EXACT UNEMPLOYMENT-RATE INDICES

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Conventional unemployment rate measures tend to overestimate the degree of labor underutilization if unemployment disproportionately affects less educated and generally less productive workers. Based on index number theory as well as on econometric techniques, we propose a number of alternative measures that are exact for specific labor aggregator functions. Our results for the United States show that the conventional, unweighted unemployment rate overestimates the true rate by about 0.6 of a percentage point, or by almost 14 percent.

I. INTRODUCTION

Few economic statistics command more widespread attention than the rate of unemployment. It is viewed as a key measure of a country's economic performance, and its release often makes the headlines and the evening news. It plays a central role in many key macroeconomic relationships, such as Okun's Law and the Phillips curve, and it is fundamental to concepts such the NAIRU. It is therefore essential to design it and to measure it in a way that is consistent with its purpose.

To economists, the unemployment rate is a measure of the degree of underutilization of the nation's labor endowment. The conventional rate of unemployment (the number of unemployed persons divided by the number of persons in the labor force) may seem reasonable to some, but adding up workers (e.g. physicians and dishwashers) without regard to their skills and without taking the relative price of their services into account makes little economic sense. There are few examples in economics where aggregation is routinely carried out in this crude a fashion. To draw a blunt analogy, it is as if we measured the nation's capital stock by adding up the numbers of trucks, office buildings, and screwdrivers.

During the last 40 years concerns in the United States about unemployment concepts and measures have led to the appointment of two blue-ribbon groups — the Gordon Committee during the 1960s and the National Commission on Employment and Unemployment Statistics (or the Levitan Commission) during the 1970s. Over the years, numerous criticisms have been directed at conventional unemployment rate statistics (Cain, 1980). These criticisms have ranged from the accuracy of the surveys that underlie the unemployment statistics to the proper concept to be measured (e.g., unemployed persons versus unemployed person hours) to various adjustments that ought to better reflect the changing demographic composition of the labor force (e.g., an age adjustment because unemployment rates tend to vary by age). Yet, the formula used to construct the index seems to have never been seriously questioned.

The productive capacity of the labor force is certainly a function of the skills and education embodied in it. This observation is presumably one reason that earnings functions based on human capital concepts include as key arguments age (a proxy for experience) and years of schooling. If the unemployment rate is relatively higher among the less skilled than among the more skilled, simply summing up the number of unemployed and dividing by the labor force will overstate the true proportion of labor's productive capacity that is unutilized. How large is the resulting bias? The answer is entirely an empirical matter upon which we try to shed some light in this paper.

In what follows, we propose several measures of the rate of unemployment. Each measure is exact (in the sense of Diewert, 1976) under certain conditions, but we believe that each one can serve as a good approximation under more general circumstances. Moreover, we construct lower and upper bounds of the "true" rate of labor underutilization, and it turns out that the conventional unemployment rate does not fall within these bounds. Finally, using March Current Population Survey data for 1964 – 1995, we compare the various unemployment rate measures for the United States.

II. AGGREGATION, LABOR CAPACITY UTILIZATION, AND UNEMPLOYMENT

Assume that aggregate production can be modeled by a multiple-input multiple-output transformation function. Assume I outputs, J non-labor inputs, and H categories of labor. We denote output quantities by y_i, the quantities of non-labor inputs by x_j, and the number of workers in each category by n_h. Let the aggregate transformation function be given by:

$$t(y_1, \ldots, y_I, x_1, \ldots, x_J, n_1, \ldots, n_H) = 0. \tag{1}$$

Assume that this transformation function is weakly separable between labor and the other inputs and outputs, so that it can be written as:

$$v[y_1, \ldots, y_I, x_1, \ldots, x_J, h(n_1, \ldots, n_H)] = v(y_1, \ldots, y_I, x_1, \ldots, x_J, n) = 0, \tag{2}$$

where:

$$n = h(n_1, \ldots, n_H); \tag{3}$$

n is an index of aggregate labor and $h(\cdot)$ is the labor aggregator function. We assume that $h(\cdot)$ is increasing, quasi-concave, and linearly homogeneous.

Weak separability means that the various categories of labor can be consistently aggregated. Assuming optimizing behavior, the profit maximization or cost minimization problem can be decomposed into two steps. The first step involves determining the optimum labor mix, given the level of aggregate labor n and the wage rates of the different labor categories. The second step involves determining the optimum level of aggregate labor and of the other inputs and outputs, given all input and output prices. We need only concern ourselves with the first step of this twin decision process.

