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Measuring Unemployment

THE UNEMPLOYMENT RATE is probably the most closely watched economic indicator in the United States. Discretionary fiscal, monetary, and public employment policies all respond to it. And especially in times of recession, economists, policymakers, and the public are extraordinarily attentive to its monthly variations. The importance of the unemployment rate thus makes essential an understanding of its monthly fluctuations.

The statistical procedures used in measuring unemployment have been a subject of great controversy. Two presidential commissions and countless academic studies have grappled with the problems of defining and counting the unemployed. Nonetheless, except among sophisticated users, little attention is paid to the reliability of unemployment statistics as indicators of current labor market conditions. Except on a few occasions when the announced unemployment rate seems aberrant, the rate tends to be accepted as an accurate reflection of economic conditions. In press coverage at least, even small fluctuations in the unemployment rate are sometimes interpreted as reflections of actual labor market developments. In this paper an attempt is made to estimate the full extent of uncertainty in measuring unemployment. This uncertainty arises from several sources, only some of which are formally measured by the Bureau of Labor Statistics (BLS), and the sum of which is never reported. It is shown that a large part of observed month-to-month movements in the unemployment rate are spurious, reflecting only statistical noise.

The importance of these issues is well illustrated by recent experience. The unemployment rate, which is estimated from a survey of households, rose quite sharply to 7.6 percent in May and declined to 7.3 percent in

June and 7.0 percent in July before rising to 7.2 percent in August. There is a widespread suspicion that at least some of these movements are spurious. The picture is further confounded by the movements in other indicators of labor market tightness. Employment, as calculated from establishment data, had been virtually constant for six months up to August, while employment as estimated from the household survey actually peaked in May. The insured unemployment rate, calculated from claims for unemployment insurance, has moved by as much as 0.2 point only once this year, in August, when it fell while the standard rate rose.

What Do Movements in the Unemployment Rate Mean?

A necessary prerequisite to sensibly interpreting fluctuations in the measured unemployment rate is an awareness of the range of uncertainty surrounding the estimated monthly rate. Surprisingly, there appear to be no estimates in the literature of the full range of uncertainty surrounding the standard published unemployment rate or its rate of change.[1]

Before turning to the calculation of the "full" standard error of the published unemployment rate I briefly review the methods used to derive this key statistic. The publication of the monthly unemployment rate is the culmination of a lengthy process.[2] Initially a probability sample of about 56,000 households is chosen. A Current Population Survey (CPS) questionnaire is then administered to one member of each household who answers the questions for all the adult members of the family. The answers are then coded and weighted in compiling raw estimates of unemployment and employment for each of four demographic subgroups, males and females, teenagers, and adults. These estimates are then seasonally adjusted using the X-11 computer program.[3] The results are added to yield

1. Both the Gordon and Levitan commissions recommended that the necessary research to remedy this deficiency be undertaken by the U.S. Department of Labor, Bureau of Labor Statistics.

2. A far more extensive discussion of the Current Population Survey procedure is contained in National Commission on Employment and Unemployment Statistics, *Counting the Labor Force* (U.S. Government Printing Office, 1979).

3. The X-11 program uses the ratio-to-moving average method to decompose a time series into trend, cyclical, and seasonal components.

Table 1. Standard Errors of Current Population Survey Data Due to Sampling Variability[a]

Percentage points

Measure, by age group	Monthly		Quarterly		Annual	
	Level	*Change*	*Level*	*Change*	*Level*	*Change*
Unemployment rate						
Total	0.12	0.12	0.09	0.11	0.06	0.08
Males aged 20 and over	0.15	0.15	0.11	0.14	0.07	0.10
Females aged 20 and over	0.17	0.18	0.12	0.15	0.08	0.12
Teenagers aged 16 to 19	0.57	0.67	0.42	0.52	0.28	0.38
Employment-population ratio						
Total	0.18	0.13	0.14	0.14	0.12	0.12
Males aged 20 and over	0.21	0.18	0.18	0.18	0.14	0.14
Females aged 20 and over	0.22	0.17	0.19	0.19	0.15	0.15
Teenagers aged 16 to 19	0.62	0.73	0.50	0.54	0.35	0.43

Source: Data are drawn from tables C, H, I, J of *Employment and Earnings*, vol. 28 (August 1981), pp. 123, 125, 126. Calculations using the tables are based on July 1981 data contained in the same issue.

a. The standard errors for changes are only valid for consecutive time periods.

estimates of aggregate unemployment and labor force. The total unemployment rate is then calculated as the ratio of these figures.

