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ALTERNATIVE MEASURES OF THE AVERAGE DURATION OF UNEMPLOYMENT

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Four alternative measures of the average duration of unemployment are examined with the intention of illustrating: (1) the biases inherent in the average incomplete duration of unemployment, a statistic that is often the only one reported by many statistical agencies; and (2) the robustness of the average complete duration of unemployment to a host of assumptions underlying its derivation by non-parametric methods. Canadian data are employed, but the results offer a guide to the construction of the average complete duration of unemployment that may have broader applications.

The unemployment rate, while certainly being one of the most closely watched economic indicators, offers on its own a rather incomplete picture of the labour market. An unemployment rate of say 10 percent may reflect a situation in which 10 percent of the labour force becomes unemployed each month and spends only a few weeks looking for a job, or a case in which the same 10 percent is unemployed for the entire year. In the first scenario the labour market is characterized by a great deal of flux with a spell of unemployment not having serious consequences, while in the latter it is a stagnant market with unemployment implying severe hardship. The welfare implications of these two possibilities may be very different, and to accurately understand the situation requires a reliable indicator of the average duration of a spell of unemployment.

While the design of the Canadian Labour Force Survey (LFS) or the U.S. Current Population Survey (CPS), like that of similar surveys in other countries, have long recognized the dynamic nature of the labour market, official releases of information on the duration of unemployment are limited to grouped data on the reported spell lengths, and the average duration of in-progress (that is incomplete) unemployment spells. This information has been used to develop measures of the average length of a *complete* spell of unemployment with both non-parametric and parametric methods. Baker and Trivedi (1985) suggest that non-parametric methods, which rely on the results of Kaplan and Meier (1958), are superior. Kaitz (1970) using data from the CPS is an early example. More recent examples from the United States are Sider (1985) and Baker (1992a), while Corak (1993) uses Canadian data.

This well established literature has led to important insights that can be used to reconsider the way duration statistics are officially released. The major objective of our research is to explore some of these insights in order to illustrate the issues that would have to be addressed in order to develop a statistic that is sufficiently

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robust for official release. Canadian data are used throughout, but our analysis may offer a guide to those using information from other countries. We examine four alternative measures of the average duration of unemployment, paying particular attention to their cyclical properties. We begin by comparing the average incomplete duration of unemployment to our preferred measure of the average complete duration with the intention of illustrating some of the biases in the former. We then discuss the derivation of the latter, pointing out some of the important underlying assumptions. By changing these we are able to derive two further measures of average complete duration, one of which has less demanding data requirements while the other has more demanding requirements. We also examine the robustness of the statistic to the manner in which response biases inherent in the data are corrected.

1. An Overview

The average duration of unemployment, as it is released by Statistics Canada, is derived from a sample of currently unemployed individuals. The LFS does not capture the complete length of an unemployment spell, only the time spent unemployed up to the reference week. The spell may continue for some time afterwards, or it may end the next day. The average duration of unemployment is the sum of all these in-progress spell lengths divided by the number of unemployed.[1] As such the official statistic is the average *incomplete* duration of unemployment for the *currently* unemployed.

The preferred statistic derived and examined in this paper is the average expected complete duration of unemployment for a cohort of individuals who begin their spell of unemployment at the same time. It is a measure of the complete length of an unemployment spell, but is based upon the assumption that the economic conditions prevailing at the time a cohort becomes unemployed will continue throughout the entire spell. In what follows we refer to it as simply "the average complete duration of unemployment."

The average incomplete duration of unemployment is a biased measure of the average complete duration for two reasons: a length bias and a sampling bias. These are clearly presented and discussed in Salant (1977). The length bias arises, obviously enough, from the fact that only in-progress spells are sampled: it implies an underestimate of the complete spell length. The sampling bias refers to the fact that the probability that an unemployed individual will be captured by the survey is proportional to the length of his or her unemployment spell: those experiencing short spells of unemployment will as a result be under-sampled by such point in time surveys. This bias implies that the complete spell length will be overestimated. Salant provides a theorem to show that the average incomplete duration will be

[1] For the most part the LFS classifies survey respondents as unemployed if they are without work and looking for work. Individuals classified as being on temporary layoff are not required to fulfill the job search requirement in order to be considered unemployed. In this case the duration of employment is the number of weeks since the layoff began. Furthermore, individuals may also be deemed unemployed in the LFS if they have found a job and expect to start within four weeks. The duration of unemployment is recorded for these "future starts" only if they also happened to be searching for work in the reference week. See Statistics Canada (1992).

