Communications

Worklife estimates should be consistent with known labor force participation

JOHN L. FINCH

New worklife expectancy estimates were published by the Bureau of Labor Statistics last year and were described at length by Shirley J. Smith in the March 1982 issue of the *Monthly Labor Review.*[1] These new figures are different from those previously published for 1970 for two reasons: First, 1977 data were used. And second, a new methodology was adopted in which the probability of entering or leaving the labor force at a particular age was incorporated explicitly into the model.

The 1970 model, with respect to the worklife expectancy of an individual known to be in the labor force at a given age, assumed that he or she would remain active until reaching the age of peak participation. As Smith observes, this assumption resulted in a worklife expectancy which was overstated for young persons. The new methodology, which measures the extent of movement into and out of the labor force, is conceptually superior to the 1970 model for those individuals whose labor force status is known in the reference year.

Under either model, the expectation of working life at a given age is simply the total number of person-years worked after that age, divided by the number of people alive at that age. Thus, the new model should give the same results for "all persons"—those in, and those not in, the labor force—as did the 1970 model, if the same data base is used in each. This is not the case.

Implicit in any worklife calculation is a labor force participation rate for each age group. Table 1 compares the participation rates implied by the Bureau's new worklife figures with the rates published by the Bureau for 1977.[2] (See appendix for methodology.) As indicated, the Bureau's implicit rates are too low for men (70 percent versus 75.1 percent) and slightly high for women (44.3 percent versus 43.7 percent).

One result of this inconsistency is that, when the new methodology is applied to 1970 data, different expecta-

John L. Finch is an economic consultant with the firm of Bassett, Parks, Silberberg, and Finch in Seattle, Washington.

Table 1. Labor force participation rates, as published, and as implied by the new worklife estimates, 1977				
Age	Men		Women	
	Published rates[1]	Implicit rates	Published rates[1]	Implicit rates
16 and over ..	78.3 [2](75.1)	70.0	48.5 [2](43.7)	44.3
16-17	50.6	40.5	42.2	36.3
18-19	74.4	57.2	60.6	51.8
20-24	86.7	75.1	66.7	62.8
25-34	95.6	92.5	59.5	63.0
35-44	95.8	94.7	59.6	65.3
45-54	91.2	90.4	55.8	60.4
55-64	74.0	67.3	41.0	40.0
65 and over	20.1	14.0	8.1	6.0

[1] These data are from *Handbook of Labor Statistics* (Bureau of Labor Statistics, 1980), table 2, pp. 8–9.
[2] Rates in parentheses have been adjusted for static population.

tions are obtained for "all persons" than were obtained with the old model.[3] This is an incorrect result, for if participation rates and mortality rates are the same in both models, worklife expectancy should be the same for "all persons." Probabilities of leaving and entering the labor force have no effect upon the *total* number of years an average person will work.

For example, suppose two people, Brown and White, are alive at age 97, and Brown works at ages 98 and 99, whereas White is retired. The worklife expectancy for "all persons" is 1 year. Now suppose as an alternative that Brown works at age 98 and then retires, while White reenters the labor market at age 99. The worklife expectancy is still 1 year, because we are not here attempting to distinguish between those, like Brown, who are active in the base year and those, like White, who are inactive.

A second result of this inconsistency is that incorrect "transition probabilities" (probabilities of leaving and entering the labor force) are obtained. As one would expect, transition probabilities are not independent of labor force participation rates. To illustrate, suppose the participation rate for a group is 80 percent in Year 1 and 90 percent in Year 2, and that 10 percent of those alive in Year 1 die by Year 2. If 95 percent of the survivors who were active in Year 1 were still active in Year 2, then 70 percent of those survivors inactive in Year 1 must, by mathematical identity, have become active by Year 2.

To accept the new BLS worklife projections, one must accept the participation rates implicit in those projec-

tions. For example, one must be willing to concede that men in their early 20's, 87 percent of whom are currently in the labor force, are about to drop out in large numbers, leaving a 75-percent participation rate[4]—an unlikely occurrence indeed. (See table 1.) Therefore, one must conclude that the transition probabilities and the Bureau's published labor force participation rates cannot both be correct. (See the appendix for a mathematical proof of this assertion.)

