Worklife Expectancy and Earning Capacity in Personal Injury Cases[1]

December 24, 2018

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Abstract

Forensic economists often use worklife statistics to estimate how long labor earnings losses may run into the future. Familiar worklife statistics describe years of expected labor force participation, allowing for voluntary time out of labor force, and are not ideal for describing years of additional work for an individual that pursues their full earning capacity. Each person's worklife can be cut short by involuntary risks of death, disability, unemployment, etc., but may also depend on voluntary non-employment, financial support from others, and societal or behavioral norms about retirement. The present work calculates worklife expectancy under the assumption that a person receives no financial support until retirement, and then pursues a normative retirement goal. The worklife estimates are suited to personal injury and wrongful death cases in which the relevant measure of earnings loss is stated in terms of earning capacity.

[1] A previous draft of this paper was presented at the annual meetings of the Western Economic Association International in Vancouver, British Columbia, Canada on 6-29-2010, and for their comments I thank Robert Baumann, Tom Roney, Gary Skoog, and James Rodgers.

1 Introduction

An injured person may suffer a long-term reduction in their ability to work, through the future years which would have been work life but for their injury. The extent of their future worklife, but for their injury, is typically not known with certainty, but can be estimated. A simple approach is to assume that worklife extends to life expectancy – the expected end of life – but this is at odds with the fact that most people retire well before they die, and also face risks of forced non-employment due to job loss and future disabling injuries. Another approach is to assume that worklife ends at some normative retirement age, such as the age at which a person qualifies for "full" Social Security benefits. This approach shortens the worklife estimate, compared to reliance on life expectancy, but still ignores some risks of non-employment. Subtracting from normative retirement age years associated with non-employment risk factors produces a further-reduced estimate of worklife. In the history of personal injury law, by year 1980 there was already criticism of reliance on Social Security retirement age for worklife assumptions, due to upward bias caused by neglected risk factors. Since then, courts have entertained a variety of methods to incorporate such risks into worklife estimation.

The present work discusses worklife estimation in relation to legal and economic notions of earning capacity. With the idea that "earning capacity" represents what a person could reasonably do work-wise, rather than what they may be reasonably expected to do, for cases subject to an earning capacity standard it suffices to consider only involuntary causes of non-employment, and ignore voluntary causes, when estimating worklife. Subtracting off non-voluntary risks of non-employment from normative retirement age produces a simple worklife estimate appropriate for estimating earnings loss in cases that are subject to an earning capacity standard of loss. This simplifies worklife estimation and is useful when voluntary non-employment can be ignored. In cases subject to an "expected earnings" standard, with no reliance on earning capacity, it is inappropriate to ignore non-voluntary risks of unemployment, and methods discussed later in this paper should not be used.

The ideas of worklife and earning capacity are combined in the present work, with the aim of simplifying the worklife estimation problem in personal injury cases that are subject to an earnings capacity standard. As a reference point, the following two sub-sections briefly review these ideas.

1.1 Earning Capacity

In personal injury cases, an injured person may suffer a loss of ability to work, with their labor earnings capacity reduced or eliminated by injury. In such cases, forensic economists are sometimes asked to estimate the lifetime economic losses associated with reduced or eliminated earnings capacity. In terms of future losses of labor income, the economist typically cannot know with certainty how much income a person could earn, or for how long they could earn it, in the "but-for" scenario in which they would have worked but-for injury. If the person has some residual ability earn income post-injury, the economist typically cannot know with certainty the span of worklife in the "with-injury" scenario.

In personal injury cases the relevant measure of lost earnings is often earning capacity, which can be interpreted as "the monies that a person is able to earn that results from skills and training" according to the current (10th) edition of Black's Law Dictionary, edited by Bryan Garner and published in year 2014. This Dictionary is often referenced by lawyers, and the term *earning capacity* appears with the same definition in the second edition of the Dictionary – which was published in 1910.[2] Denoting by BLD2 this definition of earning capacity, in personal injury law BLD2 suggests a framework in which to quantify outcomes in possibly counter-factual situations: how much income would a person earn if they used their skills and training? Some people choose never to work, and if they have valuable skills and training then their BLD2 earning capacity is their earnings in the counter-factual situation where they do work.

Earning capacity, in the BLD2 sense, relates to counter-factual earning opportunities that plaintiffs may claim as economic losses in cases where personal injury limits a person's ability to work. In courts that allow plaintiffs to claim a loss of earning capacity, economic damages will be greater than in courts where counter-factual earning scenarios are excluded, for those plaintiffs that choose never to work. Hence *earning capacity* is both a term of art and an important element of civil procedure in personal injury law.

The economics profession studies peoples choices' of labor and leisure, and relates these choices to key institutions including labor markets and the family as a social unit. Labor economics sheds light on the determinants of wages, labor market frictions, and labor force participation. It provides predictions of income for persons of a given age, education, experience, sex, and race. Such predictions foretell what will happen to people who choose to work. For those that choose not to work, prediction of their counter-factual income is not necessarily an interesting exercise from the standpoint of labor economics, but becomes interesting in connnection to poverty and economic policy. Garfinkel and Haveman (1975, 1977) study of poverty and the extent to which capacity under-utilization and/or low earning capacity itself causes poverty.[3] The term *earning capacity* appears in the lexicon of labor economics via the first volume of the Handbook of Labor Economics, published in 1986, wherein Yoram Weiss defines it as the maximal amount of net current earnings which is attainable given a person's human capital and hours worked.[4] This labor economics definition of earning capacity is similar to the BLD2 legal definition.

Forensic economists often estimate losses of earning capacity in personal injury cases, and in so doing apply the notion of earning capacity. Different interpretations of what earning capacity means can lead to different loss estimates. Forensic economists Horner and Slesnick (1999) note that courts often attach scant descriptions to what earning capacity means in personal injury cases. Horner and Slesnick interpret the legal meaning of earning capacity to be "the ability to earn money," citing Minzer, Nates, Kimball, Axelrod, and Goldstein

[2]The first edition of this Dictionary, published in 1891 and edited by Henry Campbell Black, does not include *earning capacity* as a defined term.

[3]These authors use the term "earnings capacity" and not "earning capacity."

[4]See this article listed as Weiss (1986) at the end of this paper.

(1991). To provide a clearer sense of earning capacity for forensic economists, Horner and Slesnick (1999) define earning capacity as “the expected earnings of a worker who chooses to maximize the expectation of actual earnings.” This meaning is consistent with the BLD2 law-related definition, and also with Weiss’ (1986) economics-related definition, the latter including the explicit reference to maximization that also appears in the Horner and Slesnick definition.[5] Recently, Horner and Slesnick (2017) revisited the theme of earning capacity, defining the term slightly differently: “the expected earnings of a worker who chooses to maximize the expected present value of future actual earnings.”