Let w_h be the wage rate of the employed workers in the h^{th} category. First-step optimization requires that the marginal products of each category of labor be equal to their marginal cost:

$$\frac{\partial h(\cdot)}{\partial n_h} = \frac{w_h}{w}, \tag{4}$$

where w is the Lagrange multiplier and can be interpreted as the aggregate wage rate.

The H categories of labor can be identified by skills, sex, age, etc. We assume that the workers within these categories are perfectly homogeneous. This is not as restrictive as it may sound since the number of categories can be increased almost at will. We denote the total number of workers, employed and unemployed, of the h^{th} category by ℓ_h. If all workers were employed, the aggregate labor quantity index (ℓ) would be equal to:

$$\ell = h(\ell_1, \ell_2, \ldots, \ell_H). \tag{5}$$

The rate of labor capacity utilization is therefore given by n/ℓ, and we can define the rate of unemployment u as:

$$u \equiv 1 - \frac{h(n_1, n_2, \ldots, n_H)}{h(\ell_1, \ell_2, \ldots, \ell_H)}. \tag{6}$$

The true rate of unemployment therefore depends on $h(\cdot)$, the labor aggregator function. Unfortunately, this function is generally unknown. There are ways to get around this difficulty, however. One possibility, if the appropriate data are available, is to estimate the labor aggregator using econometric techniques. An alternative approach, one that may seem somewhat less controversial (since there is no need then to specify a stochastic specification and to select an estimation method), is based on index-number theory.

III. INDEX-NUMBER APPROACH

Probably the simplest functional form for $h(\cdot)$ that we can chose is the linear one:

$$h(\cdot) = \sum_{h=1}^{H} b_h n_h, \qquad b_h \geq 0. \tag{7}$$

The first-order conditions (4) then imply:

$$b_h = \frac{w_h}{w}. \tag{8}$$

Making use of (7) and (8) in (6), we can express the linear version of the rate of unemployment (u^{LN}) as:

$$u^{LN} = 1 - \frac{\sum_{h=1}^{H} w_h n_h}{\sum_{h=1}^{H} w_h \ell_h}. \tag{9}$$

The conventional measure of the unemployment rate ($\tilde{u}$) can be viewed as a special case of (7), that where all b_h's are arbitrarily set to unity:

$$h(\cdot) = \sum_{h=1}^{H} n_h, \tag{10}$$

in which case:

$$\tilde{u} = 1 - \frac{\sum_{h=1}^{H} n_h}{\sum_{h=1}^{H} \ell_h}. \tag{11}$$

To the extent that wages vary across labor categories, the first-order conditions can clearly not be met in the case of (10).

Another natural choice for the labor aggregator function is the Leontief form:

$$h(\cdot) = \min\left\{\frac{n_1}{a_1}, \frac{n_2}{a_2}, \ldots, \frac{n_H}{a_H}\right\}, \qquad a_h > 0. \tag{12}$$

Under cost minimization, we can set:

$$n = \frac{n_h}{a_h}, \qquad \forall h. \tag{13}$$

The corresponding rate of unemployment (u^{LF}) can then be obtained as:

$$u^{LF} = 1 - \frac{n_k}{\ell_k}, \tag{14}$$

where:

$$\ell_k = a_k \min\left\{\frac{\ell_1}{a_1}, \frac{\ell_2}{a_2}, \ldots, \frac{\ell_H}{a_H}\right\}. \tag{15}$$

This implies that:

$$u^{LF} = \min\{u_1, u_2, \ldots, u_H\}, \tag{16}$$

where $u_h \equiv 1 - n_h/\ell_h$ is the unemployment rate for the h^{th} category of labor.

The Leontief aggregator function assumes that no substitution whatsoever is possible between the different categories of labor. If one category of labor is in short supply, this will severely restrict the maximum amount of aggregate labor that is available. Put in other words, actual employment would be closer to full employment than one might think, and u^{LF} can therefore be viewed as a lower bound of the true rate of unemployment. The linear functional form, on the other hand, assumes that the different categories of labor are perfect substitutes for each other. This would imply that total employment could be stretched further than it first appears: u^{LN} can therefore be viewed as an upper bound for the true unemployment rate.

