POTENTIAL GNP IN THE UNITED STATES, 1948-80

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Potential gross national product (GNP) is a measure of the aggregate supply capability of an economy, or the amount of output that could be expected at full employment. Such a measure of output at constant rates of labor and capital utilization is useful as a benchmark for economic performance, calculation of the full employment surplus as an indicator of fiscal policy, and in the projection of unemployment rates. Potential GNP for the United States is estimated for the years 1948-77, and projected for 1978-80. The calculations use a variable benchmark for the full-employment unemployment rate, based on the changing age-sex composition of the labor force, and a constant benchmark for the utilization of fixed capital. A framework for separation of productivity into trend, cycle, and irregular components is developed, and then estimated for the 1948-77 period, using quarterly data. The relationships between various age- and sex-specific unemployment rates are also estimated in construction of the variable unemployment benchmark.

I. INTRODUCTION

The concept of the output attainable by the economy if resources were fully utilized has interested economists for many years. This measure of maximum sustainable output, usually called "potential GNP," has been a useful tool for analyzing policies designed to bring about the full utilization of labor and capital resources.

The potential GNP measure that gained the widest recognition was first proposed by the U.S. Council of Economic Advisers in 1962.[1] After making a number of calculations relating the overall rate of unemployment to constant-dollar GNP, it was determined that a reasonable estimate of the GNP attainable at 4 percent unemployment equaled actual GNP in mid-1955 and grew at a 3.5 percent annual rate thereafter. Between 1962 and 1976, CEA revised its potential GNP estimates a number of times; the annual growth rate for potential output was finally pegged at 4.0 percent for the period 1968-75 when trend output was thought to be rising rapidly relative to the unemployment rate. Still, in 1976, a judgmental variant of CEA's original procedure[2] was still being used to determine potential output. Potential and actual GNP were still defined to be equal in mid-1955, and the benchmark unemployment rate was still 4.0 percent.

Research on potential GNP from 1964 to 1974 produced a number of different views on the best estimation technique, but very little disagreement about the estimates themselves.[3] All of the results were similar to the CEA estimates or even somewhat higher. Perry [12], for example, used a weighted

*This research was done while the author was on the staff of the U.S. Council of Economic Advisers. However, the views expressed are solely the author's and are not necessarily those of either the current or past Council of Economic Advisers.

[1] *Annual Report of the Council of Economic Advisers*, January 1962, p. 49ff.

[2] See Okun [11] for an explanation of the various methodologies used to relate unemployment and real output.

[3] For example: Kuh [8], Thurow and Taylor [20], Black and Russell [1] and Perry [12].

labor input measure to compensate for the changing composition of the labor force, and found that potential output was growing at 4.3 percent per year in the early 1970's, or 0.3 percent higher than the CEA estimate of 4.0 percent.

However, several aspects of the economy's performance between 1973 and 1976 indicated that the maximum sustainable output might be significantly lower than the CEA estimates. First, in 1973 a number of bottlenecks occurred both in primary materials industries and in labor markets which indicated that the economy might have even exceeded the non-inflationary level, rather than being below potential by 2.4 percent as CEA estimated. Second, shifts in the composition of the labor force toward demographic groups (particularly those aged 16–24) with relatively high unemployment rates indicated that the labor market in 1976 would be much tighter with a 4.0 percent unemployment rate than it was in 1955. In other words, if a 4.0 percent unemployment rate was consistent with a stable inflation rate in 1955, it would produce accelerating inflation in 1976.

Third, the productivity slowdown evident in the BLS statistics since the mid-1960's did not seem to be adequately included in the CEA estimate of 4.0 percent potential growth from 1968 to 1975. Although higher labor force growth offset the poor productivity performance to some extent, it was not clear that the sum of these two effects should result in growth of potential a full one-half percent higher than CEA's original estimate for the 1950's. The productivity decline in 1974 was so extraordinary compared with declines observed in earlier recessions that it demanded special attention. The persistence of the low level of productivity in 1975 and 1976 indicated that a permanent setback may have taken place. Such an occurrence would have lowered maximum sustainable output still further.

And finally, the Commerce Department revised its real output series in 1976, shifting from 1958 to 1972 prices. Such a shift could normally be expected to change the observed patterns of growth and to lower measured growth rates. The new data needed to be incorporated into the potential output measure.

For these reasons, in 1976 the Council of Economic Advisers decided to undertake a comprehensive review of the official potential GNP series and the methodology used to derive it.[4] Using a technique that incorporated the contribution of capital formation to output growth, together with a variable unemployment benchmark rising from 4.0 percent in 1955 to 4.9 percent in 1976, a new estimate of potential was calculated.[5] This paper refines the statistical methodology used to determine CEA's new potential GNP series and updates the estimates with data through the second quarter of 1977.

The new CEA estimate of potential GNP grows 3.5 percent per year between 1968 and 1976, significantly lower than previous estimates. This result makes the formulation of economic policy harder in one sense, but easier in another. The problem is that lower potential output implies that high employment will generate less output than previously estimated. For the government, this means lower revenues and a smaller budget margin for new programs or tax reductions. On the

[4]CEA was not alone in its concern about its "old" estimates of potential output. Data Resources voiced its concern over the potential output estimates in early 1976 (Brinner [3]). Publication of the 1977 *Economic Report* generated additional studies, including Perry [13], and Rasche and Tatom [15].

[5]See the *1977 Economic Report of the President* for a non-technical discussion of the issues involved, and Clark [4] for some of the statistical results used in the re-estimation process.

other hand, lower productivity implies that a smaller increase in output will achieve the same unemployment and capacity utilization targets. If increases in aggregate demand are constrained by low investment or a climate of fiscal conservatism, poor productivity performance is not unambiguously bad.

II. Disaggregation of GNP

The crucial determinant of the difference between any two historical potential GNP estimates is the rate of growth of productivity. The main question is then: *How much has the rate of productivity growth slowed down?* The answer is not easy to obtain, because productivity varies widely with the business cycle, growing rapidly in expansion in economic activity, and growing more slowly or even falling during recessions. Most of the research reported in this paper was devoted to obtaining good estimates of the trend in productivity growth by careful adjustment for cyclical factors. These cyclically adjusted productivity growth figures are then combined with estimates of factor input to obtain potential output.

The first step in estimating the trend in productivity growth was the division of GNP into four components:

1. Gross output originating in the rest of the world
2. Compensation of government employees
3. Gross housing output
4. Private nonresidential output

Gross output originating in the rest of the world, or GNP minus GDP, was an obvious candidate for exclusion from the productivity estimates because this contribution to GNP is generated by investments outside the U.S., and should not respond to domestic inputs of labor or capital.

Compensation of government employees is the only measure of government output in the national income and product accounts. This component is deflated by an index of salaries of government workers, which implies that real output of the government sector is a weighted average of government employment. Therefore, productivity for the government sector is weighted employment divided by employment, and productivity growth is defined as zero in the National Income and Product Accounts. When measuring productivity growth, it is reasonable to exclude government output so that variations in the ratio of government to total employment do not affect the productivity calculations.