The various definitions of earning capacity in the legal, economics, and forensic economics literature make clear that earning capacity is not reduced by voluntary non-employment. If a person can be reasonably expected to earn wages at a job, but chooses not to, the choice of whether or not to work does not add to or subtract from earning capacity. For a person randomly chosen from the population, there is a chance that they may not work for voluntary reasons, and chances of such voluntary non-employment reduce the expected amount of time a randomly chosen person will work. However, they do not reduce the earning capacity of a randomly chosen worker.

1.2 Worklife

Consider now the problem of estimating worklife span or duration for people who maximize their labor earning opportunities. Estimated worklife in this situation should be as long as, or longer, than for people who do not maximize earning opportunities. In some cases there may be little or no difference in worklife estimates, in the framework of earnings capacity and expected earnings, but in other situations the difference may be great. Even in cases where earnings capacity and expected earnings frameworks coincide, special consideration of an individual’s earning capacity may lead to worklife estimates very different than those in familiar worklife tables. For example, Gilbert (2014) considers the worklives U.S. Supreme Court Justices. With lifetime appointments, it is common for Justices to continue serving into their 70s and 80s, and this is made easier with the help of their support staff/clerks. Earnings capacity for Justices may extend to life expectancy, or least through the duration of their full intellectual life. Not surprisingly, worklife estimates from standard worklife tables fall far short of actual worklife for the typical Justice.

With the goal of estimating worklife in an earnings capacity framework, the best way to do so would be to apply relevant economics, statistics, and data in the simplest feasible way. The simplest way to estimate the duration of worklife is to use some fixed reference value like the age at which a person is expected to qualify for full Social Security retirement benefits and/or for Medicare health coverage. In the 1970s, the fixed-age worklife was a common approach used by economists when estimating economic losses in personal injury and wrongful death cases. For many people, the incentives associated with government transfer payments via Social Security and Medicare induce them to retire by age 65 or,

[5] It does not appear that Horner and Slesnick (1999) were aware of the Weiss (1986) article in the Handbook of Labor Economics.

more recently, by age 67 or so. But this sort of normative retirement age, when used as an endpoint year in the process of estimating labor earnings losses, can lead to overestimates of economic loss. A person with a given normative retirement age in the future may be unable to work in some years from now until that age, for reasons like premature death.

Correction for mortality risk is feasible when preparing estimates of worklife years, much as it is possible when estimating life years via life expectancy tables. The Bureau of Labor Statistics (BLS) took this approach in a series of reports on worklife, starting in the 1950s and ending in the 1980s. Two reports in the 1980s, authored by BLS staff economist Shirley Smith (1982, 1986), estimate the total years an individual will remain in the labor force. The estimates adjust for mortality risk and also the risk or the chance that a person will be out of the labor force, via a dynamic statistical model that involves both decrements – an "exit" from a particular state like "alive" or "in labor force" and also increments – an "entry" or "re-entry" into a particular state like "in labor force". Demographers in the 1970s developed this sort of increment-decrement life table to study transitions into and out of marriage, the labor force, and specific regions (via migration), see Rogers (1973), Schoen and Nelson (1974), Schoen (1975), and Rogers and LeDent (1976).

In the 1980s some economists began using increment-decrement worklife estimates when estimating labor earnings losses. The new worklife estimates were notably shorter than normative years-to-retirement based on Social Security retirement age, except for people very near to retirement. To forensic economists, this downward direction of adjustment was reasonable given the potential for years-to-retirement to produce overestimates of economic loss.[6] Also in the 1980s, Brookshire and Cobb (1983) developed an econometric method – called the Life-Participation-Employment (LPE) method – that likewise incorporated mortality and labor market risk factors, and like the BLS method tended to produce smaller estimates of economic loss than did normative years to retirement for a typical person. The BLS has not published worklife expectancy tables since the 1980s, but forensic economists have updated and extended them, see Skoog and Ciecka (2000-2001, 2001a, 2001b, 2002), Millimet, Nieswiadomy, Ryu, and Slottje (2003), and Skoog, Ciecka and Krueger (2011).[7]

The present work considers the expected span or duration of worklife for a person, under the assumption that the person acts so as to achieve their earnings capacity. Brookshire and Smith (1990) note that since "work-life probabilities address the likelihood that full earning capacity will not be achieved by a person at a specified age," a worklife calculation may not be needed for a person who pursues their earning capacity. By comparison, under the assumption that a person behaves in a way that is representative of the population – including those that opt out of the labor force – Brookshire and Smith (1990) argue that work-life probabilities are useful as reductions from earning capacity to expected earnings, and they recommend the LPE method. This method estimates the probability $Pr(E)$ of employment by noting that this probability can be expressed in terms of employment (E), labor force participation (P), and being alive (L). One way of stating this fact is to write

[6] For discussion see Nieswiadomy and Silberberg (1988) and Nieswiadomy and Slottje (1988).

[7] For more discussion see Martin (2010, Section 14-20), Millimet, Nieswiadomy, Ryu, and Slottje (2010) Ireland (2010), and Skoog and Ciecka (2016).

$Pr(E) = Pr(E|P\&L)Pr(P|L)Pr(L)$,[8] with $Pr(L)$ of being alive, $Pr(P|L)$ the probability of participating in the labor force – given that you are alive, and $Pr(E|L, P)$ the probability of being employed – given that you are alive and participating in the labor force. The LPE probability $Pr(E)$ is then an increasing function of life probability and the conditional probabilities of employment and labor force participation.

The present work takes an approach to worklife estimation that is like the "work till retirement" approach common in the 1970s, but with adjustment for the risk that a person can't work in some or all years before retirement. This approach relies on a normative retirement age, whereas the LPE and increment-decrement life table methods make no explicit use of retirement age.[9] In cases where a normative retirement age can be reasonably identified, the approach proposed here may provide a better approach to worklife expectancy and economic loss calculation than available via the LPE and increment-decrement life table approaches, if an earnings capacity standard is relevant.

The proposed reduction in worklife for risk of involuntary non-employment is not counter to the application of an earning capacity standard in employment loss cases, since earning capacity represents the choices of employment-maximizing people who necessarily face risks of non-employment. The fact that the proposed worklife estimator starts with retirement age and "whittles down" from there may seem to deprive the worker some earning capacity, and indeed some workers do work beyond commonly cited normative retirement ages. The rationale for whittling down from retirement age is that, as a matter of law, the earnings capacity standard does not seem to have emerged as a way to afford employment loss compensation to people beyond a normative retirement age, but rather to afford compensation for spouses and parents taking time to be at home and support a family there.