The linear functional form assumes that the Allen-Uzawa elasticity of substitution between the different types of labor is infinitely large, whereas the Leontief function assumes that it is zero. A less restrictive assumption would be to assume that the aggregator function has the following Cobb-Douglas form:

$$h(\cdot) = \prod_{h=1}^{H} n_h^{\alpha_h}, \qquad \alpha_h \geq 0, \tag{17}$$

where the α_h's are unknown nonnegative parameters. The first-order conditions then can be written as:

$$\alpha_h = \frac{w_h n_h}{\sum_k w_k n_k}. \tag{18}$$

Making use of (17) and (18) in (6), we obtain the Cobb-Douglas measure of the rate of unemployment (u^{CD}) as:

$$u^{CD} = 1 - \frac{\prod_{h=1}^{H} n_h^{s_h}}{\prod_{h=1}^{H} \ell_h^{s_h}}, \tag{19}$$

where $s_h \equiv w_h n_h / \left(\sum w_k n_k\right)$, an observable variable.

Finally, we may want to consider the CES case. Let the aggregator function be given by:[1]

$$h(\cdot) = (\delta_1 n_1^\rho + \delta_2 n_2^\rho + \cdots + \delta_H n_H^\rho)^{\frac{1}{\rho}}, \quad \delta_h > 0, \rho \leq 1. \tag{20}$$

The first-order conditions then can be written as:

$$\delta_h n_h^{\rho-1} (\sum_k \delta_k n_k^\rho)^{\frac{1-\rho}{\rho}} = \frac{w_h}{w}. \tag{21}$$

This can be rewritten as:

$$\delta_h = n_h^{1-\rho} \frac{w_h}{w} (\sum_k \delta_k n_k^\rho)^{\frac{\rho-1}{\rho}}. \tag{22}$$

Making use of this result in (20) and (6), we get the CES measure of the rate of unemployment:

$$u^{CES} = 1 - \frac{(\sum_h n_h w_h)^{\frac{1}{\rho}}}{(\sum_h n_h^{1-\rho} \ell_h^\rho w_h)^{\frac{1}{\rho}}}. \tag{23}$$

IV. ESTIMATES FOR THE UNITED STATES

We now examine the empirical significance of the problem discussed above. Our data are for the United States, 1964 to 1995, and are drawn from the March Current Population Survey. Our focus is on educational attainment, but we could have focused on age (experience), or on both age and schooling, or on still more categories to which the Bureau of Labor Statistics has given credence (such as sex and marital status).[2] Because we are concerned with educational attainment, we restrict our sample to persons 25 years of age and older, and we disaggregate labor into 11 levels of educational attainment. For 1995, Table 1 reports the number of labor force members, annual earnings, and the unemployment rate, by level of education. Clearly, the unemployment rate falls sharply with increased education.[3]

We show in the first column of Table 2 the conventional measure of the rate of unemployment ($\tilde{u}$) computed with the help of (11). It varies between 2.40 percent (in 1969) and 8.62 percent (in 1983). The second column shows the estimates of u^{LN}, which is exact if the aggregator function is linear. This index is systematically lower than $\tilde{u}$. The difference between the two indices varies between 0.23 percent (in 1969) and 0.87 percent (in 1983). The third column shows the estimate of u^{CD}, which is exact if the aggregator function is Cobb-Douglas. As expected, it is lower still than u^{LN}, and it can be seen that the difference between u^{CD} and $\tilde{u}$ exceeds one percentage point in some years. The fourth column shows the values of u^{CES} (for $\rho = -4$); it is marginally lower than the Cobb-Douglas estimate. The fifth column reports the values of u^{LF}, which is exact if $h(\cdot)$ has the Leontief form. As expected, this index is by far the lowest. It is noteworthy that not for a single year does the conventional measure of the unemployment rate ($\tilde{u}$) fall within the upper and lower bounds as determined by u^{LN} and u^{LF}.

We also report at the bottom of the table the coefficients of variation (COV) of the different series. Since the various indices are highly correlated, the coefficients of variation are of similar magnitude, although they are somewhat smaller in the case of the Cobb-Douglas and the CES indices.

Although the U.S. unemployment rate, as conventionally measured, drifted upward throughout much of the latter half of the 20th century, beginning in the 1980s a structural shift appears to have occurred as the unemployment and wage gaps between skilled and unskilled workers widened dramatically. This shift impacts on the differential between our measures and the traditional unemployment rate, and it is apparent in Table 2. The mean conventional unemployment rate increased from 4.20 percent during the 1964–1979 period to 5.72 percent during the 1980–1995 period. The mean Cobb-Douglas index (from column 3) increased by considerably less, from 3.74 to 4.95, so that the mean difference between the two indices rose from 0.46 to 0.77 percentage points. The divergence is even larger in the case of the CES index (column 4). Thus, the indices proposed here do not perfectly mimic the conventional measure, although they obviously tend to move with it.