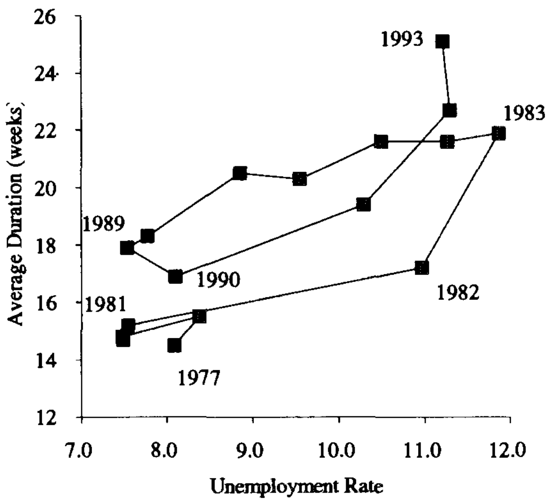

Figure 1. Average Incomplete Duration of Unemployment, Canada 1977–93

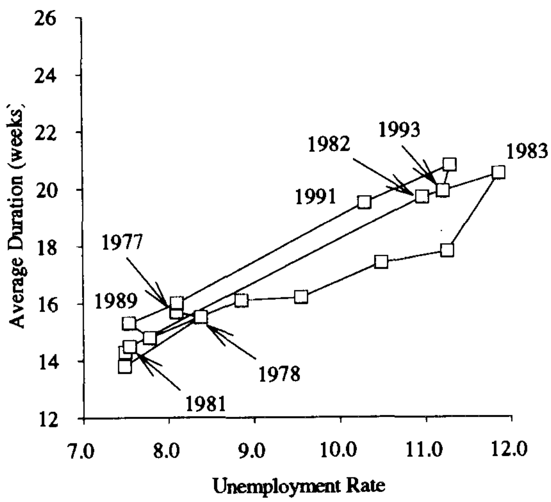

Figure 2. Average Complete Duration of Unemployment, Canada 1977–93.

greater than the average complete duration if the hazard rates governing the transition out of unemployment decline with time spent unemployed, that is the sampling bias will outweigh the length bias. For the most part this is the case in the data we examine. Over the 1977–93 period the average incomplete duration is 18.7 weeks, while the average complete duration is 16.9 weeks.

This difference between the two statistics is well known. Another difference that deserves mention concerns their cyclical variation. The relationship between each and the Canada wide unemployment rate is depicted in Figures 1 and 2. The average incomplete duration displays a broad counter-clockwise loop. In large part this is due to the fact that the composition of the unemployed changes over the business cycle, with the result that the average incomplete duration is a lagging cyclical indicator. At the onset of a recession large inflows into unemployment result in the stock of unemployed becoming more heavily weighted with individuals just beginning a spell of unemployment. While these individuals may ultimately experience long spells of unemployment, only the length of unemployment up to the time of the survey is used in calculating the average spell length. For example, between 1981 and 1982 as the economy entered into recession the unemployment rate increased by 3.5 percentage points, but the average LFS duration increased by about only one week. Similarly, as the economy moved from expansion to recession between 1989 and 1990 the unemployment rate increased, but the average incomplete duration actually fell.[2]

The pattern is just the opposite during recovery and expansion: flows into unemployment fall, and the stock of unemployed becomes more heavily weighted with individuals who are in the midst of rather long spells that began during the recession and reflect the state of the economy during that period. Thus, as recovery took hold in 1983, the unemployment rate rose by less than one percentage point, but the average duration increased by about five weeks. Between 1983 and 1985 expansion was well under way and the unemployment rate fell 1.5 percentage points, but there was virtually no change in the average incomplete duration of unemployment. Similarly between 1992 and 1993 the unemployment rate fell slightly, but the average duration of unemployment increased by almost 2.5 weeks.