Segregation of housing output into a separate category was based on the possibility that the real return from residential capital and nonresidential capital might be different. In theory, such a disparity should be only temporary, but in the actual analysis, it was thought that the fixed nonresidential capital stock measured by the Commerce Department was only a proxy for non-labor inputs to private production. Since housing was easy to exclude, it seemed worthwhile to do so.

Another important reason for excluding these three sectors is that their output is not related to the domestic business cycle. If unemployment is high and capacity utilization low, government output, the imputation to the residential capital stock, and gross product originating in the rest of the world are not necessarily low. Therefore, potential and actual output can be assumed equal in these sectors.

Private nonresidential output, the residual in GNP after (GNP-GDP), compensation of government employees, and output attributable to the residential capital stock have been subtracted, corresponds closely to many economists' preconception of private sector output, produced by capital and labor. It is this output which is most closely studied, and for which productivity estimates will be made.[6]

III. Potential and Actual Capital Input to the Private Nonresidential Sector

Productivity is a ratio of output to input; real output for the private nonresidential sector may be derived by subtraction, as described in the last section, but the corresponding capital and labor inputs must be estimated. Capital input was taken to be an estimate of the effective private fixed nonresidential capital stock multiplied by an estimate of capacity utilization. The effective capital stock measure used was the B.E.A. gross stock of private nonresidential capital, adjusted for investment in pollution abatement equipment.[7] Quarterly data were linearly interpolated from annual data; projections of capital stock were derived from an investment forecast in which the ratio of nonresidential fixed investment to real GNP rises to ten percent by 1980. Six percent of fixed investment was assumed to be for pollution abatement throughout the forecast period. Annual averages of the capital stock series are given in Table A-1.

The newly revised Federal Reserve Board manufacturing capacity utilization rate[8] was taken as the starting point for estimating the degree of capacity utilization for the private nonresidential sector. However, since output in manufacturing is much more cyclical than private sector output as a whole, the cyclical variation in the FRB manufacturing index must be reduced. This was accomplished by multiplying the difference between 87.5 and the Federal Reserve Board index by 0.5, the approximate ratio of the percentage standard deviation around trend for private nonresidential output to the percentage standard deviation around trend for manufacturing output. If the ratio of utilized capital to output is fixed in the short run, such an approximation is reasonable.

The potential capacity utilization rate of 87.5 percent was chosen because it was this rate that was reached in mid 1955, early 1968, and all of 1973, all periods when it is generally considered that output was near its potential level. If there were a close relationship between changes in the rate of inflation for private nonresidential output (or the profit rate) and measured capacity utilization, it would be appropriate to estimate the relationship, and define "potential" capacity utilization as that rate which resulted in non-accelerating prices. However, in the absence of such a "Phillips curve" for capital, 87.5 percent is a reasonable benchmark.

[6]This concept of the private sector is close to what Denison calls the "nonresidential business sector." See Denison, [6], p. 21ff. It is also very close to the Bureau of Labor Statistics' "private business sector."

[7]See Musgrave, [9], and Segel and Rutledge, [17].

[8]See Raddock and Forest, [14].

IV. Potential and Actual Labor Input to the Private Nonresidential Sector

Extensive data on employment and labor force require a much more elaborate set of calculations for the estimation of private labor input. The labor input measure that was constructed tried to adjust for the productivity of different groups of workers by dividing the labor force into four age categories (16–19, 20–24, 25–64, 65+) and also disaggregating by sex. Private employment in each of these 8 categories was obtained by subtracting an estimate of civilian government employment from total civilian employment. Private employment for each group was then weighted by mean weekly earnings for that group in May 1973.[9] Use of the weekly earnings weights approximates the contribution to production of an employee in each demographic group, including both average hourly earnings and average weekly hours. It would be better to have weights that vary over time rather than one fixed set of weights, but data are not available to construct variable weights. Therefore, the effect of changes in the age-sex weights representing changes in average weekly hours and average hourly earnings is included in the estimated trend terms described later. Rates of growth of weighted and unweighted labour input are shown in Table 1. Although the growth rate of weighted employment is less than the growth rate of unweighted employment, it is only the change in this difference that explains part of the productivity slowdown since 1966.

TABLE 1
Rates of Growth of Weighted and Unweighted Private Employment, 1948–1976

Time Period	Private Employment[a]	Private Employment (weighted by 1973 earnings)[b]
1948–55	0.58	0.61
1955–66	1.13	0.75
1966–73	1.78	1.38

[a]Civilian employment minus civilian government employment from the Current Population Survey.

[b]Civilian employment minus civilian government employment by eight age-sex groups (16–19, 20–24, 25–64, 65+; M, F) weighted by May 1973 mean weekly earnings, all from Current Population Survey.

Determination of the potential level of labor input requires two extensive calculations. First, the potential labor force must be determined. Then a benchmark unemployment rate is calculated, and used to translate potential labor force into potential employment. Since labor input is a weighted sum of employment from eight age-sex groups, levels for potential labor force and the full employment

[9]Data are available by age and sex for May of the years 1973–76. 1973 was chosen because it is closest to a cyclical peak. Such an adjustment is sometimes called "Perry-weighting" since a similar weighting scheme was used by George Perry in adjusting the unemployment rate: [12].

unemployment rate must be determined for each group. Full-employment labor input is then potential employment for each age-sex group reduced by government employment, and then weighted by mean average weekly earnings in 1973.

Potential Labor Force

Potential labor force for each age-sex group is calculated by estimating a cyclical adjustment to labor force participation for that group, and then adjusting actual labor force to full employment labor force using the adjustment. The general form of the labor force participation equations is:

$$(4)\qquad \frac{L_{it}}{POP_{it}} = a_i + b_i \cdot U_{t-1} + c_i \cdot t + d_i T1_t + e_i \cdot MIL_t + f_i \cdot SCC_t + g_i \cdot AG_t + \varepsilon_{it}.$$

Where

Li = civilian labor force in group i
POP_i = civilian noninstitutional population in group i
U = unemployment rate of men 25–54
t = time
$T1$ = trend dummy which equals 0 until 1966:4, and then increases 1, 2, 3, 4. . . .
MIL = military employment divided by the civilian noninstitutional population of men aged 16–24
SCC = degree credit enrollment in higher education as a percent of population aged 16–24
AG = proportion of civilian employment in agriculture.

Estimation results for equation (4) are given in Table 2 below. Using the lagged unemployment rate gives the largest estimate of cyclical variation in the labor force, even though the estimates are smaller than might have been expected. Use of a contemporaneous unemployment rate or a distributed lag on the adult unemployment rate generates lower estimates of cyclical variation. By using the unemployment rate of men 25–54 as a cyclical variable for all groups, the problem of upward simultaneous equation bias is avoided for all groups except men 25–64, where cyclical variation in labor force participation is very small.

The cyclical adjustment for each group was the estimate in Table 2, except for men 25–64, where an insignificant coefficient was estimated even though substantial upward bias due to simultaneity was suspected, and for women 65+, where the cyclical coefficient was insignificant and the wrong sign. The literature on pretest estimators suggests that some of the other cyclical coefficients should be set to zero,[10] but this was not done. Thus, potential labor force may be a bit high. Of course, if the reaction of labor force participation to long periods of low unemployment is much stronger than its average reaction over the cycle, potential labor force could be underestimated.