This process is likely to give rise to significant error from three sources: response error, sampling error, and seasonal adjustment error. Each monthly issue of *Employment and Earnings* contains an extensive discussion of the errors that may be expected due to sampling variability. But although the BLS provides estimates based on alternative techniques for seasonal adjustment, no quantitative measures are provided of the uncertainties associated with the seasonal adjustment process or of the errors arising from various types of response bias. The former omission is likely to be of particular importance in assessing the statistical significance of reported month-to-month changes in the unemployment rate.

Sampling and Response Errors

The BLS uses an elaborate adjustment procedure to estimate the error bands for the published rate and for its month-to-month changes. These estimates attempt to capture the effects of sampling variability. Table 1 displays BLS estimates of the standard errors associated with several un-

employment and employment rates. These standard errors have the fol-
lowing interpretations. One can be 95 percent confident that the "true"
rate lies within a range of four standard errors, centered on the published
rate.[4] The confidence level associated with a range of two standard errors
is 68 percent. The standard error of 0.12 point implies, for example,
that a monthly increase in the unemployment rate of less than 0.24 point
is not "statistically significant" in the sense that there is less than a 95 per-
cent probability that any increase in the rate actually occurred. Even an-
nual changes of 0.2 point are barely significant by this standard.

   The standard errors in the unemployment rates for individual demo-
graphic groups are greater reflecting the smaller sample and, in the case
of teenagers, the higher unemployment rate. For this group even changes
of a full percentage point from quarter to quarter are not statistically sig-
nificant. Even more striking, the increase of 9.3 percentage points be-
tween July and August in the unemployment rate for black teenagers is
not statistically significant once sampling error is recognized.

   The errors in the employment-population ratio are significantly larger
than those for the unemployment rate. This is because the employment
ratio is a much larger number—close to one-half—which more than
offsets the larger sample size available to estimate the employment ratio.
The standard error in the overall employment ratio is 0.18 point. How-
ever, the standard error of the monthly change is only 0.13 point, com-
parable to the standard error in the unemployment rate.

   It may seem surprising that the standard errors of the month-to-month
changes do not exceed the errors in the levels by a greater increment, and
that the standard errors do not decline more rapidly with increasing inter-
val length. The reason for both these effects is that the rotation group
procedure in which the same families are interviewed eight times in the
survey leads to substantial positive serial correlation in sampling errors.

   While response variability is considered in calculating these standard
errors, no account is taken of response bias. Evidence from the Reinter-
view Program of the CPS suggests that a large fraction of the unem-
ployed respondents give inconsistent answers. The answers that are given
vary significantly across rotation groups. If, as is plausible, the nature of

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   4. With a fixed sample size, the standard error of measuring an unemployment
rate is higher the higher the rate of unemployment. This is also true for the time
series of a particular rate. When unemployment rises from 5 to 9 percent, the stan-
dard error of the monthly rate rises approximately one-third.

these biases varies with economic conditions, there will be bias in the estimates of monthly changes. The magnitude of this bias is not known.

There are additional, less consequential sources of error that are not captured in the published standard errors. These include problems of undercoverage, noninterviews, and nonresponse. Because these problems are quite stable over time, they are likely to have a minimal impact on measured fluctuations in the unemployment rate.

Seasonal Adjustment

The major source of uncertainty in interpreting monthly movements in the unemployment rate arises from the problem of seasonal adjustment. This has been quite clearly illustrated in each of the postwar recessions, when experts have discounted some of the gyrations in unemployment. Perhaps the clearest example of this phenomenon came in 1975 when Julius Shiskin, then director of the BLS, testified in June before the Joint Economic Committee of Congress that unemployment in that month would exhibit a spurious decline.[5] Uncertainty in seasonal adjustment has three sources. First, at the time the unemployment rate is announced, only past data are available to estimate the seasonal structure. The data are thus subject to revision as later data become available. Second, no one knows the appropriate model of seasonality to apply in adjusting the data. The continuing controversy between advocates of additive and of multiplicative seasonal adjustment illustrates this problem. Third, even assuming the validity of a particular model of seasonality, with only a finite amount of data there will be statistical error. None of these sources of error are included in the published standard errors reported in table 1.