Our results are summarized in Figure 1, which shows the path of three unemployment-rate indices: the conventional measure ($\tilde{u}$), the linear measure (u^{LN}), and the Cobb-Douglas measure (u^{CD}). The extent of the upward bias contained in the conventional unemployment-rate measure is clearly visible. The cyclical pattern of the different series is, however, similar.

It is perhaps noteworthy that the bias appears to be greater when the unemployment rate is rising. The difference between the conventional measure and the Cobb-Douglas measure averages 0.73 for 10 years when the conventional measure rose, but 0.55 for 21 years when it fell. One possible reason for this observation is that during periods when the economy is sluggish, the least productive workers suffer disproportionate unemployment, but when the economy expands they are drawn disproportionately back to jobs.

V. ECONOMETRIC APPROACH

As suggested earlier, aggregator function $h(\cdot)$ can in principle be estimated. Assume that it has the CES form. For empirical purposes, in order to allow for technological change and other shifts in the technology, it is useful to allow the δ's to change over time. We therefore rewrite the function as follows:

$$h(\cdot) = [(\delta_1 + \delta_{1T}t)n_1^{\rho} + (\delta_2 + \delta_{2T}t)n_2^{\rho} + \cdots + (\delta_H + \delta_{HT}t)n_H^{\rho}]^{\frac{1}{\rho}}, \qquad (24)$$

$$\delta_h + \delta_{hT}t > 0, \rho \leq 1,$$

where t is a time trend. It is convenient to express the first-order conditions in share form

$$s_h = (\delta_h + \delta_{hT}t)n_h^{\rho} \left[\sum_k (\delta_k + \delta_{kT}t)n_k^{\rho} \right]^{-1}, \quad h = 1, \ldots, H, \qquad (25)$$

where s_h again is the share of the h-th type of labor in total labor costs.

We have estimated the system of share equations (25) using the nonlinear estimation procedure as implemented in SHAZAM, Version 8.0, which yields estimates of the δ's, of the δ_{hT}'s, and of ρ (whose estimate is 0.362 with a standard error of 0.046). We then introduce these estimates into (24) and (6) to get an econometric estimate of the rate of unemployment, which we denote $\hat{u}^{CES}$. The resulting figures are shown in the sixth column of Table 2. We find that they are significantly smaller than the conventional measure ($\tilde{u}$) suggests. In fact, they are quite close to the Cobb-Douglas estimates.

By constraining all Hicksian elasticities of complementarity to be constant, the CES function is rather restrictive. It is therefore tempting to reestimate the aggregator function using a flexible functional form. Assume that the aggregator function has the following Translog form:

$$h(\cdot) = \beta_0 + \sum \beta_h \ln n_h + \frac{1}{2} \sum \sum \phi_{hk} \ln n_h \ln n_k + \sum \delta_{hT} \ln n_h t + \beta_T t + \frac{1}{2} \phi_{TT} t^2, \quad (26)$$

where $\sum \beta_h = 1, \phi_{hk} = \phi_{kh}, \sum \phi_{hk} = 0$, and $\sum \delta_{hT} = 0$. Again expressing the first-order conditions in share form, we get:

$$s_h = \beta_h + \sum \phi_{hk} \ln n_k + \delta_{hT} t, \qquad h = 1, \ldots, H. \quad (27)$$

Estimation of large size Translog aggregator functions (remember that $H =$

11 in our case) almost invariably leads to curvature condition problems. We have therefore imposed concavity using the procedure of Jorgenson and Fraumeni (1981).[4] Estimation of (27) subject to this reparameterization, again using the nonlinear estimation procedure implemented in SHAZAM, makes it possible to get a Translog measure of the rate of unemployment. Estimates of this index ($\hat{u}^{TL}$) are reported in the last column of Table 2.[6] We find that the Translog measure comes quite close to the Cobb-Douglas index, and it is substantially less than the conventional rate.

