, have been unaffected by these changes. In particular, the growth of potential output has been sharply reduced by the 1973-74 and 1979-80 energy shocks and subsequent adjustments in the desired capital intensity of production. These effects have been confirmed by the re-estimation of earlier production function coefficients, and, more important, the confirmation of the prior empirical estimates in the latest round of energy price increases.

The decline in the growth of potential output since 1973 has, in recent years, been acknowledged by the Council of Economic Advisers, but through a trend reduction rather than through sharp temporary declines in 1974-75 and 1979-80 as implied here. Nonetheless, the level of potential output estimated by the CEA in recent years is little different from this Bank's estimate. The slowing in potential output masks a sharper reduction in the growth of productivity in recent years. A detailed analysis of productivity developments shows a marked deterioration in growth relative to past trends. In the measurement of potential output, this deterioration has been partially offset by a more rapid growth of both potential and actual employment.

[17]The high-employment measure of civilian employment is found by regressing changes in the logarithm of the civilian labor force on a constant, a shift for faster labor force growth after 1964 and current and one-lagged changes in the excess unemployment rate. Additional lags are not statistically significant. Moreover, the constraint that the effect of slack is zero after two quarters could not be rejected. The effect of a one percentage-point increase in slack is to increase the labor force by 0.2 percent ($t = 2.34$) in the current quarter and this is offset in the subsequent quarter. To find the high-employment civilian employment, these cyclical effects are added back to the observed civilian labor force and high-employment unemployment (UF) (LF) is removed.

(See appendix on next page)

Appendix

Potential GNP (in billions of dollars)[1]

	I	II	III	IV
1948	NA	$ 489.1	$ 502.9	$ 506.1
1949	$ 515.0	523.6	530.1	532.0
1950	536.1	540.7	546.9	555.7
1951	566.3	576.6	582.9	586.7
1952	592.3	591.4	599.3	609.3
1953	612.8	615.6	617.5	621.6
1954	630.1	634.3	641.0	643.7
1955	648.6	653.5	662.9	672.4
1956	672.3	679.7	683.5	687.8
1957	691.2	698.0	707.7	708.5
1958	710.1	720.8	730.4	731.3
1959	732.0	739.8	746.3	756.0
1960	757.7	763.6	768.4	774.5
1961	782.8	789.2	797.7	806.1
1962	813.7	824.7	828.8	828.9
1963	836.9	843.5	853.7	862.7
1964	870.9	877.1	881.2	884.7
1965	895.9	908.5	918.6	930.7
1966	942.8	955.6	963.2	973.1
1967	981.4	985.3	997.9	1,010.2
1968	1,017.1	1,033.1	1,041.4	1,051.3
1969	1,069.3	1,081.3	1,092.0	1,097.3
1970	1,109.9	1,117.8	1,128.6	1,136.6
1971	1,150.2	1,160.8	1,166.4	1,176.3
1972	1,188.9	1,203.1	1,216.8	1,226.2
1973	1,236.9	1,247.6	1,262.3	1,272.4
1974	1,273.5	1,275.0	1,280.1	1,290.3
1975	1,300.3	1,307.3	1,316.8	1,327.5
1976	1,335.3	1,345.7	1,355.6	1,370.5
1977	1,384.8	1,394.5	1,405.5	1,417.7
1978	1,437.8	1,460.7	1,479.5	1,502.2
1979	1,521.7	1,520.9	1,529.3	1,533.1
1980	1,545.6	1,544.4	1,560.9	1,573.9
1981	1,584.0	1,580.4	1,595.0	

[1]Prepared using data available through November 30, 1981.

The Role of Fiscal Policy in the St. Louis Equation

R. W. HAFER

THE "St. Louis equation" relates the growth of nominal income (GNP) to both the growth of money and high-employment government expenditures. In other words, it attempts to explain changes in GNP by changes in monetary and fiscal actions. One consistent result of estimating the St. Louis equation for the U.S. economy is that monetary actions have a strong and lasting impact on the growth of GNP, while fiscal actions have only a weak and transitory impact; fiscal effects essentially wash out over four or five quarters.

The purpose of this article is to reassess the role of fiscal actions *within the framework* of the St. Louis equation.[1] As a result of updated estimates and tests, strong evidence is presented reaffirming that fiscal actions are inconsequential in determining GNP growth, once the effects of money growth are taken into account.

IN-SAMPLE ESTIMATES

The St. Louis equation is the foundation for the small-scale monetarist model associated with the Federal Reserve Bank of St. Louis. The nature of the equation (as well as the model) is monetarist because GNP growth is determined primarily by the growth of the nominal money stock. Although the equation recognizes and empirically captures the short-run effects of stimulative fiscal actions, previous research has demonstrated that fiscal actions have no *lasting* effect on GNP growth in the St. Louis specification.[2] Not surprisingly, this finding has been the source of a continuing debate.[3]

The St. Louis equation typically is written as

$$(1)\ \dot{Y}(t) = a_0 + \sum_{i=0}^{4} m_i \dot{M}(t-i) + \sum_{i=0}^{4} e_i \dot{E}(t-i) + \epsilon(t),$$

where Y is nominal GNP, M is the money supply and E is the measure of fiscal policy. The dots above the

[1]Alternative specifications of the St. Louis equation provide other frameworks in which the role of fiscal actions could be tested. Our purpose, however, is not to test for the impact of fiscal actions across a broad class of models, but to focus attention on the widely recognized St. Louis specification. An alternative specification may be found in John A. Tatom, "Energy Prices and Short-Run Economic Performance," this *Review* (January 1981), pp. 3-17.