In 1976, the estimates in Table 2 imply a potential civilian labor force 1.1

[10] See, for example, Sclove, [16].

TABLE 2

ESTIMATES OF CYCLICAL VARIATION IN LABOR FORCE PARTICIPATION RATES BY AGE AND SEX

Estimation interval 1953:1 *to* 1976:4

(standard errors in parentheses)

	Constant	U_{t-1}	Time	$T1$	MIL	SCC	AG	$\hat{\rho}$	$\bar{R}^2$	d.w.
Men 16–19	0.411	−0.0096	0.00040	0.00277			1.95	0.60	0.897	1.81
	(0.072)	(0.0016)	(0.00058)	(0.00043)			(0.52)			
Women 16–19	0.260	−0.0059	0.00091	0.00270			1.27	0.57	0.934	1.97
	(0.080)	(0.0018)	(0.0006)	(0.0005)			(0.59)			
Men 20–24	0.877	−0.0009	0.00080		−196.3	−0.0039	1.11	0.45	0.810	1.89
	(0.059)	(0.0013)	(0.00036)		(44.1)	(0.0016)	(0.35)			
Women 20–24	0.427	−0.0019	0.00111	0.00237				0.57	0.988	1.87
	(0.001)	(0.0012)	(0.00013)	(0.00026)						
Men 25–64	0.963	−0.00017	−0.00024	−0.00066				0.64	0.979	1.86
	(0.004)	(0.0004)	(0.00005)	(0.0001)						
Women 25–64	0.333	−0.00025	0.00151	0.00043				0.78	0.995	1.91
	(0.008)	(0.00074)	(0.00013)	(0.00022)						
Men 65+	0.481	−0.00183	−0.00267	0.00138				0.80	0.991	1.68
	(0.015)	(0.0013)	(0.00024)	(0.00042)						
Women 65+	0.108	0.003	−0.00007	−0.00045				0.61	0.817	2.15
	(0.006)	(0.0008)	(0.00009)	(0.00017)						

million workers larger than the actual labor force. This figure is only slightly higher than the approximately 0.9 million "discouraged workers" estimated by the Bureau of Labor Statistics for 1976.[11]

Projections of labor force by group were made with the estimated labor force participation equations. Since they include a cyclical adjustment, the projections are slightly higher than those made recently by BLS. Annual totals for potential labor force are given in Table A-2.

Full Employment Unemployment Rates

The establishment of a benchmark unemployment rate for use in estimating potential output is a difficult problem. If there were a good statistical relationship between unemployment rates and the inflation rate, the vector of unemployment rates by age and sex that yields a constant rate of inflation could be determined directly. Unfortunately, there seems to be no unique relationship between unemployment and inflation, so this simple "Phillips curve" method of estimating an appropriate unemployment benchmark is not available. The picture is further complicated by increases in the proportion of the labor force composed of young people (aged 16–24) and of adult women (aged 25–64), which seems to have changed the relationship between the unemployment rates of different age-sex groups. The significant change in the unemployment survey in 1967 also tends to make the determination of an unemployment benchmark which is consistent over time somewhat arbitrary.

The procedure actually used makes the assumption that a 4.0 percent overall unemployment rate represented full employment in 1955. By looking at the relationship of unemployment rates between age and sex groups in 1955, the eight age-sex unemployment rates that would have yielded a 4.0 percent overall unemployment rate in 1955 may be determined. It is further assumed that the unemployment rate for men aged 25–54 has remained a stationary indicator of the state of the labor market. The increase or decrease in each group's unemployment rate is estimated using an equation of the form

$$U_i = \alpha_i + \beta_i * U + \gamma_i * \left(\frac{\widehat{LP}_i}{\widehat{LP}}\right), \tag{5}$$

where

U_i = unemployment rate of age-sex group i

U = unemployment rate of men 25–54 as before,

$\widehat{LP}_i = (\widehat{L_i/Pop_i})$ from equation (4) times Pop_i

$\widehat{LP} = \sum_i (\widehat{L_i/Pop_i})(Pop_i)$

The inclusion of the $(\widehat{LP}_i/\widehat{LP})$ term, the relative proportion of group i in the labor force (purged of short-term variations) was based on the idea of partial segregation of labor markets. A relatively high proportion of the labor force in a particular group may make it difficult for members of that group to find satis-

[11]Bureau of Labor Statistics, *Employment and Earnings*, various issues.

TABLE 3
ESTIMATES OF THE RELATIONSHIP OF AGE-SEX UNEMPLOYMENT RATES TO THE UNEMPLOYMENT RATE OF MEN 25–54 (EQUATION 5)
Estimation interval 1948:2—1977:2
(standard errors in parentheses)[a]

	Constant	U_{pm}	Labor force proportion	Time Trend	ρ	$\bar{R}^2$
Men 16–19	−1.03	1.87	208.7		0.77	0.939
	(2.33)	(0.152)	(51.5)			
Women 16–19	−7.99	1.31	493.8		0.76	0.936
	(2.15)	(0.189)	(60.2)			
Men 20–24	−0.63	1.92	36.5		0.70	0.947
	(1.23)	(0.116)	(19.1)			
Women 20–24	0.42	1.08	87.4		0.73	0.919
	(0.97)	(0.106)	(18.9)			
Men 25–64	−1.15	0.95	2.7		0.46	0.990
	(0.26)	(0.02)	(0.49)			
Women 25–64	2.33	0.77	0.11		0.60	0.925
	(0.93)	(0.05)	(3.7)			
Men 65+	2.37	0.70		−0.0072	0.49	0.786
	(0.29)	(0.07)		(0.0028)		
Women 65+	−1.59	0.36	227.4		0.42	0.559
	(0.82)	(0.09)	(60.5)			

[a]Data adjusted for 1967 CPS survey change.

factory employment. The coefficient γ_i estimates the change in relationship between the unemployment rate of group i and the unemployment rate of men 25–64. The data used in estimation of equation (5) (and equation (4)) have been adjusted for the change in sampling procedure starting in 1967 by multiplying employment and labor force by ratios obtained in 1966 by BLS using both sampling techniques.[12] While this adjustment is reasonable for high-employment years, there is no evidence on its accuracy during periods of low economic activity.

Estimation results for equation (5) are given in Table 3 for all eight demographic groups. The unemployment rates for women 25–64, women 65+, and men 25–64 did not exhibit significant change relative to the rate for men 25–54.[13] The sign of the time trend was negative for men 65+ indicating the operation of other forces such as Social Security in the labor market for these workers. However, a downward trend was evident, so the equation was re-estimated with a time trend, as shown.

The changes in benchmark unemployment rates by demographic group are illustrated by the results in Table 4. The relative labor force proportion of younger

[12]See Stein, [19]. Since the parallel surveys in 1966 used for this adjustment are only half the size of the CPS, these ratios are subject to considerable sampling variability.

