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Longer, more optimistic, lives: Historic optimism and life expectancy in the United States

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ABSTRACT

How was optimism related to mortality before the rise in "deaths of despair" that began in the late 1990s? Using the Panel Study of Income Dynamics, we show that as early as 1968 more optimistic people lived longer. The relationship depends on many factors including gender, race, health, and education. We then evaluate these and other variables as correlates of individual optimism over the period 1968–1975. We find women and African Americans were less optimistic at the time than men and whites, although this changed beginning in the late 1970′s. Greater education is associated with greater optimism and so is having wealthy parents. We then predict optimism for the same individuals in subsequent years, thus generating our best guess as to how optimism changed for various demographic groups from 1976–1995. We find people with less than a high school degree had the greatest declines in optimism, a trend with long-run links to premature mortality and deaths of despair. Our findings highlight the importance of better understanding optimism's causes and consequences.

1. Introduction

A little understood question is the extent to which optimism and aspirations actually matter to future outcomes. It seems intuitive that hope and optimism for the future provide incentives for individuals to invest in those futures. Yet it is also plausible that optimists could ultimately suffer worse outcomes by failing to insure against negative shocks, or mispredicting and making poor choices.

Several studies in the literature on the economics of well-being support the first hypothesis. In some very early work on this topic, one of us (Graham et al., 2004) found that higher levels of residual happiness, which has been interpreted as optimism, in an initial period was correlated with higher levels of income and better health in subsequent periods.[1] Since then, several studies have confirmed such a channel using a range of metrics and techniques, from twin and sibling

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[1] Residual happiness is estimated as the residuals from a regression of happiness on the usual socioeconomic and demographic control variables. The study was based on panel data for Russia. See Graham et al. (2004).

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comparisons to lab experiments, finding again that happy people have better outcomes in a range of areas from the health to the labor market to the social arena.[2]

Recent experimental studies that evoke optimism find significant changes in behavior. One such study asked respondents in U.S. soup kitchens to recall a time they felt positive about themselves, and that in turn resulted in more effort in playing games compared to those who did not receive the optimism prompt.[3] Another is based on the provision of assets – such as a cow or other livestock – to poor people in developing countries, and finds it in increased labor and other investments. The channel in both experiments, among others, seems to be the provision of new hope. While these studies cannot reveal how long the behavioral changes last, they are, at the very least suggestive of a virtuous circle.

On the other hand, there is some evidence that overly optimistic expectations may lead individuals to mis-predict what will make them better off in the future.[4] A recent study based on panel data for Germany finds that most individuals mis-predict the positive effects of life events such as marriage and the negative effects of others such as divorce, unemployment, and disability (Odermatt and Stutzer, 2019). Another study based on the same German panel finds that younger people over-predict their future life satisfaction, while older people under-predict it but have higher levels of current life satisfaction (Schwandt, 2016). These findings suggest that as individuals age they adjust their aspirations, which provides a partial explanation for the well-known U-shaped relationship between age and happiness.[5] Broadly characterized, the U-shape describes the pattern of decreasing happiness into the middle-aged years followed by increasing happiness as people age (as long as they are healthy for their age). Conceptually, having aspirations greater than achievement is associated with lower happiness. Mid-life unhappiness could partially result from high aspirations, and increasing happiness as people age, from declining aspirations.

Meanwhile, the evidence suggests optimism both protects against negative outcomes and differs across groups of people. In recent work on the U.S., one of us finds that lack of hope and high levels of stress and worry are linked to high rates of premature mortality. This premature mortality began in the late 1990s, is commonly referred to as "deaths of despair" (Case and Deaton 2015, 2017), and is most prevalent among less than college-educated non-Hispanic whites in middle-ages (45–54, corresponding with the low point of the U-shape). In contrast to non-Hispanic whites, Graham and Pinto (2019a) find poor African Americans and Hispanics have much higher levels of optimism and so far have not displayed the same mortality increase that non-Hispanic whites have, an increase that was substantial enough to drive up the U.S. average rates of mortality.[6]

One explanation for low hope among this latter group is the widespread decline of manufacturing and other blue-collar jobs. Non-Hispanic white men were the most privileged blue-collar workers; as these jobs declined they not only experienced job loss, but also lost their identity, status, and ties to their communities and societies. The starkest manifestation of this is the rise in prime age workers – particularly men – out of the labor force. Time use studies of this group show large increases in time spent on video games which, in turn, represent further disengagement from society (Krueger, 2017). The loss of close ties to society is associated with deep unhappiness and even despair, as in the case of the long-term unemployed (Clark and Oswald, 1994; Pecchenino, 2015). While African Americans were also affected by the decline in manufacturing and blue-collar jobs, they seem to have been more resilient to it – perhaps due to the long history of living with discrimination, leading to greater resilience, and or offsetting improvements in civil rights over this period.[7]

In this paper, we address three questions related to optimism. These are: (a) do optimists live longer? (b) who is optimistic? and (c) how has optimism trended in the U.S. since the 1970s?

Our concept of optimism includes but goes beyond innate character traits. We think of optimism as a belief structure, combining confidence that good rather than bad things will happen and the ability to plan for and reach goals. The latter belief requires a certain amount of agency. We treat optimism and hope as inter-changeable concepts throughout the paper. Psychologists make finer distinctions between these concepts, but in terms of our objectives and data, the two go hand in hand.[8]

[2] See, De Neve et al. (2013), De Neve and Oswald (2012), and O'Connor (2017b), and for an overview, Graham (2017).