The present work starts with a "planned" or "normative" retirement year and subtracts off chances of involuntary non-work outcomes (death, disability, unemployment, etc.) to estimate the duration of worklife. As an input, risk chances or conditional probabilities require some foundation, stated here in terms of mortality tables and time series econometric models. The resulting worklife expectancy estimates are suited to personal injury and wrongful death cases in which the relevant measure of earnings loss is stated in terms of earnings capacity. The estimates are mean values of a conditional probability distribution of worklife, and as such can be compared to the mean values from a published increment-decrement life (or worklife) table. The conditional probability distributions here use current and historical economic data to forecast situations of unemployment and disability, and in so doing can accommodate individual-specific characteristics like age, sex/gender, education level, region, and initial conditions in which a person starts off as employed or, instead, unemployed. With normative retirement ages typically in the range 65-68, the number of statistical tables that

[8]Since a person must be alive and in the labor force to employed, $Pr(E) = Pr(E\&L\&P)$. By the laws of conditional probability, $Pr(E\&L\&P) = Pr(E\&P|L)Pr(L)$, and also $Pr(E\&P|L) = Pr(E|P\&L)Pr(P|L)$, so $Pr(E) = Pr(E|P\&L)Pr(P|L)Pr(L)$, which on rearranging is $Pr(L)Pr(P|L)Pr(E|P\&L)$, with "LPE" the three events for which this formula evaluates (conditional and unconditional) probabilities.

[9]Shirley Smith, in her BLS research on workife, reports "years to workforce separation" as a retirement age based on worklife span plus estimated years of non-work, see Martin (2010, Section 7-10) for discussion.

might be needed to describe the sort of worklife statistics proposed here is greater than in published worklife tables, but by a factor of four or so, far fewer than the tables that comprise standard forensic economics works on fringe benefits or expected earnings.[10] In exceptional cases, with a retirement age outside the range 65-68, it is still possible to apply the proposed methods in a reasonably simple way.

With the probability of work (in a given future year) equal to 1 minus the sum of non-work risk probabilities, an economist can multiply projected labor earnings times work probabilities through normative retirement age, to get risk-adjusted expected earnings, then get the present value of such earnings when calculating losses in a personal injury or wrongful death case. This may give the same result as getting the present value of projected labor earnings without non-employment risk adjustment but with present values calculated only through normative retirement, but the results of the two methods are generally different.[11] Since non-employment probabilities are a first step in either approach, the econometric methods in the present work are useful for each approach, but the present work focuses on the relatively simple method of truncating annual earnings losses at the estimated end of worklife, with no non-employment risk adjustment to annual labor earnings.

With the idea here being to estimate worklife for a person that pursues their earning capacity, a possible approach is to assume that the person pursues work to life expectancy or nearly so, and this may represent a reasonable retirement plan for Supreme Court Justices and also some forensic economists. On the other hand, for workers that have a lucrative pension plan there may be little or no financial incentive to work beyond some relatively early age like 60, in which case the worker may reasonably be said to make full use of their financial opportunities – afforded by their earning capacity – by retiring early. Most people who work a career, pursue their earning capacity, and plan a retirement age do not choose that age to be the end of life or nearly so. Instead, they choose a retirement age which fits some socially validated or accepted norm.

The present work assumes that the pursuit of earnings capacity is consistent with planned retirement at some normative age. If this age is determined, in some application, to be age 67, the assumption is that the person aims to work till then, and will receive no labor income after that point. This approach voids all earnings losses that would accumulate if in fact the person did work beyond normative retirement age. Whether or not this is a good approach depends on the intent behind the courts' practice of using earning capacity to quantify earnings losses. Historically, an important rationale for the earnings capacity standard was that housewives that earn no labor income but are injured should be able to seek compensation for the loss of their ability to leave the home and earn money from work. The fact that they are able to stay at home and not earn income in the labor market is typically made possible by labor income contributed by their spouse. Absent this spousal support the wife would reasonably be expected to work for pay. If the housewife is injured

[10] See for example *Employer Paid Benefits, 2016* (Expectancy Data Press), with 180 tables, and *Full-time Earnings in the United States, 2015* (Expectancy Data), with 524 tables.

[11] In either approach, the result reflects an implicit assumption that non-employment probability equals 1 beyond normative retirement age.

and a court does not allow her to be compensated for her earnings capacity, the tortfeasor benefits from her spouse's support to her – without which she would likely have to work. This windfall to the tortfeasor from spousal support may be considered unreasonable, a "collateral source" in some sense. A similar rationale for an earnings capacity standard is available for stay-at-home homemaker husbands/fathers.

Problems of tortfeasor windfall and collateral source, which come up in framing earning losses for stay-at-home husbands and wives, could in principle be problematic in framing the losses that would occur if a person were to work beyond a given normative retirement year. If normative retirement is set at Social Security full retirement age, the individual presumably receives transfer payments beyond that age, providing retirement income. Without such transfer payments, the person may reasonably have to work to support themselves. However, while such transfer payments could be a collateral source that may lead to a tortfeasor windfall, this point does not appear to have informed the development of the earning capacity legal standard.[12] Perhaps it will in the future, but as the Social Security retirement age creeps up over time, the prospects for such seem limited.

Given an assumed normative retirement age for a specific individual, at any given age before then the individual faces risks of not making it to retirement age. These risks include death, disability, unemployment, and incarceration. The (conditional) probability of working at some age before retirement equals 1 minus the sum of the relevant risk probabilities, a simple formula that is applicable given estimates of risk probabilities. Adding up the work probabilities until retirement age, the result is the (conditional) mean value of worklife. The same year-by-year work probabilities provide other worklife statistics like median worklife.

The remainder of this paper is organized as follows. Section 2 briefly reviews measures of life expectancy and worklife expectancy. Section 3 develops a model of worklife in the framework of earnings capacity, and evaluates worklife expectancy in this framework. Sections 4 illustrates the models via some hypothetical examples, Sections 5-7 consider the estimation of probabilities that underlie worklife expectancy, and Section 8 concludes.

2 Life Expectancy and Worklife Expectancy

Worklife expectancy statistics, in application to personal injury and wrongful death cases, came in use as an alternative to assuming some fixed age for worklife's end. The essential idea in the BLS's early approach to worklife expectancy was to take the U.S. Life Tables approach to life expectancy and tailor it to worklife expectancy. This simple idea is worth reviewing as background for later sections.