In contrast the cyclical variation in the average complete duration of unemployment for those just becoming unemployed is stable throughout the period. There is a loop in the data, but it is a muted clockwise movement. Furthermore, the turning points in the movement of the statistic correspond to peaks and troughs in labour market conditions. The average complete duration peaks at the same time as the unemployment rate, declines during recovery and expansion, and increases with the onset of recession. The change in this statistic during the recession of the 1990s appears to follow roughly the same path as during the 1981–82 recession.

2. Methodology

Our derivation of the average complete duration of unemployment follows the work of Sider (1985), Baker (1992a), and Corak (1993) in using a synthetic cohort approach. This approach need not rely upon a steady state assumption, one that characterizes many earlier derivations.

Let $S(x, t)$ represent the conditional probability that an individual will stay unemployed at least to the x-th month given that he or she has been unemployed for x-1 months. $S(x, t)$ is one minus the hazard rate, and we refer to it as the continuation rate. It can be estimated from a sample of unemployed individuals as $N(x, t)/N(x\text{-}1, t\text{-}1)$, where $N(x, t)$ represents the number of individuals unemployed x months. That is, the probability of suriving to the x-th month of unemployment given unemployment of x-1 months is simply the ratio of the number

[2]The 1981–82 recession began in July 1981 and ended in October 1982 while the recession of the 1990s began in April 1990 and ended in April 1992. See Cross (1995).

of individuals reporting to be unemployed x months during period t to the number of individuals who reported being unemployed x-1 months during the previous month. It should be underscored that the same individuals are not being compared through time, rather a series of representative cross-sections. This is what we mean by a "synthetic" cohort.

We calculate six continuation rates from LFS data on the reported number of weeks of unemployment using progressively wider intervals: one month, two months, three months, four to six months, seven months to 12 months, and greater than 12 months. Wider bands are required at longer durations because of sample size limitations.[3] The fourth, fifth, and sixth continuation rates are converted to monthly equivalents by raising them respectively to the 1/3, 1/6, and 1/12 powers. This assumes that the monthly continuation rates are constant within each interval. These monthly rates are used in the derivation of the average expected complete duration of unemployment which, for a group of individuals who begin their unemployment spell at time t, is given as:

$$(1) \qquad ExpectedAvgDur(t) = \sum_{x=1}^{n} \prod_{i=1}^{x} S(i, t)$$

where $n = 25$ in our data. The first element in this summation is one. Each element is an estimate of a point on the survivor function, and the summation is the discrete time version of the result that in continuous time the average duration is equal to the integral of the survivor function.[4]

Two alternative estimators can be derived by, on the one hand, imposing a restriction, and on the other by relaxing a restriction. Equation (1) does not rely on a steady state assumption, but if such a restriction were imposed the derivation of the statistic would, from a data manipulation perspective, be simplified. In a steady state both the rate at which individuals become unemployed and the continuation rates are constant so that inflows into unemployment equal outflows. In this case $N(x\text{-}1, t)$ would equal $N(x\text{-}1, t\text{-}1)$ and $S(x, t)$ would simplify to $N(x, t)/N(x\text{-}1, t)$, the probability of surviving to the x-th month of unemployment is the ratio of those reporting to be unemployed x months during period t to those reporting x-1 months in the same period. It is in this way possible to derive the average complete duration of unemployment using the survey results from only one month of data.

Another estimator can be derived if an underlying assumption in the construction of the non-steady state estimator is relaxed. The estimator described by equation (1) is based upon the assumption that current economic conditions will continue into the future. In particular, it is assumed that the continuation rates, calculated on the basis of the labour market experience of the unemployed in the

[3]Specifically the continuation rates are derived as the ratios of the number of individuals in each of the following categories: 5–8 weeks in month t to <5 weeks in month $t-1$; 9–12 weeks in month t to 5–8 weeks in month $t-1$; 13–16 weeks in month t to 9–12 weeks in month $t-1$; 27–39 weeks in month t to 13–26 weeks in month $t-3$; 53–78 weeks in month t to 27–52 weeks in month $t-6$; 99 + weeks in month t to 53–98 weeks in month $t-12$. The LFS data are top coded at 99 weeks.