[2]See, for example, Leonall C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," this *Review* (November 1968), pp. 11-24; Leonall C. Andersen and Keith M. Carlson, "A Monetarist Model for Economic Stabilization," this *Review* (April 1970), pp. 7-25; Keith M. Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?" this *Review* (February 1978), pp. 13-19; Keith M. Carlson, "Money, Inflation, and Economic Growth: Some Updated Reduced Form Results and Their Implications," this *Review* (April 1980), pp. 13-19; and Keith M. Carlson and Scott E. Hein, "Monetary Aggregates as Monetary Indicators," this *Review* (November 1980), pp. 12-21.

[3]Earlier works include Richard G. Davis, "How Much Does Money Matter? A Look at Some Recent Evidence," Federal Reserve Bank of New York *Monthly Review* (June 1969), pp. 119-31; E. Gerald Corrigan, "The Measurement and Importance of Fiscal Policy Changes," Federal Reserve Bank of New York *Monthly Review* (June 1970), pp. 133-45; and Edward M. Gramlich, "The Usefulness of Monetary and Fiscal Policy as Discretionary Stabilization Tools," *Journal of Money, Credit and Banking* (May 1971), pp. 506-32. More recent analyses include Alan S. Blinder and Stephen M. Goldfeld, "New Measures of Fiscal and Monetary Policy, 1958-73," *American Economic Review* (December 1976), pp. 780-96; Benjamin M. Friedman, "Even the St. Louis Model Now Believes in Fiscal Policy," *Journal of Money, Credit and Banking* (May 1977), pp. 365-67; Yash P. Mehra, "An Empirical Note on Some Monetarist Propositions," *Southern Economic Journal* (July 1978), pp. 154-67; and Yash P. Mehra and David E. Spencer, "The St. Louis Equation and Reverse Causation," *Southern Economic Journal* (April 1979), pp. 1,104-20.

variable symbolize rates-of-change, a_0, m_i and e_i are parameters to be estimated, and $\epsilon(t)$ is a random error term.[4]

Through the years, various empirical measures of monetary and fiscal actions have been used to estimate the St. Louis equation. Recent redefinitions of the monetary aggregates rekindled the debate about which aggregate best explains GNP growth. Since recent evidence suggests that M1B is the preferred aggregate, it is used in this article.[5]

The consensus choice of the fiscal measure has not yet been resolved. The high-employment federal expenditure measure of fiscal policy is closely associated with the textbook income-expenditure model of the economy.[6] In that model, government purchases of goods and services plus transfers are considered a direct stimulus to nominal aggregate demand. Consequently, an increase in this measure represents an increase in the government's influence on nominal demand and, therefore, nominal income. An alternative, the high-employment federal surplus variable, captures the *net* influence of expenditures and receipts due to the changing patterns in federal government purchases and transfers, and in tax rates. Although other less commonly used measures exist, these two are used in this article to assess the influence of fiscal actions on the growth of GNP.

Equation 1 was estimated using ordinary least squares for the period I/1960-IV/1980; the regression results are reported in table 1. Equations A and B show the results obtained using the growth of the high-employment federal expenditures and the change in level of the high-employment federal surplus, respectively.[7] The results conform with previously reported findings: The summed impact of money growth is not statistically different from unity at the 1 percent level, and the cumulative impact of fiscal actions is not statistically different from zero. The growth of M1B has a significant, sustained influence on the growth of GNP; fiscal actions, measured either as the growth of high-employment federal expenditures or the change in the high-employment federal surplus, do not.

The cumulative impact of the monetary and fiscal variables is statistically comparable with previous results. Indeed, the lag pattern for the money growth variable is essentially the same as Carlson reported for a variety of sample periods.[8] As in previous studies, the impact of money growth on GNP growth is quite rapid: The repercussions of a change in the growth of money occur within two quarters and fade away by the third and fourth lagged quarters.

The lag patterns for the fiscal variables, in contrast, do not compare as well to previously reported findings. When compared with the results for other sample periods, the magnitude of the individual lag coefficients and their significance change dramatically for the fiscal variables. Indeed, it appears that, in addition to having no lasting impact on GNP growth, the fiscal variables exert no significant effect in any quarter. Although econometric difficulties preclude a firm conclusion based on the significance of individual lag estimates, the sensitivity of estimates of the fiscal measures over different sample periods suggests that a GNP-fiscal actions link is dubious. To further examine this issue, three alternative equations were estimated. These equations isolate the relative explanatory powers of the money and fiscal variables on GNP growth. Estimates from these specifications also are reported in table 1.

Equation C reports the estimation of equation 1 using only the money growth variable to explain GNP growth. Not surprisingly, the overall explanatory power of the equation is not diminished substantially by the exclusion of either fiscal policy measure. Moreover, the cumulative impact of money growth on GNP growth is not statistically different from unity over the course of one year. This suggests that the money-GNP link in the St. Louis equation is quite robust. The same cannot be said, however, of

[4]The rate-of-change specification was introduced by Carlson, who demonstrated that the original first-difference specification of Andersen and Jordan introduced econometric difficulties when estimated into the mid-1970s. See Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?"

[5]For evidence of the superiority of M1B, see Carlson and Hein, "Monetary Aggregates as Monetary Indicators;" R. W. Hafer, "Selecting a Monetary Indicator: A Test of the New Monetary Aggregates," this *Review* (February 1981), pp. 12-18; and R. W. Hafer, "Much Ado About M2," this *Review* (October 1981), pp. 13-18.

[6]"High-employment" measures are used to reduce the distortion introduced from the impact of the level of economic activity on actual government receipts and expenditures. See Keith M. Carlson, "Estimates of the High-Employment Budget and Changes in Potential Output," this *Review* (August 1977), pp. 16-22.

[7]The changes in the high-employment federal surplus variable scaled by income also was used as an alternative measure of fiscal actions. The conclusions reached in the article were not altered by this change.

[8]See Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?" and Carlson, "Money, Inflation, and Economic Growth."