VI. CONCLUSION

In this paper, we propose a number of alternative measures of the unemployment rate based on index number theory as well as on econometric techniques. These measures are exact for specific labor aggregator functions. Our results for the United States show that the conventional, unweighted unemployment rate yields an overestimate of about 0.6 percentage point, on average, or about 13.9 percent relative to our Cobb-Douglas measure. The bias appears to have increased together with the widening unemployment and wage gaps between skilled and unskilled workers starting in the 1980s.

Our conventional unemployment rate for persons 25 years of age and over is considerably lower than the official unemployment rate for persons 16 and over.[5] This lower rate is obviously due to our procedure of cutting out the young end of the labor force age distribution, where experience and education tend to be lower and unemployment rates higher. Based on the population used by the BLS to calculate unemployment rates, the unemployment rate measures proposed here would undoubtedly result in even greater measures of upward bias. Since it is frequently argued that the unemployment rate is biased downward due to the elimination of discouraged workers from the unemployment total, our estimates of bias obviously run in the opposite direction.

Of all the unemployment indices that we have reported here, we favor the Cobb-Douglas index. It is simple to calculate, it is based on index number theory rather than on more controversial econometric techniques, it allows for some, but only some, substitution between the different types of labor, and it conveys essentially the same message as the more sophisticated CES and Translog indices. A still more conservative measure would be given by the linear index. In any case, it is quite clear that the conventional measure of the rate of unemployment grossly overstates the true rate of labor underutilization, by probably more than one half of one percentage point for most years.

Some caveats are in order. The measures of labor underutilization suggested by index-number theory as discussed above require that the marginal product of each type of labor equal its marginal cost. If discrimination is present at the lower end of the wage distribution (e.g. directed against minorities who tend to have less education and higher unemployment rates than average workers), our alternative measures would bias upwards the differential with the conventional measure. Monopoly conditions in the provision of labor services (e.g. trade unions) or monopsony conditions in the hiring of workers could also drive the wedge between marginal productivity and marginal cost. Moreover, working conditions might differ across jobs and might be reflected by relative wages. However, we feel that as a first approximation our assumption that labor receives its marginal product is reasonable, and it has along tradition as a starting point for many analyses of economic phenomena.

Like many other economic concepts, the measures we have proposed here may not be easily understandable for the average noneconomist. Furthermore, they are unlikely in the foreseeable future to be calculable on a monthly basis because they require more information than is routinely gathered in labor force surveys. Nonetheless, they can easily be calculated annually and they should prove to be useful for economists engaged in empirical work, trying to estimate potential GDP or attempting to assess wage and price pressures, for instance. Many recent empirical studies in this area use sophisticated econometric and times series techniques, which makes it all the more important not to use patently biased indicators when it can be avoided. In any case, our objective in this paper was not to propose that the conventional rate of unemployment be abandoned or replaced, but rather to draw the profession's attention to the fact that it is a poor measure of the degree of underutilization of a country's labor endowment.

The Gordon Committee appointed by President Kennedy to study unemployment and other labor market statistics, suggested that the various concepts should be objectively measured, obtainable at reasonable cost, readily understood, and easily interpretable, among other criteria (Cain, 1980). In large parts because the unemployment rate as conventionally measured satisfies these criteria, it has become the basis of much economic policy. Historically, various transfer payments have been tied to the national unemployment rate, and federal allocations to state and substate areas have been linked to its local counterparts. We would certainly view our measures of labor underutilization as inappropriate guides for the conduct of social policy. The conventional rate of unemployment unquestionably gives a better reading of the human toll of unemployment. One could even argue that, when assessing the human, social, and political cost of unemployment, one should give more weight to the less privileged members of society. On the other hand, our measures could be useful for macroeconomic policy purposes. In the case of monetary policy, for instance, policymakers often rely on Taylor rules where the unemployment rate might be used as a proxy for the GDP gap. A finer measure of the degree of labor underutilization would give them a better feel about the degree of slack in the economy.

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FOOTNOTES

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1. This functional form implies that the Hicksian elasticities of complementarity are constant; they are given by $1-\rho$. As to the Allen-Uzawa elasticities of substitution, they are equal to $1/(1-\rho)$, and they are constant as well.

2. For example, Flaim (1979) has proposed adjusting the unemployment rate to account for the changing age distribution of the labor force. This adjustment would account for the maturing of the baby boom, first into young labor force ages

with typically high unemployment rates and later into older ages with typically low unemployment rates. He attributes between 0.6 and 1.0 percentage point of the change in the unemployment rate between 1957 and 1977 to the changed demographic composition of the labor force. (The March rate increased from 4.3 percent to 7.9 percent over this period.)