Before estimating the uncertainties associated with seasonal adjustment, it is necessary to describe the standard BLS seasonal adjustment procedure.[6] An estimate of trend, cycle, and seasonal is made using the

5. *Employment-Unemployment,* Hearings before the Joint Economic Committee, 94 Cong. 1 sess. (GPO, 1975), pt. 4, p. 802.

6. This discussion is based on the description included in the appendix to "An Overview of the Objectives and Framework of Seasonal Adjustment" by Shirley Kallek in *Seasonal Analysis of Economic Time Series,* Economic Research Report, ER-1, Proceedings of the Conference on the Seasonal Analysis of Economic Time Series, U.S. Department of Commerce, Bureau of the Census (December 1978), pp. 3–25.

X-11 program. The data are then checked and outliers eliminated; they are readjusted and the process is iterated. The X-11 procedure is used to determine total unemployment and labor force in each of the four demographic groups. The results are aggregated and divided to estimate the monthly unemployment rate. In applying the X-11 procedure, the BLS assumes additive seasonality for some groups (principally teenagers) and multiplicative adjustment for others. The difference can be of some consequence. Additive adjustment means that seasonal deviations from normal unemployment are not correlated with the level of unemployment, while in multiplicative adjustment it is assumed that seasonal movements are proportional to the level of unemployment.[7]

Some evidence on revision error is presented in table 2, which displays the original and revised unemployment rates for 1979 and 1980. The mean absolute revision was 0.08 and 0.09 for 1979 and 1980, respectively; the root mean square revision was 0.11 for 1979 and 0.13 for 1980. The revisions are comparable for the estimated change in the unemployment rate, averaging 0.11 in 1979 and 0.09 in 1980. These revisions are of substantive significance. Compared with the original data, the rise in unemployment during the first half of 1980 is slightly smaller, and the recovery in unemployment during the second half almost vanishes. It is noteworthy that in both years the largest revisions take place in May, when seasonal adjustment is notoriously difficult because of the exodus from schools. When quarterly changes are considered, the average revision approaches 0.1 in 1979 and 0.15 in 1980. Obviously, there is no revision of the annual unemployment rate on account of seasonality.

The second source of uncertainty concerns the appropriate method of seasonal adjustment. As the continuing controversy over this issue demonstrates, reasonable people often differ on the appropriate model for treating seasonality. An indication of the uncertainty introduced by model choice can be gleaned from the extent of the variation among alternative methods. Table 3 presents estimates of the monthly unemployment rate in 1976 and 1977 based on six different methods of seasonal adjustment.[8] The first column is the official revised unemployment rate. The second and third columns show unemployment rates, assuming additive and multiplicative seasonal adjustment, respectively, for all demo-

7. John A. Brittain discusses these questions in "Testing for and Removing Bias in the Seasonally Adjusted Unemployment Series," *BPEA, 1:1976*, pp. 211–24.

8. These years were used because I was unable to find estimates of seasonally adjusted rates using some of the methods for later years.

Table 2. Revisions of the Published Monthly Unemployment Rate

Percent or percentage points

Month and year	Originally published rate	Revised rate	Revision	Revision of change	Revision of quarterly rate	Revision of quarterly change
1979						
January	5.8	5.8	0.0	...		
February	5.7	5.9	0.2	0.2	0.1	...
March	5.7	5.8	0.1	−0.1		
April	5.8	5.8	0.0	−0.1		
May	5.8	5.6	−0.2	−0.2	0.0	−0.1
June	5.6	5.6	0.0	0.2		
July	5.7	5.6	−0.1	0.1		
August	6.0	5.9	−0.1	0.0	−0.1	−0.1
September	5.8	5.8	0.0	0.1		
October	6.0	5.9	−0.1	−0.1		
November	5.8	5.9	0.1	0.2	0.0	0.1
December	5.9	6.0	0.1	0.0		
1980						
January	6.2	6.2	0.0	0.1		
February	6.0	6.2	0.2	0.2	0.1	0.1
March	6.2	6.3	0.1	−0.1		
April	7.0	6.9	−0.1	−0.2		
May	7.8	7.6	−0.2	−0.1	−0.2	−0.3
June	7.7	7.5	−0.2	0.0		
July	7.8	7.6	−0.2	0.0		
August	7.6	7.6	0.0	0.2	−0.1	0.1
September	7.5	7.4	−0.1	−0.1		
October	7.6	7.6	0.0	0.1	0.1	
November	7.5	7.5	0.0	0.0	0.0	0.1
December	7.4	7.4	0.0	0.0		