[13]As mentioned earlier, this result indicates that the unemployment rate for all persons 25–64 could be used as a cyclical indicator in place of the unemployment rate for men 25–64. Observations of the adult women's unemployment rate relative to that of adult men shows a 0.5 point increase in the differential between them from 1962–66, a 0.7 point increase in 1967 (as predicted by the BLS partial samples) and then a 0.6 point decrease from 1967 to 1968. This strange behavior of the women's unemployment rate influenced the decision to use the rate for adult men, although results using either rate are virtually identical.

workers (aged 16–24) has risen sharply; equation (5) hypothesizes that this shift in proportions was responsible for the observed change in relative unemployment rates. When combined with estimates of the high employment labor force, these benchmark unemployment rates yield a benchmark for the overall unemployment rate, also shown in Table 4. The overall benchmark unemployment rate equivalent to 4.0 percent in 1955 is 5.1 percent in 1977. It would be an abuse of the term "full employment" to call 5.1 percent the full employment unemployment rate in 1977, given the high benchmark rates for teenagers, and the fact that the burden of this joblessness is distributed unequally across races and demographic groups. Rather, the estimates in Table 3 are a strong reminder an overall unemployment rate of 3 or 4 percent would be characterized by a very tight labor market for adults.

TABLE 4
HIGH EMPLOYMENT BENCHMARK UNEMPLOYMENT RATES 1955 AND 1977
[percent]

Demographic Group	1955	1977
Women 16–19	10.8	17.7
Women 20–24	6.2	9.1
Women 25–64	3.8	4.3
Women 65+	2.7	1.8
Men 16–19	11.7	14.8
Men 20–24	6.5	7.1
Men 25–64	3.0	2.4
Men 65+	3.6	3.2
Total (Both Sexes, 16+)	4.0	5.1

Note: Unemployment rates assume the survey technique actually used in that year.

4.0 percent in 1955 and 5.1 percent in 1977 are in no sense estimates of the lowest overall unemployment rate that does not cause inflation to accelerate. Rather, the time series of unemployment rates generated by the equations in Table 3 is a consistent set of unemployment rates over time generated by the assumption that the unemployment rate of men aged 25–54 is a stationary measure of labor market tightness. The non-accelerating inflation rate of unemployment, or NAIRU, was probably about 0.4 percentage points higher in 1955, and 0.6 to 0.9 percentage points higher today.

The high employment level of labor input is calculated in three steps. First, employment in each age-sex group is estimated by multiplying the potential labor force by one minus the benchmark unemployment rate. Second, civilian government employment is subtracted from these potential employment estimates to obtain potential employment in the private nonresidential sector. Third, potential private nonresidential employment in each age-sex group is weighted by mean average earnings in May 1973 and aggregated to obtain weighted potential labor input.

V. Cyclical Adjustment of Productivity and the Calculation of Potential GNP

The crucial step in the estimation of potential GNP is the determination of good estimates of productivity at benchmark input levels. If an equation explaining the variation of productivity with the rate of input utilization can be obtained, then a benchmark level of input can be entered into the equation to obtain the level of productivity associated with that benchmark over time.

The basic specification of the variation of productivity with utilization rates used in this study is:

$$\frac{Y_t}{Y_t^P}=\left(\frac{I_t}{I_t^P}\right)^{\beta_0}\left(\frac{I_{t-1}}{I_{t-1}^P}\right)^{\beta_1}. \tag{6}$$

where

Y_t = real output of the private nonresidential sector in quarter t.
Y_t^P = potential value of Y_t in quarter t.
I_t = weighted combination of labor and capital input in the private nonresidential sector in quarter t.

$$I_t=(K_t * CU_t)^{1/3}\cdot(L_t)^{2/3}.$$

I_t^P = potential value of I_t in quarter t.
K_t = nonresidential fixed capital stock adjusted for pollution abatement investment.
CU_t = Adjusted Federal Reserve Board manufacturing capacity utilization index.
L_t = Earnings-weighted private employment.

If the invertibility condition $|\beta_0|>|\beta_1|$ holds,[14] (6) I_t/I_t^P can be expressed as a convergent series of past Y_t/Y_t^P:

$$\frac{I_t}{I_t^P}=\prod_{s=0}^{\infty}\left(\frac{Y_{t-s}}{Y_{t-s}^P}\right)^{\alpha_s}. \tag{7}$$

Equation (7) may be familiar to many readers as a specification of the lagged response of inputs to output that has been discussed extensively in the literature.[15] Equations (6) and (7) say that in the long run, the percentage gap between potential and actual input is a constant fraction $1/(\beta_0+\beta_1)$ of the percentage gap between potential and actual output. In the short run, this fraction is smaller, due to the lagged response of input to output.[16]

[14] See G. E. P. Box and G. M. Jenkins, [2], p. 67ff, for a discussion of the conditions under which a moving average process such as (6) can be converted to a one-sided autoregressive scheme.

[15] This lagged response is sometimes called "short-term increasing returns to labor." See Sims, [18].

[16] One possibility is that capital input response is instantaneous, while labor input response is lagged. This implies a cyclical adjustment that treats labor and capital inputs differently. Experiments with such a specification yielded results insignificantly different from those reported below.

An alternative specification for the cyclical relationship between output and input is equation (7) with a one-period lag:

$$\frac{I_t}{I_t^P} = \left(\frac{Y_t}{Y_t^P}\right)^{\alpha_0} \left(\frac{Y_{t-1}}{Y_{t-1}^P}\right)^{\alpha_1}. \tag{8}$$

Equation (8) is a variant of what is sometimes called "Okun's Law." If we let

$$I_t^G = \frac{I_t^P - I_t}{I_t^P} = \text{percentage input gap}$$

and

$$Y_t^G = \frac{Y_t^P - Y_t}{Y_t^P} = \text{percentage output gap,}$$

then (8) becomes:

$$\log(1 - I_t^G) = \alpha_0 \log(1 - Y_t^G) + \alpha_1 \log(1 - Y_{t-1}^G).$$

The approximation $\log(1+x) \approx x$ for small x implies:

$$I_t^G = \alpha_0 Y_t^G + \alpha_1 Y_{t-1}^G,$$

which gives a percentage input gap as a function of current and lagged output gaps, in much the same way Okun's Law relates an unemployment gap to current and lagged output gaps.

One further assumption besides either (6) or (8) is needed: a specification for the growth in cyclically adjusted total factor productivity:

$$\log\left(\frac{Y_t^P}{I_t^P}\right) = f(t) + u_t, \tag{9}$$

where $f(t)$ describes how productivity has grown over time. The specification of $f(t)$ was made on an *ad hoc* basis; namely, total factor productivity was assumed to grow at a constant rate from 1948 to 1966, and at a different rate from 1967 to the present, to correspond with the productivity slowdown that has been widely observed. Additional "kinks" in $f(t)$ are necessary to help explain the extraordinarily bad productivity performance observed in late 1973 and all of 1974. Three variants of $f(t)$ were used:

$$f(t) = a + bt + cT1 \tag{10A}$$

$$f(t) = a + bt + c(T1) + d(T2) \tag{10B}$$

$$f(t) = a + bt + c(T1) + d(T3) \tag{10C}$$

where

t = time trend
$T1 = 0 \ldots 0$ until 1966:4, then 1, 2, 3, 4, . . . thereafter
$T2 = 0 \ldots 0$ until 1973:4, then 0.25, 0.5, 0.75, and 1.0 thereafter
$T3 = 0 \ldots 0$ until 1973:3, then 1, 2, 3, 4, 5, 4, 3, 2, 1, and 0 thereafter.