[4]Let τ index the complete duration of an unemployment spell, and let $f(\tau)$ represent the associated density function. Then $\mathscr{F}(\tau) = \int_0^\tau f(u)\, du$ is the cumulative distribution function, and $\mathscr{S}(\tau) = 1 - \mathscr{F}(\tau)$ is the survivor function. The average duration of unemployment is $\int_0^\infty \tau f(\tau)\, d\tau$. Integrating this expression by parts yields $\int_0^\infty \mathscr{S}(\tau)\, dt$. See Baker and Trivedi (1985) for more details.

recent past (that is up to one year ago), will prevail for the duration of the unemployment spell. This is not as restrictive as a steady state assumption, but it may nonetheless imply that the statistic will not be perfectly accurate.

It is possible to calculate the average duration of unemployment based upon the actual experience of a synthetic cohort of unemployed by incrementing the reference continuation rates in the following manner.

$$(2) \qquad ActualAvgDur(t) = \sum_{x=1}^{n} \prod_{i=1}^{x} S(i, t+i).$$

In contrast to equation (1), which may be referred to as a "backward-tracking" estimator, this is a "forward-tracking" estimator. It can be computed from the same set of continuation rates used earlier, but by following the experience of a synthetic cohort forward through time.

Thus, the steady state estimator has a computational advantage over the non-steady state estimator in that information from only one survey is required. When a repeated cross-sectional survey has not been undertaken for a sufficient number of periods this may be the only estimator available. Its accuracy, however, will depend upon the validity of the steady state assumption, an assumption that is unlikely to hold at business cycle turning points or in general when inflows to or outflows from unemployment are changing. The forward tracking estimator is based upon the least restrictive assumptions and is therefore the most likely of all the alternatives to be closest to the truth. Its major disadvantage, however, is the rather severe data requirements that imply it could only be calculated with a lag of about two years. Even so this estimator is of interest for our purposes because it offers a tool to assess the validity of the others.

3. DATA

The LFS requires unemployed survey respondents to report the duration of their unemployment spells in weeks. We use the monthly survey results from 1976 through 1993. The frequency distribution for the entire sample reveals significant spikes in the data at two, and especially four week intervals. There are also notable spikes at 52 weeks and 99 weeks (see Figure 3). In reporting their unemployment spells survey respondents seem to prefer even numbers to odd, and months to part months. This digit preference has also been observed in CPS data. Sider (1985) suggests that the data be smoothed before the average duration is calculated and Baker (1992b), also using the CPS, explores the implications of various smoothing assumptions. Since broad intervals are being used in the derivation, smoothing need only occur for those weeks on the interval boundaries: some fraction of individuals reporting a spell length that coincides with these boundaries need to be reallocated to the next interval. Sider reallocates 50 percent, and Baker (1992a) reallocates 30, 40, 50 percent at progressively longer intervals. Corak (1993) follows Baker's algorthm with LFS data. Baker and Trivedi (1985) note that while it is preferable to use the narrowest possible intervals in the derivation of the average duration, there may actually be a trade-off: the narrower the intervals the more apparent the digit preference, and hence the more sensitive the results to the (arbitrary) smoothing assumptions adopted. In other words, wider