Sources: Data on the revised unemployment rate comes from *Employment and Earnings*, vol. 28 (February 1981), p. 151. Data on the originally published rate are from U.S. Bureau of Labor Statistics, "The Employment Situation" (News Release), several issues.

graphic groups. The estimates in the fourth column are based on the assumption of stable seasonality during 1967–77, but otherwise use the methodology of the official rate. The results of using the X-11 technique to adjust the unemployment rate directly, rather than separately adjusting the number unemployed and the number in the labor force, are shown in the fifth column. The last column is based on regressions of the type suggested by Michael Lovell.[9]

9. Michael C. Lovell, "Least-Squares Seasonally Adjusted Unemployment Data," *BPEA, 1:1976*, pp. 225–37.

The results in table 3 indicate that, even when seasonal adjustments are performed retrospectively, there are substantial variations among different methods. The average range of estimates is 0.19 for the level and 0.17 for the month-to-month change. Note that the range of estimates does not significantly increase in the month of May and June when traditional seasonal adjustment has been a large problem. Note also that the range between different estimates of the quarterly unemployment rates is larger than the range for the monthly rates.

Even if the proper model of seasonal adjustment is specified, seasonal factors cannot be estimated precisely from a finite body of data, and this is the source of additional uncertainty. In the case of regression methods, the standard errors of the regression parameters imply a standard error of about 0.2 for the typical adjustment. Because the X-11 procedure is highly nonlinear and not based on an explicit model of seasonality, analytic computation of its standard error is impossible. A crude Monte Carlo method was thus employed to gauge this error. Thirty years of "pseudo data" were generated randomly according to a stochastic process like that followed by the unemployment rate. Seasonal factors for the thirty-first year were calculated. This procedure was replicated ten times. The uncertainty due to random variation was then estimated from the variance of the estimated seasonal factors for the thirty-first year. The results imply a standard error due to statistical limitations in estimating seasonal factors of 0.1 for the monthly level and 0.11 for the month-to-month change in the unemployment rate. The errors are about half as great for quarterly intervals.

Full Standard Errors

All these estimates can be combined to yield an indication of the total uncertainty surrounding the unemployment rate. This is done in table 4, which summarizes estimates of the standard errors from each source described above and estimates the full standard error from the several sources together. These calculations make some simplifying assumptions and are presented only as illustrative of the uncertainty surrounding the published unemployment rate. True standard errors vary with the level of the unemployment rate, and the estimates shown are based on rates typical of recent experience. The standard errors associated with model

uncertainty were assumed to be equal to one-half the average range of estimates from the several models shown in table 3. The statistical error associated with estimating the seasonal adjustment factors was based on the Monte Carlo method applied to the official unemployment rate as described above. And the full standard error was calculated on the assumption that the four individual sources of error had zero covariance among them. As summarized in table 4, the full standard error of the monthly rate is estimated to be 0.22, and an approximately equal error is estimated in the month-to-month change. About half of this is attributable to the three components of uncertainty in seasonal adjustment, none of which is considered in official publications. The error declines only very slowly as the interval increases and is as great for quarterly changes as for monthly changes. It is much smaller for yearly data, which are unaffected by seasonal error.

The relatively high standard error of 0.22 estimated for the monthly unemployment rate implies that much of the variation actually observed in the monthly rate is inconsequential. The standard deviation of monthly changes in the revised unemployment rate between 1960 and 1980 is 0.23. The standard error of monthly changes in the unemployment rate after revision is 0.18 (rather than the 0.22 of the initially announced monthly data). This implies that more than 60 percent of the variance in month-to-month changes in the revised unemployment rate is random noise. This fraction decreases to 25 percent of quarter-to-quarter changes.

The clear implication of these results is that it is a mistake to place excessive reliance on a single monthly unemployment observation. It is more sensible to discount aberrant observations on the unemployment rate until they are confirmed by subsequent announcements. On the other hand, it should be stressed that the reported rate is the best guess of the unemployment rate available at the time of publication. It is as likely to be too low as too high. If a point estimate is required, it should be used. On the basis of the standard errors estimated above, when the reported unemployment rate moves up 0.22 point in a month, there are five chances in six that some increase actually occurred (although this probability includes increases too small to alter the rate calculated to one decimal point). Thus the basic message of this analysis is not that announcements should be ignored, but only that they should be treated with caution.