Table 1

Regression Results for Alternative St. Louis Equations, I/1960-IV/1980

	Equations Tested[1]				
Coefficients	A	B	C	D	E
Constant	2.46 (2.17)	2.69 (2.69)	2.80 (2.84)	6.02 (5.42)	8.52 (18.13)
m_0	0.401 (3.40)	0.359 (2.82)	0.422 (3.73)		
m_1	0.393 (5.07)	0.349 (3.92)	0.397 (5.28)		
m_2	0.225 (2.21)	0.200 (1.87)	0.218 (2.16)		
m_3	0.062 (0.85)	0.061 (0.74)	0.065 (0.90)		
m_4	−0.013 (0.11)	−0.001 (0.00)	0.007 (0.06)		
Σm_i	1.067 (5.53)	0.969 (3.50)	1.109 (6.30)		
e_0	0.062 (1.46)	−0.006 (0.13)		0.086 (1.70)	−0.031 (0.61)
e_1	0.020 (0.62)	−0.031 (0.84)		0.047 (1.22)	−0.006 (0.13)
e_2	−0.021 (0.58)	−0.058 (1.47)		0.016 (0.38)	−0.059 (1.23)
e_3	−0.018 (0.54)	−0.072 (1.94)		0.039 (1.02)	−0.090 (2.00)
e_4	0.014 (0.33)	0.057 (1.33)		0.076 (1.54)	−0.073 (1.39)
Σe_i	0.056 (0.59)	−0.225 (1.63)		0.265 (2.50)	−0.196 (1.18)
$\overline{R}^2$	0.349	0.361	0.355	0.055	0.017
SE	3.493	3.460	3.477	4.209	4.291
DW	2.02	2.07	2.02	1.52	1.47

[1]All equations estimated using a fourth-degree Almon polynominal lag with both end points constrained to zero. Equations A and D use high-employment federal expenditures; equations B and E use high-employment federal surplus. M1B is the money measure used throughout. Absolute values of t-statistics appear in parentheses; $\overline{R}^2$ is the coefficient of determination corrected for degrees of freedom, SE is the regression standard error and DW is the Durbin-Watson statistic.

the empirical relationship between the fiscal actions and GNP.

Equations D and E in table 1 report the results of regressing GNP growth on the growth of high-employment expenditures and changes in the level of high-employment surplus, respectively. In equation D, the estimated coefficients are noticeably different from those in equation A. The first lag coefficient is more than double the estimate from equation A, and the second and third lag terms are positive. More important, the cumulative impact for the expenditures variable is *positive* and statistically significant at the 5 percent level. Unfortunately, these results are marred by the existence of significant first-order serial correlation among the residuals, evidenced by the low Durbin-Watson (DW) statistic.

The presence of significant serial correlation in equation D provides important information. One potential cause of serial correlation is the omission of an important explanatory variable which is cyclical. The consequence of such an omission is that the error term will absorb the cyclical pattern of the variable, and the successive error terms will not be random. It is clear from a comparison of equations A and D that the excluded variable is the growth of M1B: Adding money growth to equation D eliminates first-order serial correlation. If one assumes that equation A is the "correct" specification, the model represented by equation D (because it is misspecified) yields coefficient estimates that may be seriously biased and significance tests of questionable efficacy. Thus, the evidence provided by equation D does not support the existence of a significant, lasting affect on GNP growth of fiscal actions captured by the growth of high-employment expenditures.

Equation E in table 1 presents the results of regressing GNP growth on changes in the high-employment federal surplus. In line with *a priori* reasoning, the results suggest that an increase in the size of the high-employment surplus retards GNP growth. Although the summed impact of the surplus variable is of the appropriate sign, it is not statistically different from zero. This variable does not exert a significant, lasting effect on GNP growth, a finding consistent with equation B. The presence of serial correlation, however, again suggests the possibility of a misspecification. This is evidenced by comparing equations D and B: The addition of the money growth variables removes the serial correlation problem. This result indicates that equation E, like equation D, is misspecified without the money variable.[9]

Any uncertainty about the relative impact of monetary and fiscal actions on GNP growth can be dispelled further by a comparison of equations A, B and C in table 1. This comparison allows us to address the question "Given the influence of monetary actions on GNP growth, does the information contained in the fiscal variables significantly improve upon money's explanatory power?"

To answer this question, one need only examine the reported t-statistic for the relevant summed variables. For example, equations A and B indicate that *adding* the fiscal variables to the GNP money regression does not significantly improve the explanatory power: The t-statistics for the respective Σe_is are not greater than normally acceptable critical values. These results indicate that, once the influence of money growth is accounted for, the addition of the fiscal variables does not statistically improve the explanation of GNP growth. These results further point to the statistical dominance of money growth over either fiscal measure in explaining changes in GNP growth.

STABILITY AND CAUSALITY TESTS

The results of two additional statistical tests are reported in this section. The first test examines the stability properties of the alternative specifications reported in table 1. The second test provides some evidence about the causal ordering of the monetary and fiscal variables with respect to GNP growth.

To test the temporal stability of the equations presented in table 1, the I/1960-IV/1980 sample period was split at II/1970 (the mid-point of the sample) and the Chow test was applied. The test results are reported in table 2.[10]

The Chow test results indicate that the stability hypothesis is rejected *only* for the regressions of GNP growth on the two fiscal variables, that is, equations D and E: The calculated F-statistics exceed the relevant 5 percent critical value. The calculated F-statistics for the equations that include money growth or use money growth alone to explain GNP growth indicate that they provide structurally stable parameter estimates across the I/1960-IV/1980 period. These findings imply that the relationship between GNP growth and money growth has remained relatively stable across the 20-year sample period. On the other hand, they suggest that the effects of fiscal actions on GNP growth are uncertain and may be quite different across economic environments.