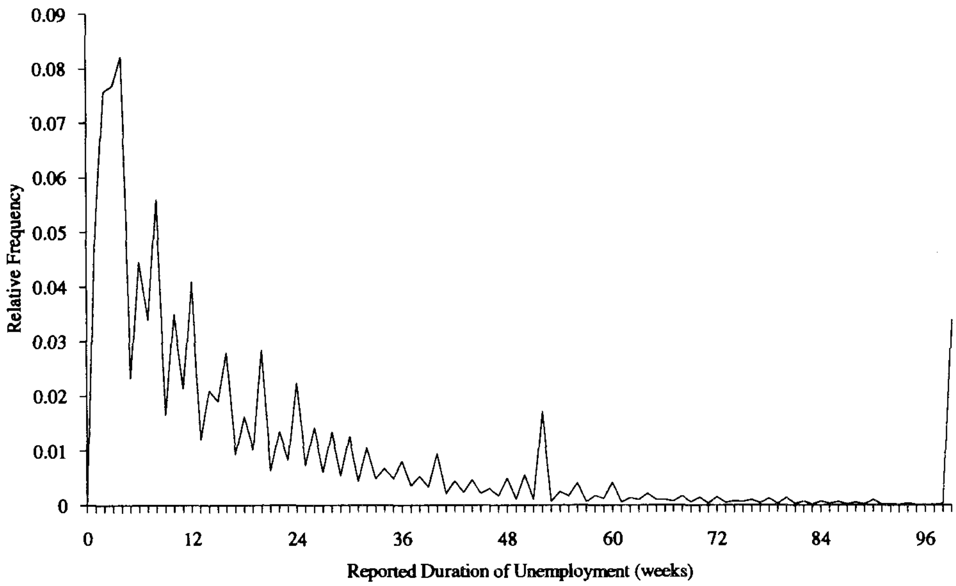

Figure 3. Sample Frequency Distribution, LFS Reported Duration of Unemployment Canada 1977–1993

intervals may reduce the efficiency of the statistic but they may also reduce the distortion caused by measurement error. The spike at 99 weeks represents both the effect of digit preference and the truncation of the distribution due to top coding by survey administrators. An assumption must be made regarding how this spike is allocated among adjacent intervals. Sider (1985), Baker (1992a, 1992b) and Corak (1993) base their smoothing on the assumption that half of the respondents are at 99 weeks because of a response bias.

The choice of smoothing weights in the existing literature is made arbitrarily. The design of the LFS, however, permits a closer analysis of the nature of this response bias. The LFS has a rotational design with respondents being surveyed for six consecutive months before being dropped. Paul (1986) uses linked records of individual responses between adjacent survey months to examine the response bias inherent in the reported weeks of unemployment. She finds that the unemployed who are classified as job seekers (about 89 percent of unemployed respondents) show consistent month to month responses 67.8 per cent of the time (over the 1979–82 period). Paul codes the duration responses into four week intervals, and defines a consistent response to be a linked record which shows an increase by one interval between adjacent survey months. The change in duration from one month to the next was on average 2.9 weeks for inconsistent reporters, less than the expected four weeks. Thus, there is on average (for about 30 percent of the sample) a tendency to under report unemployment duration. Similar results were found for those unemployed because of temporary layoff. As a rough rule of thumb these findings suggest that the appropriate weight for smoothing LFS data might be in the range of 30 percent and that the redistribution should be towards longer durations.

4. Results

The three alternative measures of the average complete duration of unemployment are presented in Table 1 for 1977 through 1993, with the exception of the actual average duration which is available only up to 1991 due to the need to follow the synthetic cohort forward through time. As mentioned, the derivation of this estimate embodies the least restrictive set of assumptions, and is likely the most accurate. As such it represents a reference case by which to judge the other two measures.

TABLE 1
Alternative Measures of the Average Complete Duration of Unemployment (weeks)

Year	Expected Non-Steady State	Expected Steady State	Actual (forward tracking)
1977	15.7	14.8	15.2
1978	15.5	15.2	14.8
1979	13.8	14.2	14.0
1980	14.3	14.0	14.3
1981	14.5	13.8	17.5
1982	19.7	16.6	19.1
1983	20.5	19.9	18.0
1984	17.8	18.0	16.8
1985	17.4	17.8	15.8
1986	16.2	16.5	15.2
1987	16.1	16.4	14.8
1988	14.8	15.2	14.9
1989	15.3	15.0	16.6
1990	16.0	14.9	19.4
1991	19.5	17.6	21.1
1992	20.8	18.9	N.A.
1993	19.9	20.2	N.A.
Mean (S.D.)	16.5 (2.08)	16.0 (1.75)	16.5 (2.12)

Note: Table entries are annual averages of monthly data and are based upon a smoothing weight of 0.3. The mean and standard deviation are calculated for 1977 through 1991. N.A.—not available.