The "A" variant gives no additional consideration to plummeting productivity in 1974, and just treats it as another set of observations on the cyclical variability of productivity. The "B" variant implies a once-and-for-all downward shift in the trend level of productivity in 1974, possibly due to the shift in the relative price of energy or underestimation of real output in an inflationary environment. The "C" variant explains the lower productivity in 1974 as an extraordinary cyclical movement that disappears by the end of 1975.

Equations (6), (9), and (10A–C) can be combined to yield a regression equation for total factor productivity in the private nonresidential sector which can then be used for estimating potential GNP. Equation (6) implies:

$$\log\left(\frac{Y_t}{I_t}\right) = \log\left(\frac{Y_t^P}{I_t^P}\right) + (\beta_0 - 1)\log\left(\frac{I_t}{I_t^P}\right) + \beta_1 \log\left(\frac{I_{t-1}}{I_{t-1}^P}\right).$$

Substituting in (9) and (10A–C) yields:

$$\text{(11A)} \quad \log\left(\frac{Y_t}{I_t}\right) = a + bt + cT1 + (\beta_0 - 1)\log\left(\frac{I_t}{I_t^P}\right) + \beta_1 \log\left(\frac{I_{t-1}}{I_{t-1}^P}\right) + u_t$$

$$\text{(11B)} \quad \log\left(\frac{Y_t}{I_t}\right) = a + bt + cT1 + dT2 + (\beta_0 - 1)\log\left(\frac{I_t}{I_t^P}\right) + \beta_1 \log\left(\frac{I_{t-1}}{I_{t-1}^P}\right) + u_t$$

$$\text{(11C)} \quad \log\left(\frac{Y_t}{I_t}\right) = a + bt + cT1 + eT3 + (\beta_0 - 1)\log\left(\frac{I_t}{I_t^P}\right) + \beta_1 \log\left(\frac{I_{t-1}}{I_{t-1}^P}\right) + u_t.$$

The regression equations derived from the alternative specification (8) along with equations (9) and (10A–C) are:

$$\text{(12A)} \quad \log\left(\frac{Y_t}{I_t}\right) \approx (\alpha_0 + \alpha_1)a + (\alpha_0 + \alpha_1)bt$$
$$+ (\alpha_0 + \alpha_1)cT1 - (\alpha_0 - 1)\log\left(\frac{Y_t}{I_t^P}\right) - \alpha_1 \log\left(\frac{Y_{t-1}}{I_{t-1}^P}\right) + u_t.$$

$$\text{(12B)} \quad \log\left(\frac{Y_t}{I_t}\right) \approx (\alpha_0 + \alpha_1)a + (\alpha_0 + \alpha_1)bt$$
$$+ (\alpha_0 + \alpha_1))cT1 + (\alpha_0 + \alpha_1)\, dT2$$
$$- (\alpha_0 - 1)\log\left(\frac{Y_t}{I_t^P}\right) - \alpha_1 \log\left(\frac{Y_{t-1}}{I_{t-1}^P}\right) + u_t.$$

$$\text{(12C)} \quad \log\left(\frac{Y_t}{I_t}\right) \approx (\alpha_0 + \alpha_1)a + (\alpha_0 + \alpha_1)bt$$
$$+ (\alpha_0 + \alpha_1)cT1 + (\alpha_0 + \alpha_1)cT3$$
$$- (\alpha_0 - 1)\log\left(\frac{Y_t}{I_t^P}\right) - \alpha_1 \log\left(\frac{Y_{t-1}}{I_{t-1}^P}\right) + u_t.$$

It should be noted that the algebraic manipulations required to derive (12) from (8) and (10) imply that the disturbances in (12) will exhibit second-order serial correlation if the disturbances in (10) have first order serial correlation. Thus is was not surprising when second-order serial correlation was found in the estimation of (12) (and handled by a second-order generalization of the Cochrane–Orcutt two stage procedure).

Estimates of the parameters in equation (11A–C) and (12A–C) obtained by the Cochrane–Orcutt two-stage procedure are given in Table 5 below. Standard errors are not given for the parameters of $f(t)$ in the estimates of equation (12), since these are obtained by dividing least squares coefficients, implying that they have infinite variance. It is reasonable to assume that equations 11A–C give more reliable estimates, for two reasons. First, the division problem allows estimation errors for α_0 and α_1 in equation (12) to contaminate the growth parameters a, b, and c. Second, the longer lag specification (equation (7)) seems more appropriate than the short 1-period lag in equation (8).

It is difficult to discriminate between the two hypotheses about the 1973–74 "productivity disaster" implicit in the B and C variants of the equations. If the B variant is the correct specification, and the level of productivity shifted downwards in 1974, high inflation rates could be the cause. If such high inflation rates caused price increases to be overestimated, real output has been underestimated, and the productivity loss exaggerated. Some evidence for this view can be found in the Federal Reserve Board Industrial Production Index, which fell less than real GNP over the 1973–75 period. One also suspects the rapid rise in the relative price of energy, although the mechanism for loss in productivity due to the high price of oil is not obvious. In a theoretical model with homogeneous capital, even if the elasticity of substitution were zero, potential GNP measured in 1972 dollars would not fall at all. A Cobb–Douglas formulation generates implausible reductions in energy usage of 40 to 50 percent. A vintage model for capital could explain the drop only if U.S. capital is more energy intensive than foreign capital. In this case, production using the most energy-intensive capital in the U.S. might not cover variable costs at world output prices.

The other view, consistent with the "C" specification, is that the cyclical movement in productivity was just much stronger in the 1973–75 recession than in previous downturns. Probably the truth lies somewhere in between; a once-and-for-all drop in total factor productivity of about 2 percent combined with some extra cyclical loss may be close to correct.