Suppose that in a given year – call it year "0" – a researcher wants to estimate the remaining lifespan of a person that is alive at time 0. Let A_t be the binary random variable that equals 1 if the person is alive in some year $t > 0$, and equals 0 otherwise. The per-

[12]Since the Social Security system provides transfer payments that are deemed needful in many cases, courts may not be much concerned about missed work opportunities to work beyond Social Security retirement age, at least for the typical person.

son's remaining lifespan, as of time 0, is then a sum – denoted here as $S_{L,0}$ – of variables $A_1, A_2, ..., A_n$:

$$S_{L,0} = \sum_{t=1}^{\infty} A_t \tag{1}$$

With $S_{L,0}$ a random variable, suppose it has a known, objective, frequentist probability distribution conditional on information available at time 0. The mean or expected value $E_0[S_{L,0}]$ of this conditional distribution is the traditional notion of life expectancy (LE), which from (1) takes the form:

$$\text{LE} = \sum_{t=1}^{\infty} E_0[A_t] \tag{2}$$

Since A_t is a binary (0 and 1) variable, its expected value $E_0[A_t]$ is the same as the conditional probability $P_0[\text{alive}_t]$ of being alive in year t, in which case life expectancy is the sum of year-specific survival probabilities $P_0[\,\text{alive}_t\,]$:

$$\text{LE} = \sum_{t=1}^{\infty} P_0[\,\text{alive}_t\,] \tag{3}$$

Mortality tables, such as the *U.S. Life Tables, 2014* period tables, provide death and survival counts from which conditional probabilities $P_0[\,\text{alive}_t\,]$ can be estimated for individuals of a known age at time 0, with separate counts and probabilities available for mean and women.

To modify the model of life expectancy (LE) for estimating worklife expectancy (WLE), assume as earlier that a given individual is a known age at time 0. Let the binary random variable W_t equal to 1 if the person is working in a given year $t > 0$, and let $W_t = 0$ otherwise. Let $S_{W,0}$ be the individual's work span, over all years $t = 1, 2, ...$, in which case $S_{W,0}$ is a sum of terms $W_1 + W_2 + \cdots$:

$$S_{W,0} = \sum_{t=1}^{\infty} W_t \tag{4}$$

Since a future year in which an individual is working must also be a year in which they are alive, the year-specific variables W_t and A_t are related via:

$$W_t \leq A_t \tag{5}$$

in which case:

$$S_{W,0} \leq S_{L,0}. \tag{6}$$

In other words, worklife span must be no greater than life span.

Assume that at time 0 there are objective, rational probabilities for the outcomes of each work variable $W_1, W_2, ...$ Based on these (conditional) probabilities, let $E_0[S_{W,0}]$ be the conditional mean of worklife span $S_{W,0}$. From (4), the expected worklife span – or worklife expectancy (WLE) – is:

$$\text{WLE} = \sum_{t=1}^{\infty} E_0[W_t]. \tag{7}$$

Since the conditional mean $E_0[W_t]$ is also the conditional probability $P_0[\,\text{work}_t\,]$ of working in period t, WLE takes the form:

$$\text{WLE} = \sum_{t=1}^{\infty} P_0[\,\text{work}_t\,]. \tag{8}$$

The chance of working $P_0[\,\text{work}_t\,]$ in any future year t is no greater than the chance $P_0[\,\text{alive}_t\,]$ of being alive in year t, and from (3) and (8) WLE can be no greater than LE:

$$\text{WLE} \leq \text{LE}. \tag{9}$$

To apply the model (8) of worklife expectancy, it suffices to know the probabilities $P_0[\,\text{work}_t\,]$ of work in each future year. The BLS worklife studies in the 1980s estimated probabilities of being active in the labor force (either working or unemployed), and the probability $P_0[\,\text{active}_t\,]$ exceeds the work probability $P_0[\,\text{work}_t\,]$ by an amount that equals the probability of unemployment: $P_0[\,\text{unemployed}_t\,]$. Relying on the BLS worklife tables, and their successors in the forensic economics literature, therefore leads to some anticipated downward bias in estimating WLE if WLE is defined via (8).[13]

Some adults choose not to work, but are able to to so, perhaps because they receive spousal support, adult-life parental support, or because they are wealthy. If the relevant economic loss framework is one of expected earnings rather than earnings capacity then, when estimating work probabilities $P_0[\,\text{work}_t\,]$ via population survey data, estimated work probabilities should be reduced by the frequency of individuals that choose not to work – opting out of the labor force. But in an earnings capacity framework, estimated work probabilities should not be reduced by the frequency of individuals opting out of the labor force before some normative retirement age, as this would downward bias the WLE estimate. Given that there is some upward bias in BLS-type worklife estimates of (8), the idea of introducing downward bias in an earnings capacity framework might lead to a fortuitous outcome where upward and downward biases cancel each other, producing unbiased estimates. For economists who, like the author, lack confidence in this sort of serendipity, the next section considers worklife in terms that avoids these two sources of bias when estimating worklife expectancy in an earnings capacity framework.

[13]On the other hand, if WLE is defined in terms of probabilities $P_0[\,\text{active}_t\,]$ rather than $P_0[\,\text{unemployed}_t\,]$, then this bias vanishes.

3 Earning Capacity and Worklife

As in Section 2, consider the situation of a person who at time "0" is of a known age, and who either will or will not live and work in future years $t = 1, 2, ...$ With W_t the binary random variable that indicates whether the person works in year t, let W_{pt} be the binary variable that indicates whether they have the potential or capacity to work in year t. The span of future years in which they have the capacity to work is the sum $W_{p0} + W_{p1} + ...$, denoted here as $S_{W_p,0}$:

$$S_{W_p,0} = \sum_{t=1}^{\infty} W_{ct}. \tag{10}$$

A person that works in year t also the capacity to work in year t, and is also alive, in which case the binary variables W_t, W_{ct}, and A_t are related via:

$$W_t \leq W_{ct} \leq A_t \tag{11}$$

Assume that at time 0 there are rational, objective probabilities associated with having the capacity to work in future years t. Define worklife expectancy – in an earning capacity framework – as the expected span $E_0[W_{c,0}]$ of worlife capacity. Worklife expectancy is then:

$$\text{WLE} = \sum_{t=1}^{\infty} E_0[W_{ct}] \tag{12}$$

The conditional expectation $E_0[W_{ct}]$ is also the conditional probability $P_0[\text{employable}]$ that the person in question has the capacity or potential to work – being employable – in which case worklife expectancy is:

$$\text{WLE} = \sum_{t=1}^{\infty} P_0[\,\text{employable}_t] \tag{13}$$

To apply this WLE measure, the present work assumes that worklife capacity extends up to a known normative retirement age R, then stops. Let T_R be the corresponding year at which the person reaches age R, and assign the value:

$$P_0[\,\text{employable}_t] = 0 \text{ for each } t > T_R. \tag{14}$$

Then WLE is the sum of employability probabilities through normative retirement age:

$$\text{WLE} = \sum_{t=1}^{T_R} P_0[\,\text{employable}_t]. \tag{15}$$

By construction, WLE is less than life expectancy LE. Also, if the probability restriction (14) is correctly specified then WLE expressed as (15) is greater than when it is defined without reference to earning capacity – via (8) – since in that case:

$$\text{WLE} = \sum_{t=1}^{T_R} P_0[\,\text{work}_t] \tag{16}$$

and the inequality (16) $\leq$ (15) of worklife values reflects the fact that (15) covers situations where a person is employable but chooses not to work.