The second test examines the statistical causal ordering between the monetary and fiscal variables and GNP growth. This test procedure, developed by Granger, involves estimating a set of equations for each pair-wise test.[11] To test for Granger causality, it is assumed that the information relevant to the prediction of the respective variables is contained solely in the data series Y and X (e.g., GNP and money or fiscal variables). The test procedure consists of estimating the equations

$$(2)\quad Y(t) = \sum_{i=1}^{n} \alpha_i X(t\text{-}i) + \sum_{j=1}^{n} \beta_j Y(t\text{-}j) + \epsilon(t)$$

and

$$(3)\quad X(t) = \sum_{i=1}^{m} \lambda_i X(t\text{-}i) + \sum_{j=1}^{m} \delta_j Y(t\text{-}j) + \eta(t).$$

It is assumed that $\epsilon(t)$ and $\eta(t)$ are uncorrelated error series. Unidirectional causation from X to Y is

[9]The reader may note that equation C, the specification employing only the money growth variable, is not beset by the problems of serial correlation. This, along with the textual evidence, strongly suggests that the misspecification problems affect only the regressions of GNP growth on fiscal variables.

[10]The mid-point was chosen to maximize the power of the test. On this point, see John U. Farley, Melvin Hinich and Timothy W. McGuire, "Some Comparisons of Tests for a Shift in the Slopes of a Multivariate Linear Time Series Model," *Journal of Econometrics* (August 1975), pp. 297-318. The Chow test may be inappropriate given the existence of serially correlated errors, as evidenced in equations D and E. Even so, the stability test results in table 2 are based on the ordinary least squares estimation found in table 1 as a matter of consistency. Using GLS estimates of equations D and E in table 1 indicates that the stability hypothesis still is rejected at the 5 percent level: The F-statistics are 3.02 and 3.44 for the GLS estimates of equations D and E, respectively.

[11]C. W. J. Granger, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica* (July 1969), pp. 424-38. For a useful comparison of various causal tests, see Edgar L. Feige and Douglas K. Pearce, "The Casual Causal Relationships Between Money and Income: Some Caveats for Time Series Analysis," *Review of Economics and Statistics* (November 1979), pp. 521-33.

Table 2
Stability Test Results for GNP Equations, II/1970 Break Point

Equation[1]	Calculated F-statistic	Reject Stability[2]
A	1.63	No
B	1.62	No
C	1.53	No
D	2.83	Yes
E	3.62	Yes

[1]See table 1 for description of alternative equations.
[2]Based on 5 percent critical value (F(7,70) = 2.14).

Table 3
Granger Test Results

Exogeneity test[1]	Calculated F-statistic	Reject exogeneity of policy variable
$\dot{M} \rightarrow \dot{Y}$	2.68[2]	No
$\dot{Y} \rightarrow \dot{M}$	0.56	
H$\dot{E}$GE $\rightarrow \dot{Y}$	1.10	Yes
$\dot{Y} \rightarrow$ HE$\dot{G}$E	0.24	
$\triangle$HEGS $\rightarrow \dot{Y}$	0.66	Yes
$\dot{Y} \rightarrow \triangle$ HEGS	2.92[2]	

[1]The arrow indicates hypothesized direction of causality.
[2]Significant at 5 percent critical value (F(4,71) = 2.50).

implied if the estimated coefficients on the lagged X variable in equation 2 are statistically different from zero as a group and the set of estimated coefficients on the lagged Y variable in equation 3 is not statistically different from zero. Conversely, unidirectional causation from Y to X exists if the set of lagged X coefficients in equation 2 is not statistically different from zero and the set of lagged Ys in equation 3 is statistically non-zero as a group. Feedback is suggested when the sets of X and Y coefficients are statistically significant from zero in both equations 2 and 3. Independence occurs when the sets of X and Y coefficients are not significant in equations 2 and 3.

The Granger test results, based on the I/1960-IV/1980 sample, are reported in table 3.[12] The first pair-wise test is done with money growth and GNP growth ($\dot{M}$,$\dot{Y}$). The calculated F-statistics suggest that there is unidirectional causation from money to GNP.[13] In the second bivariate test, with the growth of high-employment government expenditures (HE$\dot{G}$E), neither F-value surpasses the 5 percent critical value. These results suggest that the growth of high-employment expenditures and GNP growth are independent. The last test, which uses the change in the high-employment government surplus variable ($\triangle$HEGS), indicates that unidirectional causation from GNP growth to changes in the surplus measure cannot be rejected.

To summarize, the statistical evidence suggests that money growth causes GNP growth. The findings presented here provide no empirical support for the "reverse causation" argument. The evidence about the relationship between fiscal measures and GNP growth, however, suggests that GNP causes fiscal actions. This is true specifically for the surplus measure; the outcome for the expenditures variable indicates no causal relationship in either direction (independence). These findings indicate that there is no *reliable* relationship between GNP growth and the fiscal measures used in this article. The preceding Chow test results support this conclusion by showing that only the relationship between money and GNP is statistically stable across the entire sample period.

POST-SAMPLE ESTIMATES

The final piece of evidence used to assess the relationship between GNP growth and monetary/fiscal actions is a comparison of the relative post-sample predictive abilities of selected equations found in table 1. To this end, each equation initially was estimated from I/1960 through IV/1970. Four-quarter-ahead estimates of GNP growth were then generated using actual values of the money and fiscal measures over this period. The

[12]The estimated equations consist of four lagged dependent variables and four lagged "causal" variables. Because the Granger test requires the data to exhibit stationary characteristics, a linear time trend and seasonal dummies were entered into the estimated regressions. Moreover, the full-period results are based on the finding of no structural break in the estimated test equations. For a further discussion and application of the Granger test, see Hafer, "Selecting a Monetary Indicator."

[13]This finding is supported by previous empirical research. See Christopher A. Sims, "Money, Income, and Causality," *American Economic Review* (September 1972), pp. 540-52; Mehra and Spencer, "The St. Louis Equation and Reverse Causation;" and Hafer, "Selecting a Monetary Indicator." Contrary findings are presented in Feige and Pearce, "Casual Causal Relationships."