The high noise-to-signal ratio in the monthly unemployment rate suggests that in assessing labor market tightness policymakers should ex-

Table 3. Unemployment Rates under Alternative Seasonal Adjustment Procedures, 1976–77

Percent or percentage points

Month and year	Official	X-11 additive	X-11 multiplicative	X-11 stable seasonals	Direct additive adjustment	Additive regression	Range	Range of changes	Range of quarterly levels	Range of quarterly changes
				Adjustment procedures						
1976										
January	7.9	8.0	7.8	7.9	7.9	8.2	0.4	...		
February	7.7	7.8	7.6	7.7	7.7	8.1	0.5	0.1	0.4	...
March	7.6	7.6	7.5	7.6	7.6	7.8	0.3	0.2		
April	7.6	7.6	7.6	7.6	7.6	7.6	0.0	0.1		
May	7.4	7.2	7.5	7.5	7.5	7.3	0.3	0.3	0.1	0.4
June	7.5	7.5	7.5	7.5	7.4	7.5	0.1	0.3		
July	7.7	7.8	7.8	7.7	7.7	7.6	0.2	0.2		
August	7.8	7.8	7.8	7.8	7.9	7.7	0.2	0.2	0.2	0.3
September	7.7	7.7	7.8	7.7	7.8	7.6	0.2	0.1		
October	7.7	7.8	7.9	7.7	7.8	7.7	0.2	0.1		
November	7.8	7.8	7.8	7.9	7.8	7.7	0.2	0.2	0.1	0.1
December	7.8	7.8	7.8	7.9	7.8	7.8	0.1	0.1		

1977

January	7.4	7.4	7.3	7.4	7.5	7.7	0.4	0.4		
February	7.6	7.6	7.5	7.5	7.5	7.9	0.4	0.2	0.3	0.4
March	7.4	7.4	7.4	7.4	7.4	7.6	0.2	0.2		
April	7.1	7.1	7.1	7.1	7.1	7.1	0.0	0.2		
May	7.1	6.9	7.1	7.1	7.2	7.0	0.3	0.2	0.1	0.4
June	7.1	7.1	7.1	7.0	7.0	7.0	0.1	0.2		
July	6.9	7.0	7.0	6.9	7.0	6.8	0.2	0.2		
August	7.0	7.1	7.0	7.0	7.0	6.9	0.2	0.1	0.2	0.2
September	6.8	6.9	6.9	6.8	6.9	6.8	0.1	0.1		
October	6.8	6.9	6.9	6.8	6.8	6.8	0.1	0.1		
November	6.7	6.8	6.7	6.8	6.7	6.8	0.1	0.2	0.1	0.3
December	6.4	6.4	6.3	6.4	6.3	6.4	0.1	0.1		

Table 4. The Standard Errors for the Level and Change of the Unemployment Rate
Percentage points

	Monthly		Quarterly		Annual	
Type of error	Level	Change	Level	Change	Level	Change
Sampling	0.12	0.12	0.09	0.11	0.06	0.08
Seasonal adjustment						
Revision	0.12	0.12	0.10	0.10	0.00	0.00
Model uncertainty	0.15	0.08	0.08	0.15	0.00	0.00
Statistical	0.10	0.11	0.05	0.06	0.00	0.00
Full standard error	0.22	0.22	0.16	0.22	0.06	0.08

Source: Calculations by the author as described in the text.

amine alternative labor market indicators in addition to the unemployment rate. These might include data generated by the unemployment insurance system and the BLS establishment survey. Such data have the additional virtue of being free of some of the conceptual difficulties that plague the unemployment rate. As Kim Clark and I have urged elsewhere, changes in employment, measured by the establishment survey, may provide a better guide to changes in labor market conditions than changes in unemployment because of ambiguities in the definition of the labor force.[10]

The results in this paper suggest that a large part of monthly unemployment fluctuations are spurious. It would be valuable to examine in a similar way the error characteristics of other frequently reported economic statistics such as money supply figures, indexes of industrial production, and wholesale and consumer prices. It is likely that similar error magnitudes would be revealed.

10. Kim B. Clark and Lawrence H. Summers, "Labor Market Dynamics and Unemployment: A Reconsideration," *BPEA, 1:1979,* pp. 13–60.