Over 1977 to 1991 the non-steady state estimate has virtually the same mean and standard deviation as the actual estimate (16.5 and 2.1 weeks). There are notable differences, however, in the cyclical patterns of the two statistics. The actual average complete duration (that derived by forward tracking) follows the business cycle closely, rising sharply between 1980 and 1981, peaking at 19.1 weeks during 1982 as well as reaching a low of 14.8 weeks during 1987. In fact it leads the onset of the 1990 recession, rising sharply between 1988 and 1989. In contrast the turning points of the non-steady state estimator are a year later, the peak at 20.5 weeks in 1983, and the low at 14.8 weeks in 1988. It also rises in 1989, but not as sharply. The backward tracking method leads to an underestimate of the average duration during recessions, and an overestimate during recovery and expansion. The differences between the two statistics can be substantial at the business cycle turning points. During 1981 the non-steady state estimate is 3.0 weeks shorter than the actual, but 2.5 weeks longer during 1983. Similarly at the onset of the recession in 1990 it was as much as 3.4 weeks below the estimate derived by forward tracking. The absolute difference between the two estimates is greater than one week in 7 of the 15 years for which data are available.

Clearly, the assumption that current economic conditions will continue into the future is violated around cyclical turning points. If the labour market is deteriorating continuation rates should be expected to increase with the result that the average duration calculated from backward tracking will understate actual developments, while if they are improving continuation rates should be expected to decrease with the result that it will overstate the truth.

The patterns displayed by the steady state estimate relative to the actual estimate are similar in nature, but greater in degree. The steady state estimator leads to an overall average duration of 16.0 weeks with a standard error of 1.75, slightly less than the other two estimators. It lags the business cycle even more than the non-steady state estimate. Both non-steady state and the actual estimate of average duration increase during the run-up to the 1981–82 recession, but the steady state estimate decreases in each year between 1979 and 1981, increasing only in 1982. A similar pattern occurs between 1988 and 1990. As a result the differences between the steady state and the actual estimate are even greater than the differences between the non-steady state and the actual estimate. In 1981 the steady state estimate is 3.7 weeks shorter than the actual, and in 1990 4.5 weeks shorter. The difference between the two exceeds one week in 10 of the 15 years.

These patterns are due to the fact that changes in the incidence of unemployment associated with recession and expansion cause the cross section of in-progress spells used in the steady state calculation to become too heavily or too lightly weighted by shorter duration spells. As a result the steady state estimate is lower than the actual estimate and even the non-steady state estimate at the onset of recessions (as incidence rises), and above both during recovery and expansion (as incidence falls).

The information presented in Table 2 illustrates the effect of various smoothing assumptions on the non-steady state and steady state estimates of average complete duration. In all cases we assume that no smoothing is required at 99 weeks. As the weight used in the smoothing aglorithm increases from 0 to 0.5, the average spell duration lengthens by about 3 weeks, from 15.2 to 18.3 weeks for the non-steady state estimate. The effect of changing the smoothing assumption upon the steady state estimate is similar, increasing the overall average by about 3 weeks from 14.8 weeks with no smoothing to 17.7 weeks with a weight of 0.5.

The choice of the smoothing weight is most critical for those weeks representing the densest part of the distribution. In particular, the magnitude of the estimate obtained is influenced in the first instance by the weight chosen to reallocate the number of respondents reporting four weeks of unemployment. For example, when 30 percent of those reporting four weeks are allocated to the next interval but no other reallocations are made the average duration over 1977–93 is 16.6 weeks. This figure is only 0.3 weeks less than that resulting from a reallocation of 30 percent for all of the transition weeks. In fact, the smoothing of just this one point changes the overall average duration by 1.4 weeks, from 15.2 to 16.6 (see the entry in the first column, first row of Table 2). Thus, the duration

TABLE 2

IMPACT OF CORRECTIONS FOR RESPONSE BIAS ON THE AVERAGE COMPLETE DURATION OF UNEMPLOYMENT: STEADY STATE AND NON STEADY STEADY ESTIMATES (weeks)

Weight Used in Correcting Response Bias	Non-Steady State	Steady State
0.0	15.2	14.8
0.2	16.3	15.8
0.3	16.9	16.4
0.4	17.6	17.0
0.5	18.3	17.7

Note: Data are averages over 1977 to 1993.

estimate is highly dependent upon the weight chosen for the fourth week, but not very senstivie for other transition weeks associated with longer spell durations.