Table 4

Post-Sample Prediction Errors of GNP Growth[1]

Sample period from I/1960 to fourth quarter:	Equation: Money only	Money growth and high-employment expenditures	Money growth and high-employment surplus
1970	0.22%	0.20%	−0.31%
1971	2.06	1.58	1.98
1972	1.35	2.07	1.10
1973	−1.18	−1.83	−0.18
1974	2.28	2.01	0.69
1975	0.41	0.65	1.70
1976	1.23	1.14	1.36
1977	2.58	2.80	2.94
1978	−1.83	−1.94	−0.48
1979	−0.11	−0.60	−1.48
Average Error	0.70%	0.61%	0.73%

[1]Errors are actual less predicted and are calculated for the four quarters following the sample period.

estimation period was then extended to include the four quarters of 1971, and four-quarter-ahead forecasts for 1972 were constructed. This procedure was continued each year through 1980. The average errors in predicting GNP growth are presented in table 4. Since the purpose of these comparisons is to determine if the alternative fiscal policy measures add anything to the estimates of GNP growth *once money growth is known*, results for three equations are presented: money only, money and high-employment expenditures, and money and high-employment surplus.

The results in table 4 indicate that, on average, money alone (equation C) results in GNP growth prediction errors that are less than 1 percentage point. The addition of the expenditures measure of fiscal policy (equation A) leads to only a marginal reduction in the average error, while the addition of the surplus measure (equation B) leads to a marginal *increase* in the average forecast error. Although these changes may appear rather substantial, tests reveal that the average errors for the alternative specifications are not statistically different. In fact, the calculated t-statistics comparing the averages are all less than unity.[14] Based on the equations' relative predictive abilities, therefore, one would do just as well, on average, to use only money growth to predict future GNP growth as using money growth and either of the two fiscal policy measures examined in this article.

CONCLUSION

This paper has re-examined the role of fiscal policy in the context of the St. Louis equation. The results are broadly consistent with previous findings. Specifically, fiscal actions exert neither a significant nor lasting impact on the growth of GNP.

Augmenting previous work, however, the results here provide further evidence against the reliance on fiscal policy measures to explain movements in GNP. Three conclusions can be drawn from these test results: The fiscal policy measures 1) do not significantly increase the explanatory power or forecasting ability of an equation that already incorporates money growth; 2) do not exhibit stable statistical relationships with GNP growth; and 3) are not exogenous with respect to GNP growth. The evidence suggests that fiscal actions are ineffective for stabilization purposes. Moreover, the results add increasing stature to the use of monetary policy as a tool in stabilizing fluctuations in economic activity.

[14]For instance, the t-statistic comparing the average error term from the "money only" regression to that using money and the expenditures variable is 0.14. The statistic comparing money only and the regression using the surplus measure is −0.50. Comparing the mean forecasts generated by the two fiscal equations yielded a t-statistic of −0.19.

Food and Agriculture — Current Situation and Prospects for 1982

CLIFTON B. LUTTRELL

THIS article is largely a summary of the United States food and agricultural outlook for 1982 as discussed at the Annual National Agricultural Outlook Conference in November 1981. The overall outlook for this year is for increased production and lower prices for most farm products. Retail food prices, which rose about 8 percent last year, are likely to rise at an even slower rate in 1982.

In addition to the prospective impact of larger farm commodity supplies, agricultural prices will also be affected by a slowing in the growth of overall food demand this year. Restrictive domestic monetary policies designed to reduce inflation will tend to reduce the growth in domestic demand. Similar restrictive monetary policies in a number of foreign countries point to a sluggish foreign demand for U.S. farm products.

Despite the expected relatively low prices of farm products and the rising farm production costs, the quantities of most commodities available, such as cereals and bakery products, beef and veal, and fresh fruits and vegetables, are likely to rise further in 1982. A record 1981 feed grain crop boosted 1981-82 feed grain supplies to 280.1 billion tons, 11 percent above last year. Large feed grain supplies and lower feed prices will induce farmers to maintain livestock production at a relatively high level. Wheat and rice supplies are at record levels and a large potato crop was harvested. Of the major crops, only the 1981 fruit crop was somewhat smaller than a year ago. Thus, the overall farm and food outlook for this year is for increased output of farm products, especially livestock products, and relatively large food supplies.

Net farm income after inventory adjustments rose in 1981 to about $22 billion or about $2 billion above the 1980 total. Net income in 1982 will be determined chiefly by returns on crops to be planted later this year. However, it may decline from last year's level, especially if there are further increases in crop inventories in the 1982-83 crop year.

OUTLOOK FOR AGRICULTURE

Economic conditions in the farm sector in 1982 are likely to change very little from 1981, especially for the next several months. The supply of farm products relative to demand is expected to remain relatively high and, despite further overall inflation, farm commodity prices will probably increase little, if any. Production expenses, while rising at a slower rate than a year ago, are expected to continue to increase, resulting in little change in net cash receipts through mid-year.

The success of 1982 crops, however, will be a major factor in determining conditions in the last half of the year. Because the demand for crops is relatively inelastic in the short run, another large crop will result in a further decline in relative prices of farm products and lower real farm income. A small crop, however, could lead to an increase in farm prices and incomes.

Recent Production and Price Movements

To some extent, the overall outlook for food and agriculture this year is related to the relative prices of these commodities vs. other commodities. This relationship is clearly observable in the growth rates of crop and livestock production during recent decades. Production of all farm products in the United States rose at about 2.5 percent per year through the 1970s, following a relatively slow growth rate of about 0.6 percent per year in the last half of the 1960s (table 1). The higher growth rate for farm products in the 1970s followed relatively higher farm product prices, especially in the first half of the decade.