To compute or estimate WLE via (15), for a given normative retirement age R and year T_R, it is enough to find the probabilities $P_0[\,\text{employable}_t]$ for $t = 1, 2, ..., T_R$. To that end, note that at time t an individual is employable only if they are not a member of each of the following mutually exclusive groups: (a) the people that die in year t, (b) the people that are alive but have work-prohibiting disabilities at time t, (c) the people alive and have no work-prohibiting disabilities and are looking for work but can't find it at time t, being unemployed, (d) the people that fall into some other risk category that prevents their employability.

$$\begin{aligned} P_0[\,\text{unemployable}_t] &= P_0[\,\text{death}_t] + P_0[\,\text{disability}_t] \\ &\quad + P_0[\,\text{unemployment}_t] + P_0[\,\text{other risk}_t] \end{aligned} \tag{17}$$

Provided that probability assessments are available for scenarios (a) through (d), worklife can be evaluated by summing up these probabilities at each t, to get $P_0[\,\text{unemployable}_t]$, then finding WLE via:

$$\text{WLE}_\text{c} = T_R - \sum_{t=1}^{T_R} P_0[\,\text{unemployable}_t] \tag{18}$$

4 Theoretical Examples

To compare worklife measures across earning expectancy and earning capacity frameworks, this section develops three successively more general theoretical examples, and illustrates each numerically.

Example 1 (linear probability): In year 0, a person has T_R years until retirement and faces linearly decreasing probabilities of employability and work, as years progress from $t = 1, 2, ..., T_R$:

$$P_0(\text{employable}_t) = \beta_c \left(1 - \frac{t-1}{T_R}\right) \tag{19}$$

$$P_0(\text{work}_t) = \beta_w \left(1 - \frac{t-1}{T_R}\right) \tag{20}$$

for some parameters β_c and β_w, and for each $t = 1, 2, ..., T_R$. Note that, for $t = 1$, the parameters are the chance of being employable and working, respectively:

$$P_0(\text{employable}_1) = \beta_c, \tag{21}$$
$$P_0(\text{work}_1) = \beta_w, \tag{22}$$

in which case β_c and β_w must each be in the range (0,1). Also, since being employable is at least as likely as is working, $\beta_c \geq \beta_w$. After some simple algebra, evaluating worklife expectancy (WLE) formulas (15) and (16) via linear probability specifications (19) and (20) yields:

$$\text{WLE}_\text{c} = \beta_c \left(\frac{T_R + 1}{2} \right) \tag{23}$$

$$\text{WLE}_\text{e} = \beta_w \left(\frac{T_R + 1}{2} \right). \tag{24}$$

where WLE_c is worklife expectancy in an earning capacity framework, and WLE_e is worklife expectancy in an earning capacity framework. Here the ratio of WLE_c to WLE_e is β_c/β_w, which is at least 1 in value, and is the same for each value of T_R. To put some numbers to these formulas, let $\beta_c = 0.95$ and $\beta_w = 0.8$, and for a normative retirement age of $R = 67$ years consider WCE and WLE at a current or starting age 20 - where $T_R = 67 - 20 = 47$, age 30 – where $T_R = 67 - 30 = 37$, as well as ages 40, 50, and 60. WCE and WLE are then as follows:

Table 1: Worklife in a Linear Probability Model

age, start	T_R	WLE$_\text{c}$	WLE$_\text{e}$
20	47	19.2	16.00
30	37	15.2	12.67
40	27	11.2	9.33
50	17	7.2	6.00
60	7	3.2	2.67

For example, if retirement age is 67 years old and T_R is 47 the time "0" in the above-described modelling framework is 47 years before age 67, which is age 20, and the values of β_c and β_w are the respective chances (conditional on time 0 information) that a 21 year-old will: (a) be employable, and (b) will work. Worklife values in this table are low relative to published worklife estimates for a person age 20: both WCE and WLE have the person ending worklife in their 40s if work years run consecutively, whereas published estimates would have that end in a person's 50s. While different numerical results are possible by changing the values of parameters β_c and β_w, neither WLE_c nor WLE_e can exceed $(T_R + 1)/2$ in this model, so at age 20 neither approach can have worklife ending past age $20 + (47 + 1)/2 = 43.5$ if work years run consecutively.

In Example 1, calculations of WLE_c and WLE_e rely on simple formulas for the probability of being employable or working. In this hypothetical setup a comparison of WLE_c to WLE_e entails no econometric issues of probability estimation, or consideration of demographics-informed parameter values, and so entails no comparison of WLE_c to specific econometric estimates of WLE_e – including BLS-type dynamic models and LPE models. Of course, Example 1 is purely illustrative and its parameterization (23) and (24) is restrictive, relying on just two parameters β_c and β_r. To get more flexibility in the model, rather than stay with a two-parameter model, additional parameters can be added, as in the following.

Example 2 (linear probability with intercepts): As in Example 1, in year 0 a person has T_R years until retirement and faces linear decreasing probabilities of employability and work, as years progress from $t = 1, 2, ..., T_R$, with the relevant linear forms having possibly non-zero "intercepts":

$$P_0(\text{employable}_t) = \alpha_c + \beta_c \left(1 - \frac{t-1}{T_R}\right) \tag{25}$$

$$P_0(\text{work}_t) = \alpha_w + \beta_w \left(1 - \frac{t-1}{T_R}\right) \tag{26}$$

for some "intercept" parameter values α_c and α_w in the range (0,1), and some "slope" parameter values β_c and β_w. For $t = 1$, the parameters provide the chances of employability and work, as follows:

$$P_0(\text{employable}_1) = \alpha_c + \beta_c, \tag{27}$$

$$P_0(\text{work}_1) = \alpha_w + \beta_w, \tag{28}$$

in which case necessary conditions or restrictions on parameters are: $0 \leq \alpha_c + \beta_c \leq 1$ and $0 \leq \alpha_w + \beta_w \leq 1$. To ensure that employability and work probabilities remain in the interval [0,1] for all values of R, T_R, and t, it then suffices to restrict the values of α_c and α_w to the unit interval. WLE_c and WLE_e formulas (15) and (16), evaluated via (25) and (26), take the form:

$$\text{WLE}_c = \left(\alpha_c + \frac{\beta_c}{2}\right) T_R + \frac{\beta_c}{2}, \tag{29}$$

$$\text{WLE}_e = \left(\alpha_w + \frac{\beta_w}{2}\right) T_R + \frac{\beta_w}{2}. \tag{30}$$