Perhaps the survey from which the transition probabilities were obtained captured the effects of some transitory movement into and out of the labor force. If so, this movement should not be extrapolated into the future, because changes observed in a single sample cannot reliably be projected over people's lifetimes, and because no trend toward significantly lower male participation has been observed between 1977 and the present. Alternatively, it is possible that sampling error by the survey was magnified by iterative computation of the participation rates employed in the Bureau's estimates. In any event, the transition probabilities should be adjusted to make them consistent with known participation rates.

If the labor force participation rates and transition probabilities used in the new model are made consistent with published participation rates for 1977 (see appendix), significantly different worklife expectancies are obtained. Table 2 presents a comparison between the Bureau's 1977 worklife figures and the revised figures calculated by the author. (Results of the author's calculations for single years of age are available on request.) The adjusted transition probabilities are used solely to distinguish people who are currently in the labor force from those who are not. These probabilities do not affect "all person" worklife expectancies, because there is no justification for such an effect, unless observed transition is seen as a predictor of future participation

Table 2. BLS worklife estimates compared with revised figures based on published labor force rates, by sex and labor force status, 1977

[in years]

Sex and age	All persons			In labor force		Not in labor force	
	BLS	Revised	Difference	BLS	Revised	BLS	Revised
Men:							
Age 16 ..	38.5	41.3	+2.8	39.6	42.2	38.1	40.6
Age 20 ..	36.8	39.0	+2.2	37.3	39.4	35.9	37.8
Age 30 ..	29.2	30.7	+1.5	29.3	30.7	27.2	28.6
Age 40 ..	20.3	21.6	+1.3	20.4	21.7	16.9	18.3
Age 50 ..	11.7	13.0	+1.3	12.2	13.4	7.2	8.7
Age 60 ..	4.3	5.6	+1.3	5.2	6.6	1.9	2.8
Age 70 ..	0.9	1.2	+0.3	2.6	2.5	0.6	0.7
Women:							
Age 16 ..	27.7	27.3	−0.4	28.8	28.2	27.4	26.7
Age 20 ..	26.0	25.3	−0.7	26.7	25.9	25.2	24.4
Age 30 ..	19.9	19.1	−0.8	20.9	20.1	18.2	17.6
Age 40 ..	13.7	13.4	−0.3	14.9	14.6	11.4	11.5
Age 50 ..	7.5	7.8	+0.3	9.2	9.6	4.9	5.5
Age 60 ..	2.5	3.1	+0.6	4.4	5.3	1.2	1.6
Age 70 ..	0.5	0.6	+0.1	2.4	2.3	0.2	0.3

Table 3. Changes in men's worklife expectancies by age during 1970–77, as estimated by BLS and as revised

[in years]

Age	BLS estimates			Revised figures		
	1970	1977	Difference	1970	1977	Difference
16	41.4	38.5	−2.9	41.4	41.3	−0.1
20	39.4	36.8	−2.6	39.4	39.0	−0.4
30	31.2	29.2	−2.0	31.2	30.7	−0.5
40	23.2	20.3	−2.9	23.2	21.6	−1.6
50	14.8	11.7	−3.1	14.8	13.0	1.8
60	7.4	4.3	−3.1	7.4	5.6	−1.8
70	5.4	.9	−4.5	5.4	1.2	4.2

which somehow invalidates currently observed participation rates.

As previously indicated, worklife estimates consistent with published participation rates are substantially greater for men and slightly lower for young women than those issued by the Bureau last year. Additionally, Table 3, which presents the original estimates and the revised figures for the 1970–77 trends in worklife expectancy for men, indicates that, while labor force participation has indeed fallen for older men, the drop is less than originally reported.

The increment-decrement model remains a useful tool for distinguishing the work expectancies of persons now in the labor force from those of persons who are not. However, it adds no information to the conventional model for predicting the worklife of "all persons." In any case, if the model is applied correctly, the estimates should be consistent with known labor force participation.

Methodological appendix. The labor force participation rates for specific ages were obtained by solving the 10th degree polynomial:

$$f(x) = \sum_{i=0}^{10} a_i x^i$$

where x is age and $f(x)$ is the fraction of those born who are in the labor force at exact age x. The solution for the 11 coefficients, a_i, is possible because

$$\int_u^v f(x)dx$$

is known for the eight age groups (16–17, 18–19, 20–24, 25–34, 35–44, 45–54, 55–64, and ≥ 65) and because it was assumed that $f(99) = 0$, that the BLS figure for $f(75)$ is correct, and that the BLS figure for

$$\int_{75}^\infty f(x)dx$$

is correct.