During the 1965-70 period, the price of all farm products rose on average only 2.4 percent per year, compared with an average increase of 4.2 percent per year for the consumer price index. This decline in relative price of farm products, especially for crops, reduced the incentives for production.

The increase in export demand for farm products in the early 1970s, coupled with the reduced stocks of crops held by the government in price support operations, led to a sharp turnaround in the prices of farm products compared with general prices. During the 1970-75 period, the average prices of all farm products rose sharply (11 percent per year) and production quickly increased in response. Overall farm output, as shown in table 1, rose at a 2.45 percent rate in the first half of the 1970s, compared with a 0.6 percent rate during the previous five years.

Crop production growth was greater than livestock production during the 1970s, reflecting the relatively larger rise in crop prices, especially during the first half of the decade. During the 1970-75 period, crop production rose at a 3.89 percent rate compared with −0.77 percent for livestock production. In contrast, during the last half of the 1960s, livestock output increased at a 2.02 percent rate compared with a 0.20 percent rate of increase for crops.

The government held large inventories of crops acquired in price support operations during the 1960s. As inflation accelerated in the late 1960s, however, government price supports for these products failed to keep pace with general inflation, and government-held stocks were reduced. The value of farm commodities owned by the government (largely crops) declined from $4.1 billion at the end of 1965 to $1.6 billion at the end of 1970.[1] Partly as a result of this reduction in government stocks, crop prices declined both in nominal terms (−0.6 percent per year) and relative to other prices.

Table 1

Rates of Change of Production and Prices of Farm Products

	Percent changes, annual rates[1]		
	1965-70	1970-75	1975-81
Prices			
All farm products	2.4%	11.0%	5.5%
Livestock	4.7	7.8	6.7
Crops	−0.6	15.0	4.5
Consumer prices	4.2	8.0	8.0
Production			
All farm products	0.60	2.45	2.47
Livestock	2.02	−0.77	2.04
Crops	0.20	3.89	3.41

[1]Beginning year average to ending year average.

SOURCE: U.S. Department of Agriculture, *Agricultural Statistics* (1980), and *Agricultural Outlook* (1981).

Following the sharp increase in exports (largely crops) and the decline of stocks in the early 1970s, crop prices rose at a 15 percent rate and livestock product prices at a 7.8 percent rate.[2] During this period, the annual rate of inflation as measured by the consumer price index was 8.0 percent. A sizable change in the relative production of crops and livestock followed: Crop output rose at a 3.89 percent rate while livestock output declined at a 0.77 percent rate. This decline reflected the higher-priced feed and the slower growth in demand for livestock products.

During more recent years, 1975-81, the growth rate of export demand for crops has declined, and agricultural prices, which remained relatively high

[1]U.S. Department of Agriculture, *Agricultural Statistics* (1980).

[2]For an analysis of the rise in export demand, see Clifton B. Luttrell, "Rising Farm Exports and International Trade Policies," this *Review* (July 1979), pp. 3-10.

into the last half of the decade, now have declined relative to other prices. Growth in the average price of all farm products decelerated during the 1975-81 period to a 5.5 percent rate compared with the general inflation rate of 8 percent as measured by the consumer price index. The price of livestock products, however, rose at a faster rate than crops, and livestock production accelerated somewhat from the 1970-75 rate. Nevertheless, partly as a consequence of the favorable 1981 weather, crop output rose at a faster rate than livestock output.

Incentive for Farm Production

Agricultural prices in late 1981 were relatively low when compared with the general price level. For example, late in the fourth quarter, farm product prices were 8 percent below levels of a year earlier and only 26 percent above their 1977 average. In contrast, the consumer price index was about 10 percent above a year earlier and 54 percent above its 1977 average. Moreover, prices paid by farmers for production items were about the same as a year earlier and 46 percent above the 1977 average.

While there is less incentive for increased overall farm production this year than last, supply and demand factors are more encouraging for livestock producers than for crop producers. Large feed supplies and accompanying relatively low feed prices mean lower feed cost for livestock producers and, consequently, some improvement in livestock returns relative to those for crops. Average crop prices in the fourth quarter of 1981 were down 15 percent from a year earlier, while livestock prices were down only 10 percent.[3] Similarly, a comparison of recent prices with the average for 1977 shows that, during this period, the average price of livestock products rose 33 percent while that of crops increased only 19 percent.

Meat Animals and Poultry

A relatively high level of meat and poultry production is expected later this year following a slight reduction in output during the first quarter.

Beef production is likely to increase 2 percent to 4 percent. The slaughter of nonfed cattle is expected to remain large, and placements of cattle in feedlots are likely to expand from the relatively low number currently on feed.

Although *pork* production in early 1982 will likely be greater than was projected last autumn, slaughter for the year is expected to be 4 percent to 6 percent less than a year ago. Based on intended farrowings, however, the slaughter level in late 1982 may equal that of late 1981.

Despite the more favorable feed prices this year, *broiler* producers are planning only a small expansion for 1982. This follows an 11 percent increase last year, when sizable losses were incurred on much of the output as the larger than expected pork supplies depressed poultry prices.[4] Broiler output will likely continue above 1981 levels in the first part of this year but may decline to 1981 levels in the fourth quarter. Turkey production in 1982 is likely to be lower than 1981 production as a result of reduced prices and relatively low net returns last year.

Given the prospective supply of and demand for meat and poultry, 1982 average prices of these products are not expected to greatly exceed the average of 1981. Choice beef prices are expected to increase only moderately through the first half of the year and may average only 1 percent to 2 percent above the range of the past two years. Hog prices in the first half of the year are expected to average about 10 percent above the 1981 level but are likely to be only moderately higher in the second half of the year. Broiler prices are expected to average slightly higher than last year, lower in the first half and higher in the second. Turkey prices are expected to rise to about 70 cents per pound in the second half of the year, up from 55-56 cents per pound in late 1981.