The coefficient $\left(\alpha_c + \frac{\beta_c}{2}\right)$ on T_R in (29) can exceed 1/2, unlike in Example 1, as can the coefficient $\left(\alpha_w + \frac{\beta_w}{2}\right)$ in (30). Setting $\alpha_c = (n-1)/n$ for some counting number n, and setting $\beta_c = 1/n$, results in: $\left(\alpha_c + \frac{\beta_c}{2}\right) = \frac{2(n-1)}{2n} + \frac{1}{2n} = (2n-1)/(2n)$ which can be made as close to 1 as desired for large n, and similarly $\left(\alpha_w + \frac{\beta_w}{2}\right)$ can be made as close to 1 as desired, so the coefficients on T_R in (29) and (30) can exceed 1/2 and be arbitrarily close to 1. To illustrate numerically, let $\alpha_c = 4/5, \beta_c = 1/10$, $\alpha_w = 1/2, \beta_w = 1/4$, and for a normative retirement age of $R = 67$ years consider WLE_c and WLE_e at a current or starting ages of 20, 30, 40, 50, and 60, analogous to Table 1. Results are as follows:

Table 2: Worklife in a Linear Probability Model With Intercepts

age, start	T_R	WLE$_\mathrm{c}$	WLE$_\mathrm{e}$
20	47	40.0	29.5
30	37	31.5	23.3
40	27	23.0	17.0
50	17	14.5	10.8
60	7	6.0	4.5

In Table 2, for a 20 year-old worklife ends at age 60 based on WLE_c and about age 50 based on WLE_e, if work years run consecutively. At later starting years (age 30, 40, etc.), the gap between WLE_c and WLE_e narrows. Like Example 1, Example 2 is only illustrative, but also shows that simple linear probability models can produce numerical values for worklife spans that are not entirely unlike ones seen in empirical worklife tables. The virtue of theoretical examples is to highlight some essential theoretical properties of WLE_c and WLE_e as defined in the present work.

A limitation of the setup in Examples 1 and 2 is that the probability of being employable, or working, in the first future year ($t = 1$) is the same regardless of the starting age, as indicated in (21)-(22) and (27)-(28). It is perhaps more plausible that these probabilities depend on the starting age. A simple way to accommodate such a dependency is to let the parameters of the linear probability model depend linearly starting age a_0 via $T_R = R - a_0$.

Example 3 (linear model with parameter heterogeneity): Let the model be as in Example 2 but with probability parameters that depend linearly on the number T_R of years between now and normative retirement:

$$\begin{aligned}
\alpha_c(T_R) &= \gamma_{c1} + \gamma_{c2} T_R, & (31)\\
\beta_c(T_R) &= \delta_{c1} + \delta_{c2} T_R, & (32)\\
\alpha_w(T_R) &= \gamma_{w1} + \gamma_{w2} T_R, & (33)\\
\beta_w(T_R) &= \delta_{w1} + \delta_{w2} T_R. & (34)
\end{aligned}$$

for some parameters $\gamma_{c1}, \gamma_{c2}, \delta_{c1}, \delta_{c2}, \gamma_{w1}, \gamma_{w2}, \delta_{w1}, \delta_{w2}$ whose values are restricted so that each of the values $\alpha_c(T_R)$, $\alpha_w(T_R)$, $\alpha_c(T_R) + \beta_c(T_R)$, and $\alpha_w(T_R) + \beta_w(T_R)$ lies in the range [0,1] for each T_R in the range $[A, R]$, where A is the lowest starting age to which the model will apply. To illustrate, let $A = 20$, $R = 67$, $\gamma_{c1} = 4/9$, $\gamma_{c2} = 1/(3*67)$, $\delta_{c1} = \gamma_{c1}/2$, $\delta_{c2} = \delta_{c1}/2$, and let each of the γ and δ parameters for "w" be three-fourths the respective values for "c". The resulting numerical values for worklife are as follows:

Table 3: Worklife in a Linear Probability Model With Intercepts and Heterogeneity

age, start	T_R	α_c	β_c	α_w	β_w	$\mathrm{WLE_c}$	$\mathrm{WLE_e}$
20	47	0.678	0.339	0.509	0.254	40.0	30.0
30	37	0.629	0.314	0.471	0.236	29.2	21.9
40	27	0.579	0.289	0.434	0.217	19.7	14.8
50	17	0.529	0.265	0.397	0.198	11.4	8.5
60	7	0.479	0.240	0.359	0.180	4.3	3.2

The results here are similar to those in Table 2, but now the probabilities $\alpha_c + \beta_c/2$ and $\alpha_w + \beta_w/2$ of employability and work in the first year out are falling as the starting age increases from 20 to 60. The values of WLE_c and WLE_e age 20 are the same (to 1 decimal place) in the two tables, but at later ages the values are lower in Table 3.

In Example 3, worklife measures WLE_c and WLE_e are expressed mathematically in terms of 8 parameters, and with the illustrative choice of parameter values the calculated values of WLE_c and WLE_e are perhaps in the ballpark of typical worklife expectancy estimates found in recent literature. In Example 2 there are just four parameters, and in Example 1 there are only 2. Hopefully, these examples illustrate some of the ways in which the worklife expectancy measure WLE_c can differ numerically from WLE_e. As might be expected, at later starting ages there may be little difference between WLE_c and WLE_e, while at earlier starting ages the difference might be large.[14]

Examples 1 through 3 illustrate the principle of modelling worklife via parametric probability models. In empirical estimation of worklife, if one evaluates mortality risk via U.S. Life Tables in the usual way then the modelling exercise implicitly non-parametric – at least in part. Whether or not the proposed worklife measure WLE_c should be specified non-parametrically depends on the appropriate model for underlying risks of unemployability – via (18). The next section considers empirical estimation of life and work spans, and the role in estimation of parametric and non-parametric models.

[14]A more general class of parametric models than considered here would be those in which probabilities of employability and work are quadratic functions of elapsed year t, rather than linear functions.

5 Estimating Life and Worklife Spans

From the standpoint of forensic economics, interest in lifespans and worklife spans usually centers on personal economic losses associated with future labor income or health care costs. The goal is to reasonably determine how many additional years a given individual will continue to live, continue to work, or continue to be employable, with the starting point – time "0" in the theoretical models presented in Sections 3 and 4 – being the date of whatever incident triggered economic losses.