Given that

(1) $A_{t+1} = (AA)A_t + (IA)I_t$,

where A_t is the number of active persons at age t, I_t is the number of inactive persons, (AA) is the fraction of active persons who remain active until the next age $(t+I)$, and (IA) is the fraction of inactives who become active; and, given that all those alive, N_t, are either active or inactive:

$$(2) \qquad N_t = A_t + I_t;$$

given that the participation rate, W_t, is the fraction of those alive who are active:

$$(3) \qquad W_t = \frac{A_t}{N_t};$$

and, given that the probability of remaining alive for one year, P_t, is:

$$(4) \qquad P_t = \frac{N_{t+1}}{N_t};$$

then it follows that:

$$(5) \qquad (AA) = P_x \frac{W_{t+1}}{W_t} - \left(\frac{1}{W_t} - 1\right) (IA).$$

That is, if mortality and participation rates are known (that is, P and W are given), then the transition probabilities, (AA) and (IA) cannot equal just any values which happen to appear in a sample. If those values do not lie along the line segment defined by equation 5, then either they or the underlying mortality and participation rates must be incorrect.

In fact, the transition probabilities used in the BLS estimates for males lie mainly below this locus (like B):
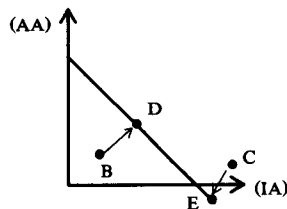
A first attempt to adjust the BLS transition probabilities minimally by moving to the locus perpendicularly (B to D) led to some negative figures (C to E). Therefore, it was decided to adjust all figures proportionately (B to D' and C to E'):
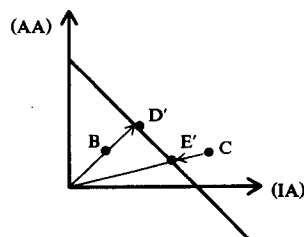
———FOOTNOTES———

[1] Shirley J. Smith, "New worklife estimates reflect changing profile of labor force," *Monthly Labor Review*, March 1982, pp. 15–20.

[2] *Handbook of Labor Statistics*, Bulletin 2070 (Bureau of Labor Statistics, 1980), pp. 8–9.

[3] See Smith, "New worklife estimates," table 3, p. 17.

[4] See Shirley J. Smith, *New Worklife Estimates*, Bulletin 2157 (Bureau of Labor Statistics, 1982), table 4A, p. 10. An example of an implicit participation rate for 20-year-old men would be 63,850/96,892 = 75.1 percent, well below the 86.7 percent actually observed for such persons.

Labor force participation rates are not the relevant factor

SHIRLEY J. SMITH

The new BLS worklife estimates presented in my article in the March 1982 issue of the Review are the result of a computer simulation spelling out the lifetime implications of age-specific mortality, labor force entry, and exit rates which prevailed in this country during 1977. They were derived using a new model, known as the increment-decrement working life table. This model was tested against its predecessor, the conventional worklife model, and judged superior because of its explicit allowance for movement into and out of the job market at midlife. (The earlier technique had estimated worklife expectancies and entry and exit rates from a cross-sectional profile of labor force activity rates. This entailed assuming continuous labor force involvement from age of first entry to age of final retirement.)

The preceding critique by John L. Finch maintains that, because the labor force participation rates implicit in the new 1977 working life tables do not match annual average rates for the year published elsewhere by BLS, the worklife expectancies displayed in these tables are wrong. To paraphrase his argument, the implicit rates for men are too low and those for women are somewhat high. As a result, "incorrect 'transition probabilities' . . . are obtained." He states that, through biased entry and exit rates, errors are passed on to the worklife expectancy figures. According to Finch, the 1977 tables understate the length of working life for men and overstate that of younger women.

Finch makes a number of valid observations which, on first reading, seem to substantiate his claim. He is correct in noting that, if the participation rates and

Shirley J. Smith is a demographic statistician in the Division of Labor Force Studies, Bureau of Labor Statistics.