Dairy Products and Eggs

Reflecting the relatively high government price supports ($13.10 per hundredweight (cwt.) for 3.67 percent milk) and lower feed prices, milk production is expected to increase, at least in the first half of 1982. The U.S. Department of Agriculture projects that dairy output may decline from year-earlier levels in the second half of the year, but equal last year's output for the year as a whole. An industry report given

[3]U.S. Department of Agriculture, *Agricultural Outlook* (December 1981).

[4]Pork is a good substitute for poultry. Hence, with large pork supplies and relatively low pork prices, consumers tend to substitute pork for poultry in their diets. This results in reductions in the demand for and price of poultry as well.

at the outlook conference, however, points to a further rise in milk production of 2 percent from the record 1981 level.[5]

In either case, production of dairy products is expected to exceed domestic consumption plus exports in the first half of 1982, which will result in further additions to government stocks through price support operations. Government purchases in price support operations on a milk equivalent basis totaled about 11 percent of production in the first three quarters of 1981 and such purchases will remain large. Industry estimates of the cost to taxpayers of such purchases are as high as $2.5 billion. Milk prices for all of 1982 are expected to average about 1 percent above 1981. With favorable feed costs in prospect, dairy farmers should realize higher net returns.

Egg producers have been reducing the number of replacement pullets as a result of unfavorable price relationships since early 1980. Egg production, however, has been maintained by producers keeping their hens in production longer. Production in late 1981 was down slightly from 1980 levels, and may continue below year-earlier levels through mid-1982. With somewhat higher egg prices in prospect, production is likely to rise in the second half of the year and equal last year's level for the entire year. Egg prices are expected to average about 74 cents per dozen for the year, up from 70 cents per dozen in 1981.

Crops

As a result of record crops of wheat, coarse grain and rice this marketing year, world supplies of most crops are well above their 1980/81 levels. These larger supplies have led to lower average prices and less incentive for production growth in 1982. Nevertheless, weather is a major factor in crop production, and weather conditions as the crop develops will be a major factor in determining both the size of the 1982 crop and the average prices received by farmers.

Food Grains (Wheat and Rice)

The 1981 record *wheat* crop of 2.75 billion bushels, up 16 percent from 1980, combined with a relatively large June 1981 carryover, provides a 1981/82 market supply of 3.74 billion bushels. This is 14 percent above the previous record of 1980/81.

Export demand for U.S. wheat is expected to rise as a result of relatively small crops in the Soviet Union and Eastern Europe. Wheat exports are projected at a record 1.9 billion bushels, up from 1.5 billion last year and an average of 1.05 billion for the 1970/79 decade. Increased shipments are in prospect to the Soviets, India, Brazil, Iran and Morocco, but China is expected to remain the largest U.S. wheat customer. Hence, the average farm price for 1981/82 wheat may remain near that of last year, despite the increased short-run supply.

Stocks of wheat at year-end are expected to be down to about 908 million bushels from 991 million bushels last year, reflecting the increased exports. Nevertheless, the Secretary of Agriculture last September announced plans to implement a reduced acreage program for the 1982 wheat crop.

Rice production in 1981 was estimated at 178.8 million cwt., 12 percent above the prior 1980 record level. This plus carryover stocks results in a total rice supply of 195.4 million cwt. for the 1981/82 marketing year, or 14 percent more than the previous 1980/81 record.

Rice exports for 1981/82 are projected at 79.0 million cwt., down from 91.4 million last year, with domestic use at 56.5 million cwt., up 3.8 percent from last year. Hence, year-end stocks are likely to total 55 million to 60 million cwt., well above last year's carryover.

Because of record production, carryover stocks and the expected decline in export demand, the season-average price of rice is expected to decline to about $10 per cwt., $2 per cwt. below last year's price. Hence, with a target price (below which deficiency payments are made to eligible farmers) of $10.68 per cwt. in effect, deficiency payments by the government to eligible producers are expected.

Feed Grains (Corn, Oats, Barley, Sorghum Grain)

The U.S. feed grain supply of 280.2 million metric tons is about 10 percent more than a year ago. A record crop of 245 million tons, 3 percent above the previous 1979 record crop and 24 percent above the 1980 crop, was produced. Corn production, about four-fifths of total feed grain, was up 22 percent.

With the large crop, the supply of feed grain increased faster than demand, and the price declined. Corn prices are expected to average only about

[5]E. Linwood Tipton, *Dairy Outlook, Production Consumption Estimates 1982* (Government Printing Office).

Table 2
Changes in Per Capita Consumption of Major Food Products

Food Group	1980 consumption in pounds (retail weight)	Percent change in 1978	1979	1980	1981 (Preliminary)	1982 (Forecast)
All foods	1408	−0.4%	0.8%	−0.9%	−1.4%	1%
Cereals and bakery products	150	−1.1	3.8	−0.5	0.7	1
Beef and veal	78	−5.7	−10.9	−2.3	0.4	2-3
Pork	68	0.2	14.1	7.1	−7.0	−6
Poultry	61	4.7	8.4	0.2	2.0	0
Eggs	35	1.8	2.0	−2.0	−3.4	−2
Dairy products	308	0.4	−0.6	−3.0	0.0	1
Fresh fruits	84	−1.8	3.4	4.0	−3.0	1
Fresh vegetables	207	−0.7	1.9	0.9	−3.0	5
Processed fruits and vegetables	142	0.9	1.5	−2.8	−1.5	−5
Sugar and sweets	133	0.7	1.5	−2.7	−2.0	1-2
Fats and oils	55	3.4	2.5	0.4	−0.8	1-2
Nonalcoholic beverages	11	7.7	3.7	−5.0	3.6	1

SOURCE: U.S. Department of Agriculture, *The Current Food Situation and Outlook for 1981.*

$2.60-$2.90 per bushel for the year, down from about $3.10 per bushel last year.