The effect of smoothing the data spike at the top code of 99+ weeks is also important. We modified our preferred estimator which uses a weight of 0.3 at all intervals by reallocating 50 percent of respondents at the top coded value into the preceding interval. This has the effect of reducing the average duration from 16.9 weeks to 16.2 weeks. As illustrated in Figure 3 this data point represents fully 3 percent of the sample, and thus any adjustment made to it have a significant influence on the overall estimate. The decision of how much to smooth at this interval centers upon how much of the response is due to the truncation of the distribution, and how much is due to response bias. If response bias causes an insignificant fraction then no smoothing is required. Since smoothing of responses beyond the fourth week has little effect upon the duration statistic we expect that smoothing for response bias at 99 weeks may also have little effect. Even if the response bias at 99+ weeks is as large as that at 52 weeks, the smoothing of it still would not significantly affect the final estimate.[5]

5. CONCLUSIONS

In this paper we examine several issues associated with the derivation of the average complete duration of unemployment. There are four major results. First, the average complete duration of unemployment is a superior indicator of prevailing labour market conditions than the average incomplete duration. The former offers an indication of the duration of unemployment that those becoming unemployed can be expected to experience, and its fluctuations correspond with turning points in the business cycle. The average incomplete duration, on the

[5]We also examine the effect of using wider intervals in the calculation of the continuation rates in our working paper, Corak and Heisz (1995a). In our data the loss of information in widening the intervals overrides any possible improvements through an attenuation of response bias. This underscores the importance of using as narrow an interval specification as possible, at least for the short tail of the distribution. It should be noted, however, that Baker and Trivedi (1985) reach the opposite conclusion.

other hand, is a lagging cyclical indicator, and can lead to grossly incorrect inferences about the current state of the labour market. It measures the experience that the currently unemployed have had, not what those currently becoming unemployed will have. Second, the non-steady state estimator of the average complete duration is preferred to the steady state estimator. The latter is significantly shorter than the former during the onset of recessions. While there are computational advantages associated with the use of a steady state assumption they are not that great, unless of course a sufficiently long series of repeated cross sectional surveys is not available. Third, in spite of this the non-steady state estimator will not be entirely accurate around business cycle turning points because it is based upon the assumption that the economic conditions prevailing in the recent past will continue through the course of the unemployment spell of those just becoming unemployed. We derive an estimator based on the tracing forward in time of a synthetic cohort of unemployed that is free of this problem. The non-steady state estimates may understate the figure derived from this forward tracking estimator by as many as 3 weeks or more at the onset of a recession, and can overstate it by as many as 2.5 weeks at the onset of expansion. The data requirements associated with the forward tracking estimator, however, prevent it from being produced on a timely basis. It may nonetheless be of interest for historical or diagnostic reasons. Fourth, and finally, the assumptions used in the smoothing of the underlying data in order to correct for response errors in reported duration have an influence on the level of the duration statistic. Smoothing is most important for the densest part of the distribution, generally the fourth week but also those points that correspond to top coding of the data by survey administrators.

Caution is required in extending these findings to data from other countries. The choice between the steady state and non-steady state is clearly in favour of the latter when the appropriate data are available, but the choice of a smoothing weight is less clear-cut. The existing literature appears to make an arbitrary decision. In our data a weight of 0.3 is defensible on the basis of an analysis of the reporting patterns of survey respondents, something that may vary from country to country. This issue, and the treatment of top coding, would require further exploration before any universal recommendations could be made.

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