The estimates of potential GNP shown in Table 5 are derived by eliminating the cyclical components in each equation and setting labor and capital inputs to their potential values. This yields a potential for private nonresidential GNP, which then is added to the non-cyclical components (compensation of government employees, imputation to the residential capital stock, and income from investment abroad) to obtain potential GNP. The B variant shows the lowest potential for 1977, reflecting the pessimistic assumption that the drop in productivity in 1974 not explainable by normal cyclical factors was permanent. The equation (12) estimates are higher than those from equation (11); this difference may be caused by incorrect specification of the lag between changes in output and input gaps in equation (12). For example, the long-run elasticity of the input gap with respect to

TABLE 5

PARAMETER ESTIMATES AND IMPLIED POTENTIAL GNP FOR EQUATIONS (11A–C) AND (12A–C): LONG-RUN GROWTH AND CYCLICAL VARIATION IN TOTAL FACTOR PRODUCTIVITY
(Quarterly data; estimation interval 1948:3 or 4 to 1977:2)

	Constant	Time	$T1$	$T2$	$T3$	$\log\left(\frac{I_t}{I_t^P}\right)$	$\log\left(\frac{I_{t-1}}{I_{t-1}^P}\right)$	$\log\left(\frac{Y_t}{I_t^P}\right)$	$\log\left(\frac{Y_{t-1}}{I_{t-1}^P}\right)$	ρ_1	ρ_2	$d.w.$	$\bar{R}^2$	1955 Potential GNP (billions of 1972 dollars)	1977 Potential GNP (billions of 1972 dollars)
11A	−3.70	0.00456	−0.00155			0.878	−0.422			0.78		1.70	0.997	656.1	1392.4
	(0.0095)	(0.00017)	(0.00038)			(0.114)	(0.115)								
11B	−3.70	0.00443	−0.00058	−0.042		0.822	−0.414			0.76		1.80	0.997	653.7	1378.1
	(0.0083)	(0.00016)	(0.00042)	(0.11)		(0.111)	(0.110)								
11C	−3.70	0.00455	−0.00139		−0.00659	0.806	−0.352			0.79		1.86	0.997	655.9	1399.4
	(0.0096)	(0.00018)	(0.00039)		(0.0022)	(0.112)	(0.113)								
12A	−3.69	0.00442	−0.00099					0.656	−0.148	1.02	−0.34	1.62	0.9998	658.8	1413.8
								(0.022)	(0.022)						
12B	−3.69	0.00436	−0.00044	−0.028				0.644	−0.163	0.97	−0.32	1.59	0.9998	657.7	1402.6
								(0.023)	(0.022)						
12C	−3.69	0.00441	−0.00084		−0.00523			0.649	−0.144	1.08	−0.39	1.80	0.9998	658.6	1420.4
								(0.022)	(0.021)						

(Standard errors in parentheses.)

the output gap is $1/(\beta_0+\beta_1)=0.716$ in equation (11B), while the same elasticity is $(\alpha_0+\alpha_1)=0.562$ in equation (12B). By allowing the lag to be longer in (11), the sum of the coefficients is larger; the larger long-run elasticity implies a smaller output gap for a given input differential.

Estimates Using Only Labor Input

Discussions of potential output are usually based on labor input only, largely because the measurement of the capital stock is based on a number of arbitrary (but necessary) assumptions, and because the weight of capital in total input is the subject of some controversy. It is instructive, then, to investigate the effect of the capital stock estimates on the calculation of potential output by performing the analysis using labor input only. All the same equations ((11A–C) and (12A–C)) may be estimated by replacing I_t, the combination labor and capital input, with L_t, the labor input component only. The basic equations are then

$$\frac{Y_t}{Y_t^P}=\left(\frac{L_t}{L_t^P}\right)^{\beta_0}\left(\frac{L_{t-1}}{L_{t-1}^P}\right)^{\beta_1}, \tag{6'}$$

$$\frac{L_t}{L_t^P}=\left(\frac{Y_t}{Y_t^P}\right)^{\alpha_0}\left(\frac{Y_{t-1}}{Y_{t-1}^P}\right)^{\alpha_1}, \tag{8'}$$

and

$$\log\left(\frac{Y_t^P}{L_t^P}\right)=f(t)+u_t. \tag{9'}$$

The analysis is exactly the same, but the basic productivity concept is labor productivity instead of total factor productivity. If the capital input measure is sufficiently poor, ignoring capital will produce better estimates. The results of the "labor input only" regressions are given in Table 6.

The results are virtually identical; estimated potential GNP is about 1 percent lower in 1955 and about 1 percent higher in 1977. The difference is primarily due to a somewhat higher capital utilization rate relative to the unemployment rate in the mid-1970's, compared to 20 years earlier.

The elasticity of the output gap with respect to the labor input gap is higher than the elasticity of the output gap with respect to the weighted gap for labor and capital. $1/(\beta_0+\beta_1)=0.569$ for equation (11B') while $(\alpha_0+\alpha_1)=0.400$ for equation (12B'). This is not surprising, for capital utilization should adjust more rapidly to output than labor utilization. It is also not surprising that the sum of the coefficients $\alpha_0+\alpha_1$ is very close to the sum reported in "Okun's Law" equations, given that (12') is essentially Okun's Law, as explained earlier. Unlike the total factor productivity estimates, second order serial correlation was not significant in (12A'–12C'), implying that some other form of specification error is responsible for the low Durbin–Watson statistic after the first-order serial correlation correction.

The range of the 12 estimates of potential GNP derived from the regression equations are given in Table 7 and shown pictorially in Figure 1. Projections of the labor force, capital stock and the components of non-cyclical output given in

TABLE 6

PARAMETER ESTIMATES AND IMPLIED POTENTIAL GNP FOR EQUATIONS (11A′–C′) AND (12A′–C′): LONG-RUN GROWTH AND CYCLICAL VARIATION IN LABOR PRODUCTIVITY

(Quarterly data; estimation interval 1948:3 to 1977:2)

	Constant	Time	$T1$	$T2$	$T3$	$\log\left(\frac{L^t}{L_t^P}\right)$	$\log\left(\frac{L_{t-1}}{L_{t-1}^P}\right)$	$\log\left(\frac{Y_t}{L_t^P}\right)$	$\log\left(\frac{Y_{t-1}}{L_{t-1}^P}\right)$	ρ_1	$d.w.$	$\bar{R}^2$	1955 Potential (billions of 1972 dollars)	1977 Potential (billions of 1972 dollars)
11A′	−3.11	0.00683	−0.00179			1.79	−0.98			0.77	1.75	0.998	650.2	1405.5
	(0.011)	(0.00020)	(0.00044)			(0.20)	(0.20)							
11B′	−3.11	0.00671	−0.00081	−0.045		1.67	−0.99			0.77	1.86	0.998	648.0	1389.6
	(0.010)	(0.00020)	(0.00052)	(0.014)		(0.20)	(0.20)							
11C′	−3.11	0.00682	−0.00162		−0.00690	1.67	−0.86			0.78	1.87	0.998	650.0	1413.1
	(0.011)	(0.00020)	(0.00045)		(0.00265)	(0.20)	(0.20)							
12A′	−3.10	0.00663	−0.00117					0.784	−0.190	0.85	1.15	0.9998	651.8	1421.9
								(0.022)	(0.021)					
12B′	−3.10	0.00654	−0.00053	−0.029				0.773	−0.197	0.86	1.19	0.9998	650.2	1410.1
								(0.022)	(0.020)					
12C′	−3.10	0.00663	−0.00109		−0.00679			0.771	−0.188	0.86	1.27	0.9998	651.8	1426.2
								(0.021)	(0.020)					

(Standard errors in parentheses.)