Exports are likely to be up somewhat, 74 million metric tons compared with 69 million in 1980/81, and domestic use may increase from 147 million to 156 million metric tons. Nevertheless, a 50 million metric ton carryover is estimated for this year, well above the 35 million last year.

Fats and Oils (Soybeans and Cottonseed)

Soybean production of 2.1 billion bushels last year was 415 million bushels more than in 1980. Coupled with relatively large beginning stocks, the total quantity available for 1981/82 was boosted to 2.4 billion bushels. This is 13 percent above a year ago and only 1 percent below the record 1979/80 level. With the large supply available and no major increase in demand, prices to farmers have declined from year-ago levels and are expected to average from $5.50 to $7.00 per bushel for 1981/82, well below the $7.61 estimated for 1981.

Cottonseed production may reach a record 6.2 million short tons. When added to last year's very small carryover of 0.4 million short tons, supplies this year will total a relatively large 6.6 million short tons. Prices for cottonseed averaged $105.50 a ton during the early autumn or $10 per ton less than a year earlier. The season average price is forecast at $110 a ton, 12 percent less than last year, due to the relatively large supply of cottonseed and soybeans, which is a good substitute for cottonseed.

Cotton

The relatively large 1981 cotton crop of 15.5 million bales (480 pounds per bale) plus a 2.7 million bale carryover provides 18.2 million bales for domestic consumption and export during 1981/82. With domestic cotton consumption estimated at 6.2 million bales and exports at 7.0 million bales, carryover stocks at the end of 1981/82 are projected to be relatively high at 5.0 million bales.

Cotton producers receive a deficiency payment by the government if the 1981 calendar year average price of upland cotton is less than the target price of 70.87 cents per pound. Such deficiency payments may be relatively large for the 1981 crop as the September price for upland cotton was only about 63 cents per pound.

Tobacco

Tobacco production in 1981 was estimated at 2.01 billion pounds, up 13 percent from a year earlier. The large crop and some increased carryover indi-

Table 3

Changes in the Consumer Price Index of Food

Component	Relative importance in food CPI	Percent change in 1978	1979	1980	1981 (Preliminary)	1982 (Forecast)
Food	100.0%	10.0%	10.9%	8.6%	8.2%	7%
Food away from home	30.7	9.0	11.2	9.9	9.3	8
Food at home	69.3	10.5	10.8	8.0	7.8	6
Cereals and bakery products	8.7	8.9	10.1	11.9	10.2	7-8
Beef and veal	9.8	22.9	27.3	5.7	1.8	5-7
Pork	4.7	12.9	1.5	−3.4	9.8	8-11
Other meats	3.0	17.8	14.7	3.8	5.0	6-7
Poultry	2.3	10.3	5.0	5.1	5.5	3-5
Fish and seafood	2.3	9.5	9.8	9.2	8.9	8-9
Eggs	1.3	−5.5	9.5	−1.8	7.8	4-5
Dairy products	9.3	6.7	11.6	9.8	7.5	4-5
Fresh fruits	2.4	19.4	12.4	6.2	5.3	8-9
Fresh vegetables	2.8	7.9	2.9	8.9	20.1	−1-0
Processed fruits and vegetables	4.5	10.5	8.6	7.0	12.2	9-10
Sugar and sweets	2.9	12.2	7.8	22.9	8.2	2-3
Fats and oils	1.9	9.5	8.0	6.6	11.5	5-6
Nonalcoholic beverages	7.6	5.7	5.0	10.6	4.1	2-3
Other prepared foods	5.8	8.0	10.1	10.8	10.5	9-10

SOURCE: U.S. Department of Agriculture, *The Current Food Situation and Outlook for 1981.*

cate that total supplies for the 1981/82 marketing year will be about 5 percent larger than a year ago. Government price support levels for tobacco are 12 percent higher than a year ago so that cash receipts to farmers from sales of the 1981 crop are up about 25 percent. The formula for government price supports for eligible tobacco requires that the support price for the 1982 crop be increased 11 percent from the 1981 level. Thus, with an average tobacco harvest, cash returns from tobacco sales will rise 11 percent.

FOOD OUTLOOK

Led by sizable gains in the output of fresh vegetables, beef and veal, overall food supplies this year are forecast sufficiently high to provide a 1 percent increase in consumption per capita. Increases are also in prospect for cereals and bakery products, dairy products, and fresh fruit (table 2). Some reduction in consumption per capita is in prospect for pork, eggs, and processed fruit and vegetables.

Crude foodstuff prices are not expected to rise much at the farm level this year, only about 1 percent to 4 percent. As indicated earlier, beef, poultry, dairy product and egg price increases will be minimal. If hog production declines relative to demand as expected, pork price increases may equal the inflation rate. Fresh fruit prices may also rise at the inflation rate. Farm level prices for most cereals and dry edible beans, however, will be lower than in 1981. Consequently, most of the increase in food costs this year will occur in the processing and marketing sector.

The average price increase for food at grocery stores is estimated to be about 6 percent (table 3). No major price changes are forecast for any food group. Price increases for pork, processed fruit and vegetables, and other prepared foods such as cereals and bakery products, where most of the costs represent processing and marketing services, will likely approach the rate of inflation.

SUMMARY

The U.S. Department of Agriculture forecasts that there will be no improvement in net farm incomes in 1982. Expectations are for rising food supplies and relatively moderate food price increases.

Abundant quantities of most farm products are available for domestic use and export following the record 1981 crop harvest. While exports are expected to rise further, supplies of most crops and livestock products will be sufficient to limit price increases to less than the rate of inflation. Cash receipts to farmers could be down from $1 billion to $3 billion and the decline in net income could be greater.

Larger quantities of food are in prospect for consumers, and the food component of the consumer price index will likely increase at less than the rate of inflation.