Before estimating work or employability time spans it is useful to briefly consider the relatively simple problem of estimating lifespans. From the standpoint of the current year, which at the time of writing is year 2018, suppose a forensic economist knows the age of a person this year and wants to estimate their life expectancy. As discussed in Section 3, life expectancy LE is the sum of conditional probabilities $P_0[\text{alive}_t]$ of being alive in all future years, as of time 0 which here is assumed to be year 2018. To estimate these probabilities, let X be the lifespan of a randomly selected person and suppose that the lifespans X_{it} of the individuals i that died in year t are independent and identically distributed (iid), and also suppose that these lifespans are iid across years t. Suppose that X is a continuous random variable with some probability density function $f(x)$. In the current year ($t = 0$), suppose that there are n recorded lifespans $X_{01}, ...X_{0n}$, providing a density estimate $\hat{f}(x)$ at each positive age x. The probability that a person who reaches a given age a will be alive t years later is:

$$P(X \geq t + a | X \geq a) = \frac{\int_{t+a}^{\infty} f(x)dx}{\int_{a}^{\infty} f(x)dx} \tag{35}$$

With $\hat{f}(\cdot)$ the probability density estimate for lifespan X, the estimated conditional probability $\hat{P}_0[\text{alive}_t]$ that a person age a at time 0 will be alive t periods later is:

$$\hat{P}_0[\text{alive}_t] = \frac{\int_{t+a}^{\infty} \hat{f}(x)dx}{\int_{a}^{\infty} \hat{f}(x)dx} \tag{36}$$

This method of life expectancy calculation is the "period" method as it relies on a single period's sample of lifespans X for people observed to die in that period, and for internal consistency implicitly assumes that a randomly selected person's chances of dying at specific ages remains unchanging over time. The assumptions underlying this method are clearly restrictive and make no account of the long-term mortality-reducing effects of advancements in medicine.

Statistical methods provide many possible density estimators $\hat{f}(\cdot)$ for lifespan X, both parametric and non-parametric estimators. The U.S. Center for Disease Control's current Life Tables use a blend of parametric and non-parametric approaches: non-parametric on the shorter end of life span, parametric on the longer end. The most recent CDC Life Table is for year 2014, and for a person that reaches age a the reader of this table can estimate

$\hat{P}_0[\text{alive}_t]$ as the ratio $\frac{l_{a+x}}{l_x}$, with l_x the estimated number of people (per hundred thousand) surviving to age x, and l_{a+x} the number surviving to age $a + x$.

Given estimates of (conditional) life probabilities $\hat{P}_0[\text{alive}_t]$, the corresponding estimates of being dead in future year t are $\hat{P}_0[\text{dead}_t] = 1 - \hat{P}_0[\text{alive}_t]$. These are inputs to work span estimation since mortality risk reduces both life span and work span. For the worklife expectancy measure WLE_c defined in Section 3, two additional risk factors are (total, employment prohibiting) disability and unemployment.

To model disability risk, assume that all adults who suffer disability that prevents them from work are entitled to receive Social Security Disability Insurance (SSDI) benefits. Similar to the "period" approach to modelling life and death probabilities, for a randomly chosen individual i in the population at time t, let D_{it} be the variable that equals 1 if the person is on SSDI, and equals 0 otherwise. Suppose that the variables D_{it} are IID across the population and over time, and the total adult population size remains constant over time. Then the probability of being totally disabled – from an employment standpoint – takes the form $P_0(D_{it} = 1)$. To estimate this probability, let $D_0 = \sum_i D_{i0}$ be the total number of people on SSDI in current year 0, let N_0 be the population size at time 0, and estimate $P_0(D_{it} = 1)$ via D_0/N_0 for $t = 1, 2, ...$[15]

To model unemployment risk, assume that all adults that are unemployed receive unemployment benefits. Like disability risk, assume that a "period" model applies to unemployment risk. For a randomly chosen individual i at time t, let U_{it} be the variable that equals 1 if the person is collecting unemployment insurance, and let U_{it} equal 0 otherwise. Let U_{it} be IID across individuals and time, in which case the chance of unemployment risk in future period t is $P_0(U_{it} = 1)$. To estimate this risk, let U_0 be the number of adults collecting unemployment benefits at time 0, and estimate $P_0(U_{it} = 1)$ by U_0/N_0 with the N_0 the population size – as earlier.[16]

To illustrate the estimation of risks and worklife expectancy WLE_c, consider the following example.

Example 4: For a person age 40 in the current year, let their normative retirement age be 67 years old. WLE_c, given by (18), then takes the form:

$$\mathrm{WLE_c} = 27 - \sum_{t=1}^{27} P_0[\,\text{unemployable}_t] \tag{37}$$

with the (conditional) probability $P_0[\,\text{unemployable}_t]$ being the sum of conditional probabilities of death, (total) disability, unemployment, and other risk factors. Assume here that the remaining/other risk factors have zero probability. To apply the above-described estimates

[15] Like life and death probabilities based on the CDC "period" model, (total) disability probabilities based on a "period" model of SSDI disability clearly rely on restrictive assumptions. For more on this point see discussion later in this paper.

[16] Once again the "period" modelling approach is restrictive, and a more dynamic approach may be preferred, see later discussion.

of risk probabilities, for death probabilities Table 1 (Life table for total population: United States, 2014) provides the survivor counts $l_40, l_41, ..., l_67$ and estimated (conditional) life probabilities $\hat{P}_0(\text{alive}_1) = l_{41}/l_{40}$,..., $\hat{P}_0(\text{alive}_{27}) = l_{67}/l_{40}$, and corresponding death probabilities. For disability risk, the number of disabled workers currently[17] receiving SSDI benefits is 8,633,765, and the number of people in the population age 18 and older is – based on year 2017 U.S. Census data, 251,455,205 people, in which case a simple estimate of the probability that an adult is (totally) disabled is $8633765/251455205 = 0.034$ or 3.4 percent. For unemployment risk, the unemployment rate for May 2018 was 3.8 percent. These estimates provide the following table of risk probabilities:

[17]For May 2018 the Social Security Administration provides this count online at ssa.gov.