TABLE 7
ESTIMATES OF POTENTIAL GNP
(billions of 1972 dollars)

Year	Minimum Estimate	Maximum Estimate	1977 CEA Estimate
1948	494.5	501.8	492.8*
	517.1	524.6	514.4*
1950	535.7	543.6	537.0*
	560.0	571.0	560.5*
	580.8	593.7	584.9
	604.0	615.9	608.2
	625.1	636.5	627.7
1955	648.0	658.8	651.4
	676.0	685.7	673.9
	696.0	708.1	697.2
	721.9	732.0	721.3
	743.5	752.9	746.2
1960	772.0	779.6	771.9
	801.0	807.1	798.6
	819.9	828.5	826.4
	848.6	856.5	857.1
	880.8	888.3	890.3
1965	913.9	923.3	925.0
	944.6	957.7	960.8
	981.9	997.2	996.3
	1017.4	1034.1	1031.7
	1053.8	1074.1	1068.3
1970	1090.8	1114.4	1106.2
	1124.9	1152.2	1145.5
	1165.3	1194.2	1186.1
	1208.8	1240.2	1228.2
	1249.2	1282.0	1271.7
1975	1287.6	1324.9	1316.9
	1331.7	1373.7	1363.6
	1378.1	1426.2	1412.0*
	1426.0	1477.7	1462.1*
	1477.1	1530.9	1513.9*
1980	1531.6	1587.5	1567.7*

*Unofficial.

tables A–1, A–2, and A–6 were used to obtain potential GNP projections to 1980. The large increase in the range of potential since 1973 reflects the uncertainty generated by the precipitous productivity decline in 1974. By 1980, the range of estimates is almost 4 percent of potential GNP, a figure that does not overestimate our ignorance about the level of output in 1980, when unemployment and capacity utilization may be nearer their benchmark levels.

Most of the producvitity decline since the late 1960's cannot be explained by the changing age-sex composition of the labor force, the changing industrial composition of labor-hours, or changes in the rate of growth of the capital/labor ratio.[17] Instead, the slowdown must be allocated to a residual category, or "technical progress." Since reasons for apparent changes in the trend rate of

[17]See Norsworthy and Fulco [7] for a discussion of the reasons for the productivity slowdown. Embodied technical progress and investment in research and development may have contributed to the slowdown, but these factors were not analyzed.

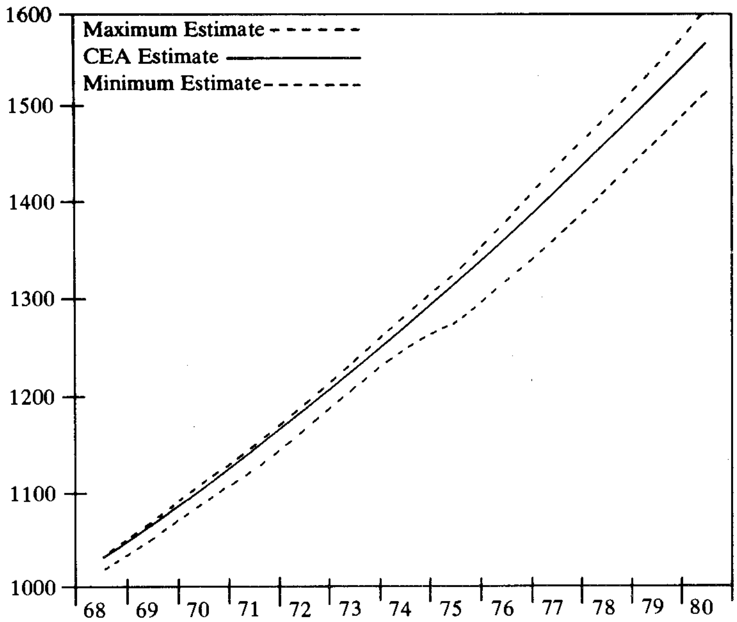

Figure 1. Potential GNP: CEA Estimate and Range 1968–80 (billions of 1972 dollars)

productivity growth are not well understood, it may be the case that the trend productivity growth rate will be higher from 1977 to 1980 than it was from 1966 to 1973. Even if there was a permanent 2 percent loss in productivity in 1974, altered relative prices may generate the incentive for productivity increases that were not particularly profitable at low energy prices. Therefore, cautious optimism either in the form of assuming that the 1974 productivity decline was temporary, or in the assumption that the productivity growth trend will be higher from 1977 to 1980 than it was in 1966–73, generates potential GNP in 1980 of about $1,560 billion 1972 dollars.

The estimates for the years 1952–68 conform very closely to previous estimates of potential output for the U.S. economy. Potential GNP is calculated to be very close to actual GNP ($654.8 billion 1972 dollars) in 1955, and the growth rate of potential is very close to Okun's original estimate of 3.5 percent per year for 1952–62.[18] The growth of potential in 1962–68 is also very close to the 3.75 percent per year that had previously been estimated by the Council of Economic Advisers.[19] Since 1968, however, the growth in potential output has been much lower than was previously estimated. Potential output growth for 1968–75 is estimated here at about 3.5 percent per year instead of 4.0 percent for that period estimated by the Council in 1976.[20]

[18] Okun, [8].
[19] *Business Conditions Digest*, August 1976, p. 95.
[20] Ibid.

Although part of the difference between the previous 4 percent growth rate and the new CEA 3.5 percent rate can be explained by the increase in the unemployment benchmark from 4 percent to 4.9 percent in 1976, by far the largest part of the decrease is due to slow productivity growth. Calculations of the trend in total factor productivity using 4 percent unemployment as a benchmark indicate that estimated potential GNP would be 0.3 to 1.1 percent higher with this standard, depending on how the reduced unemployment is distributed among demographic groups.

VI. Unemployment and Real GNP Change: Checking the Results

As a rough check on the potential GNP estimate of 1332–1374 billion 1972 dollars for 1976, the relationship between changes in the overall unemployment rate and changes in real GNP was estimated using equations 13A and 13B.

$$\text{(13A)}\quad \underset{}{\Delta U_t} = \underset{(0.04)}{0.38} - \underset{(0.02)}{0.24}*\Delta\%\text{GNP}_t - \underset{(0.02)}{0.18}*\Delta\%\text{GNP}_{t-1}$$

$\bar{R}^2 = 0.77 \qquad d-w = 1.89 \qquad$ data: quarterly 1953:2–1976:4

$$\text{(13B)}\quad \Delta U_t = \underset{(0.04)}{0.45} - \underset{(0.02)}{0.25}*\%\Delta\text{GNP}_t - \underset{(0.01)}{0.10}*\%\Delta\text{GNP}_{t-1}$$

$$-\underset{(0.01)}{0.08}*\%\Delta\text{GNP}_{t-2} - \underset{(0.005)}{0.05}*\%\Delta\text{GNP}_{t-3} - \underset{(0.003)}{0.03}*\%\Delta\text{GNP}_{t-4}$$

(last four regression coefficients constrained to lie on a straight line)

$\bar{R}^2 = 0.75 \qquad d-w = 1.89$ data: quarterly 1953:2–1976:4

$\Delta U_t = U_t - U_{t-1}$
= percentage point change in the overall unemployment rate U.

$\Delta\%\text{GNP}_t = 100*(\text{GNP}_t - \text{GNP}_{t-1})/\text{GNP}_{t-1}$,
= percentage change in Gross National Product measured at 1972 prices.