3. Over the entire period, the correlation coefficient between w_h/w_1 and u_h/u_1 is -0.689.

4. A sufficient condition, for the Translog function to be *globally* concave is that the matrix $\Phi \equiv [\phi_{hk}]$ be negative semi-definite. This can be imposed by setting $\Phi = -TT'$, where $T \equiv [\tau_{hk}]$ is a lower triangular matrix.

5. Our average figure is 5.0 percent compared to a BLS average of 6.5 percent.

6. Since $(\hat{u}^{TL})$ is exact for what is a *flexible* functional form, it is a *superlative* index in the sense of Diewert (1976).

Figure 1: Alternative Unemployment-Rate Indices, 1964–1995 (percentages)

Table 1:
Labor Force, Average Annual Earnings, and Unemployment Rate,
by Level of Education: March 1995

	level of education	number of labor force members (ℓ_h)	average annual earnings (w_h)	unemployment rate (u_h)
1.	less than 1st grade	166	13,662	12.05%
2.	1st-4th grade	435	14,418	10.81%
3.	5th & 6th grade	986	14,886	7.40%
4.	7th & 8th grade	1,266	17,133	8.21%
5.	9th grade	1,011	17,132	8.61%
6.	10th grade	1,442	18,780	9.15%
7.	11th grade	1,552	19,287	9.86%
8.	12th grade	21,704	24,043	5.16%
9.	1st-3rd year college	17,555	28,660	4.24%
10.	4th & 5th year college	11,721	40,355	2.62%
11.	6th & more years college	6,101	58,321	2.15%

Source: Current Population Survey, March, 1995.

Table 2:
Alternative Unemployment-Rate Indices (Percentages)

year	$\tilde{u}$	u^{LN}	u^{CD}	u^{CES}	u^{LF}	$\hat{u}^{CES}$	$\hat{u}^{TL}$
1964	4.59	4.08	4.03	3.99	0.84	4.07	3.91
1965	3.87	3.45	3.38	3.38	0.69	3.40	3.29
1966	3.18	2.86	2.78	2.81	0.94	2.78	2.70
1967	2.98	2.65	2.57	2.60	0.59	2.59	2.54
1968	2.76	2.49	2.42	2.45	0.72	2.41	2.38
1969	2.40	2.17	2.10	2.14	0.32	2.10	2.07
1970	3.82	3.50	3.47	3.44	0.80	3.45	3.44
1971	4.54	4.20	4.08	4.14	1.28	4.09	4.05
1972	4.30	4.02	3.91	3.98	1.45	3.91	3.90
1973	3.69	3.42	3.33	3.37	1.29	3.31	3.33
1974	3.66	3.42	3.34	3.38	1.34	3.32	3.34
1975	6.90	6.27	6.06	6.07	1.83	6.09	6.16
1976	5.85	5.38	5.23	5.25	1.80	5.21	5.25
1977	5.74	5.32	5.20	5.21	2.12	5.16	5.24
1978	4.49	4.14	4.02	4.07	1.79	3.99	4.08
1979	4.37	4.06	3.96	4.00	1.87	3.93	4.02
1980	4.79	4.37	4.26	4.27	1.56	4.22	4.31
1981	5.61	5.10	4.94	4.95	1.42	4.91	4.98
1982	7.38	6.63	6.35	6.38	1.90	6.45	6.59
1983	8.62	7.75	7.51	7.39	2.54	7.55	7.69
1984	6.39	5.71	5.54	5.51	1.99	5.58	5.68
1985	6.06	5.42	5.17	5.24	2.10	5.25	5.30
1986	5.78	5.14	4.98	4.96	1.78	5.01	5.07
1987	5.35	4.76	4.65	4.61	1.77	4.63	4.67
1988	4.47	3.96	3.85	3.84	1.17	3.84	3.87
1989	4.15	3.69	3.61	3.61	1.58	3.61	3.58
1990	4.41	3.89	3.81	3.78	1.49	3.79	3.76
1991	5.85	5.13	5.04	4.96	1.76	5.04	4.98
1992	6.47	5.70	5.54	5.50	2.18	5.59	5.42
1993	6.06	5.37	5.25	5.22	2.62	5.30	5.15
1994	5.55	4.89	4.78	4.75	2.17	4.81	4.66
1995	4.56	4.01	3.98	3.92	2.15	4.01	3.85
COV	0.205	0.208	0.203	0.202	0.212	0.207	0.216