Table 4: Worklife Estimated Risk Probabilities, by Year and Total

year	age	death	disability	unemployment	all
2019	41	0.002	0.034	0.038	0.074
2020	42	0.003	0.034	0.038	0.076
2021	43	0.005	0.034	0.038	0.077
2022	44	0.007	0.034	0.038	0.079
2023	45	0.009	0.034	0.038	0.081
2024	46	0.011	0.034	0.038	0.083
2025	47	0.013	0.034	0.038	0.086
2026	48	0.016	0.034	0.038	0.088
2027	49	0.018	0.034	0.038	0.091
2028	50	0.021	0.034	0.038	0.094
2029	51	0.025	0.034	0.038	0.097
2030	52	0.028	0.034	0.038	0.101
2031	53	0.032	0.034	0.038	0.105
2032	54	0.037	0.034	0.038	0.109
2033	55	0.041	0.034	0.038	0.114
2034	56	0.046	0.034	0.038	0.119
2035	57	0.052	0.034	0.038	0.124
2036	58	0.058	0.034	0.038	0.130
2037	59	0.064	0.034	0.038	0.137
2038	60	0.071	0.034	0.038	0.143
2039	61	0.078	0.034	0.038	0.151
2040	62	0.086	0.034	0.038	0.158
2041	63	0.094	0.034	0.038	0.167
2042	64	0.103	0.034	0.038	0.175
2043	65	0.112	0.034	0.038	0.185
2044	66	0.122	0.034	0.038	0.194
2045	67	0.132	0.034	0.038	0.205
sum		1.289	0.927	1.026	3.242

At the bottom right of Table 4, the sum of all risk probabilities in all years is 3.242, in which case the estimated worklife expectancy is WLE_c = 27-3.242 = 23.76 years.

In Example 4, risk probabilities are estimated using stationary "period" models of the relevant risk variables, and the method of worklife estimation is very simple. For a person age 40 with normative retirement age 67, in Example 4 they are estimated to end employability at age 63.76 if worklife is applied in consecutive years. This example does not specify demographics – sex/gender, education, race, etc., in which case a direct comparison to worklife expectancy statistics in the tables published by Skoog, Ciecka, and Krueger (2011) is imperfect, but the WLE_c estimate of 23.76 compares to Skoog et al. (2011) WLE estimates of 22.21 (Table 16) for "initially active" men with Associate's degree, and 21.62 (Table 24) for initially active women with Associate's degree. These statistics to compare to illustrative hypothetical WLE_c and WLE_e values of $WLE_c = 19.7$ and $WLE_e = 14.8$ in Table 3. A comparison of the WLE_c estimate of 23.76 in Example 4 to the Brookshire and Cobb (1983) LPE worklife estimation method is not possible because Brookshire and Cobb[18] do not compute the mean of the LPE worklife probability distribution, but rather use estimated year-specific probabilities to weight economic losses prior to determining their present value. Still, the relevant probabilities of worklife can be summed, yielding WLE as defined by (8) and (16). For this, the labor force partipation rate (the "P" in LPE) is currently 62.7 percent (May 2018, source: Bureau of Labor Statistics), and the employment rate within the labor force is 1 minus the unemployment rate of 3.8 percent (noted earlier) – this being 96.2 percent (the "E" in LPE). The year specific LPE probability estimate $\hat{P}(\text{work}_t)$ is then the life probability times 0.627 times 0.962, as in the following table:

[18] See also Brookshire and Smith (1990).

Table 5: Work Life Estimated via LPE Probabilities

year	age	life	participation	employment	product
2019	41	0.998	0.627	0.962	0.602
2020	42	0.997	0.627	0.962	0.601
2021	43	0.995	0.627	0.962	0.600
2022	44	0.993	0.627	0.962	0.599
2023	45	0.991	0.627	0.962	0.598
2024	46	0.989	0.627	0.962	0.597
2025	47	0.987	0.627	0.962	0.595
2026	48	0.984	0.627	0.962	0.594
2027	49	0.982	0.627	0.962	0.592
2028	50	0.979	0.627	0.962	0.590
2029	51	0.975	0.627	0.962	0.588
2030	52	0.972	0.627	0.962	0.586
2031	53	0.968	0.627	0.962	0.584
2032	54	0.963	0.627	0.962	0.581
2033	55	0.959	0.627	0.962	0.578
2034	56	0.954	0.627	0.962	0.575
2035	57	0.948	0.627	0.962	0.572
2036	58	0.942	0.627	0.962	0.568
2037	59	0.936	0.627	0.962	0.564
2038	60	0.929	0.627	0.962	0.560
2039	61	0.922	0.627	0.962	0.556
2040	62	0.914	0.627	0.962	0.551
2041	63	0.906	0.627	0.962	0.546
2042	64	0.897	0.627	0.962	0.541
2043	65	0.888	0.627	0.962	0.535
2044	66	0.878	0.627	0.962	0.530
2045	67	0.868	0.627	0.962	0.523
sum		25.711	16.929	25.974	15.508

At the bottom of Table 4 is the sum of LPE work probabilities through normative retirement age, which is 15.508 years. This estimate fits WLE as defined by equation (16), and is similar to the Skoog, Ciecka, Krueger (2011) WLE estimates discussed earlier. If instead WLE probabilities are summed through age 100, using the same Life Table for life probability estimates, the WLE estimate becomes 24.85, somewhat higher than the worklife capacity estimate of 23.76 computed earlier.

The estimation methods illustrated here for a person of age 40 are equally applicable to adults of other ages. In later sections of this paper WLE_c estimates are tabulated by age and normative retirement date. Section 6 considers the issue of dynamic populations for which a "period" model of employability risk may be usefully substituted by a dynamic model or forecast, and Section 7 estimates WLE_c for specific demographic groups (men, women, college-educated, etc.).

6 Modified Estimates for Dynamic Risks

The methods in Section 5 can be applied with models of non-employment risk that allow for dynamics. For example, rather than assuming an unemployment rate of 4 percent, say, in each future year, the unemployment rate can be treated as a dynamic time series and forecasted. A simple framework for such forecasts are the linear autoregressive models which can be estimated using historical data. Getting forecasts from such models is a standard exercise. Under the assumption that the autoregressive time series is stationary (and mixing/ergodic), the conditional mean as forecast converges to the unconditional mean at long horizons, in which case the dynamic content of the model becomes of little relevance at longer horizons. In a later version of this paper, the author will illustrate these themes and compare the results to those in Section 5.

7 Modified Estimates for Demographic Groups

The examples shown earlier are highly simplified and stylized, with no worklife "breakout" or detail tables by various demographic groups. Such breakout tables are straightforward to construct, for males and females, by education group. A later version of this paper will include such tables.

8 Conclusion

The earning capacity standard, for evaluating employment and earnings loss, is a part of law that allows plaintiffs to recover for potential labor earning losses, even is they reasonably may have never worked in the future. This part of law creates some challenges for the economist who estimates the present value of such losses, as the worklife expectancy of such a person requires some care to interpret. A useful interpretation should somehow match the legal framework and its underlying principles. The present work pursues this theme and estimates worklife without penalizing plaintiffs for projected voluntary time out of the labor force, consistent with an earning capacity standard.

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