Equation 13A implies that a one percentage point reduction in the overall unemployment rate will be associated with a 2.4 percent increase in real GNP in the long run, while equation 13B implies an eventual 2.0 percent increase. A 2.8 percentage point decrease in the unemployment rate in 1976 from the realized 7.7 percent to the 4.9 percent CEA benchmark would therefore increase real GNP 5.6 to 6.7 percent. Since GNP at 1972 prices was $1264.7 billion in 1976, these increases imply a potential output of 1336 to 1350 billion 1972 dollars. These figures are below the middle of the potential GNP range for 1976.

It should be noted that the result of 2.5 or less for an estimate of $\%\Delta\text{GNP}/\Delta U$ is lower than the 3.0 or greater used by some economists. The confusion here probably lies in the distinction between the short-run and long-run responses of unemployment to output. In the short run (one quarter), it takes an additional increase of 4 percent in real output to reduce unemployment by an additional one percentage point. However, additional unemployment reductions are forthcoming in future quarters even if there are no additional marginal increases in real output. Since attention is focused on real growth and unemployment during periods of slack economic activity, it is natural to estimate the growth in output that would give an acceptable decline in the unemployment rate. At the beginning of a recovery, this "required real growth" may be very high.

VII. Conclusion

The new CEA estimates of potential output are confirmed by the updated results presented in this paper. The changes generated by an additional year's data are very small, with the biggest adjustment being the increase in the unemployment benchmark from 4.9 percent to 5.1 percent. The atypical productivity decline experienced in 1974 has not been reduced in the past year, adding more weight to the argument that 2 to 3 percent was permanently lost from the trend level of productivity.

The CEA potential GNP estimates in the 1977 *Economic Report of the President* are, if anything, optimistic about the gains in output resulting from a reduced level of unemployment. In the second quarter of 1977, CEA estimated that a reduction in the unemployment rate from the observed 7.0 percent to 4.9 percent would have increased real GNP from $1330.7 to $1405.8 billion, or 5.6 percent. The 1977:2 potential estimates in section V range from 1372.3 to 1419.6 billion, using a slightly higher 5.1 percent unemployment benchmark. "Okun's Law", with a multiplier of 2.0 to 2.5, yields a range of $1386.6 to $1400.6 billion, using the 4.9 percent unemployment benchmark. Thus, the results reported here indicate an "output gap" which is generally smaller than the official CEA gap of 5.6 percent. Estimates of the output gap which are significantly larger than this must be based on assumptions about large cyclical variations in the labor force and productivity which are unsupported by the data.

Results on the "potential growth rate" for the economy over the next five years are much less precise. Structural models (as opposed to the empirical trend-fitting equations used in this study) of growth in labor force participation and productivity have not been developed to the point that they can be used to make good conditional predictions. Therefore, any projection of potential output must be an extrapolation of past trends. A growth rate in potential output of 3.5 percent per year is consistent with the growth rates of the labor force and output per worker which have been observed since the late 1960's. However, high labor force growth, coupled with a return to the pre-1966 trend in total factor productivity, strong capital stock growth and lower relative youth unemployment rates could generate spectacular economic growth over the next five years. Alternatively, sluggish performance in all these areas could result in a very low real growth rate. Erratic behavior of productivity, coupled with recent changes in labor force participation trends and unstable prices, make any projection of future growth rates subject to wide variability.

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TABLE A-1

FIXED NONRESIDENTIAL CAPITAL STOCK AT 1972 PRICES EXCLUDING POLLUTION ABATEMENT CAPITAL

(billions of 1972 dollars)

1948	632.8	1965	1110.4
	658.0		1164.2
1950	681.1		1291.3
	707.5		1273.3
	734.2		1331.1
	761.1	1970	1387.6
	787.9		1437.2
1955	815.4		1486.1
	845.7		1541.7
	876.3		1600.6
	902.0	1975	1649.0
	925.0		1687.1
1960	950.5		1729.9
	976.4		1783.5
	1003.6		1845.6
	1033.5	1980	1913.2
	1067.2		

Note: Figures are *average values* of capital stock during the given year.

TABLE A-2

POTENTIAL CIVILIAN LABOR FORCE 1948–1980

(millions of persons)

1948	60.6	1965	74.4
	61.5		75.6
1950	62.4		77.2
	62.0		78.6
	62.1		80.5
	62.9	1970	82.7
	63.8		84.3
1955	65.0		86.7
	66.5		88.7
	67.0		91.1
	68.0	1975	93.3
	68.6		95.9
1960	69.8		98.0
	70.8		99.7
	70.8		101.4
	72.0	1980	103.3
	73.2		

TABLE A-3
PRIVATE EMPLOYMENT, 1948–1975
(millions of persons)

1948	53.1		58.7
	52.3		60.0
1950	53.1	1965	61.5
	53.9		62.6
	53.8		63.2
	54.7		64.3
	53.5		65.9
1955	55.3	1970	66.2
	56.9		66.3
	56.9		68.4
	55.6		70.8
	56.9		71.9
1960	57.8	1975	70.3
	57.6	1976	72.5
	58.0		

TABLE A-4
ESTIMATED CAPACITY UTILIZATION RATE FOR THE PRIVATE SECTOR, 1948–1976[a]
(percent)

1948	85.0		85.5
	80.8		86.6
1950	85.2	1965	88.5
	86.7		89.3
	86.4		87.2
	88.4		87.3
	83.8		86.9
1955	87.3	1970	83.4
	86.8		82.8
	85.6		85.3
	81.3		87.5
	84.6		85.8
1960	83.8	1975	80.5
	82.4	1976	83.8
	84.5		

[a]Annual average rate. Quarterly series (R_t) is derived from the FRB manufacturing utilization rate (F_t) (see Raddock and Forest [10]) according to the following formula:

$$R_t = 1/2(87.5 + F_t)$$

TABLE A-5

FULL EMPLOYMENT UNEMPLOYMENT BENCHMARK EQUIVALENT TO 4.0 PERCENT UNEMPLOYMENT IN 1955 (percent)

1948	4.4	1965	4.5
	4.3		4.6
1950	4.3		4.5
	4.2		4.5
	4.1		4.6
	4.0	1970	4.7
	4.0		4.7
1955	4.0		4.9
	4.1		5.0
	4.1		5.0
	4.1	1975	5.1
	4.1		5.1
1960	4.2		5.1
	4.2		5.2
	4.2		5.2
	4.3	1980	5.2
	4.3		

Note: Unemployment rates are computed relative to the sampling procedure actually used in a given time period. The CPS survey change in 1967 causes the shift in the benchmark unemployment rate from 1966 to 1967.

TABLE A-6

PROJECTIONS OF NONCYCLICAL GNP COMPONENTS 1976–80 (billions of 1972 dollars)

Year	Compensation of Federal Employees	Compensation of State and Local Government Employees
1976[a]	48.4	97.3
1977	48.6	98.7
1978	48.6	101.9
1979	48.7	105.2
1980	48.7	108.7
	Gross Output Attributed to Residential Housing Stock	Gross Output Originating in Rest of World (GNP–GDP)
1976[a]	111.6	6.7
1977	114.8	8.0
1978	118.4	9.2
1979	122.2	10.3
1980	126.2	11.3

[a]1976 figures are actual, included for comparison.