[3] See Haushofer and Fehr (2014) and Hall et al., (2014)

[4] See Kahneman and Thaler (2006) and Frey and Stutzer (2014)

[5] A wide body of work consistently finds a U-shape in life-cycle happiness across countries (Blanchflower and Oswald, 2016; Graham and Ruiz Pozuelo, 2017). These studies control for the primary confounding factors such as income and health and therefore the "pure" effect of aging, with everything else held constant. Other studies alternatively look at aging without these controls, evaluating so-called "experienced" well-being, in which case the U holds in fewer countries and usually in richer rather than poorer ones. Moreover, in a study critiquing aspects of the U-shape, one of us still finds similar evidence. Average experienced life satisfaction (over 17 countries) declines from approximately age 30, until about age 50, then increases again until about age 75 (Morgan and O'Connor, 2017). For an excellent review of the psychological as well as economic studies, see Rauch (2018).

[6] In many U.S. data sets there is no distinction between whites of Hispanic and non-Hispanic origin. Although certain data sources allow for making this distinction, by matching answers on both race and ethnicity (e.g., as used in Graham and Pinto (2019a)), the current literature generally mixes Hispanic and non-Hispanic whites as whites. When we refer to whites, we mean non-Hispanic whites. Our econometric analysis, meanwhile, separates whites and Hispanics into separate categories, as is done in the Gallup data.

[7] Indeed, the gaps in optimism between blacks and whites have attenuated for those in more precarious situations, such as for prime aged males out of the labor force. See Graham and Pinto (2019b). More generally, African Americans report increasing happiness from the 1970s into the 2000s. For possible explanations, see Stevenson and Wolfers (2008).

[8] See, for example, Bailey et al. (2007). In some related new survey work, one of us (Graham), with Ruiz-Pozuelo, also test whether the agency component of these two concepts is associated with surmounting negative events, which in turn builds resilience (Graham and Ruiz Pozuelo, 2018, 2017).

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We posit that optimism is related to numerous life circumstances in a simultaneous way, reflecting the virtuous circle highlighted in the studies cited above. For example, optimists are more likely to invest in their education, and greater education leads to better outcomes along many dimensions of life. Some scholars, in contrast, view optimism simply as a personality trait, which is "set like plaster" (Costa and McCrae, 1994), implying that education cannot cause optimism.[9] However, as a belief structure, it can plausibly be interrelated with life circumstances. Both psychology and economics discuss how belief structures depend on circumstances and how beliefs can affect those circumstances. In psychology, for example the Broaden and Build Theory discusses the role of positive emotions in generating psychological capital, which can be drawn upon to improve how an individual responds to setbacks and uncertainty and thereby lead to improved outcomes (Fredrickson, 2004). Borghans et al. (2008) discuss how positive psychological characteristics can be learned[10] and how economic theory could be adjusted to accommodate them in the production function.[11]

Our first question evaluates the proposition that optimistic people live longer. Our proxy for optimism is based on a question in the Panel Study of Income Dynamics (PSID); it is referred to as Life Work Out (LWO) and defined in Section 2.2. We estimate the relationship between an individual's reported LWO during the period 1968–1975 and their probability of being alive in 2015. Based on three models of mortality, our findings confirm that people reporting higher LWO live longer. What is more, the results of an instrumental variable (IV) approach support a causal interpretation of this relationship. These findings place new importance on understanding optimism, both across people and over time.

Second, we assess who reports greater LWO. Similar to the initial micro studies of happiness (e.g., Blanchflower and Oswald, 2004), which established its correlates, it is important to establish those of optimism, which remain understudied in economics. Among our findings for the period under study, women report lower LWO and LWO is positively associated with characteristics such as: greater income, greater parents' income, higher education, better health, homeownership, and marital status (divorce is negatively associated). The findings imply that falling real income, reduced homeownership, and greater divorce rates contributed to a growing lack of hope among the groups that experienced these changes in the past decades – in particular those with less than a high school education.

Third, we predict the evolution of LWO over time in the U.S. Several scholars posit that the growing lack of hope and the rise in deaths of despair stem at least in part from long run forces (Case and Deaton, 2017, 2015; Cherlin, 2014; Graham and Pinto, 2019a, among others). Our findings support this theory. Before deaths of despair began to rise in the 1990s, many of the correlates of LWO trended negatively, but not equally across groups. To illustrate, we predict trends in LWO for the period 1976–1995 based on the correlates of LWO observed during the period 1968–1975. People with less than a high school level of education experienced the worst trend of any group evaluated – experiencing negative changes in the correlates identified above (e.g., income) and a resulting decline in LWO.[12] This group is also prone to deaths of despair, while those with more education did not fare so poorly – suggesting that the symptoms of a low level of education include lower optimism and greater mortality. This finding persists using two sample definitions, notably when following the same individuals over time.[13] Our predictions of historical LWO are the only of their kind. It is possible to plot similarly historic trends in a related alternative to LWO (happiness) in the United States, but not for the same individuals as we do.

In Section 2, we discuss our primary data and methods to evaluate LWO's effect on mortality. We include a discussion of our variable LWO in relation to other questions about optimism. In Section 3, we present the results, concerning both the effects of LWO on mortality as well as the correlates of LWO. We also discuss causality as it pertains to the relationship between LWO and mortality. In Section 4, we detail the methods used to predict the trends in LWO for different population groups, and we present the findings.

2. Data and methods

2.1. Data

Life Work Out (LWO) and mortality data are from the Panel Study of Income Dynamics (PSID) (PSID, 2017a). The PSID is a longitudinal, family survey, which was administered annually from 1968 to 1996, and every other year after that (ongoing today). The sample is nationally representative of U.S. families when applying population weights. One adult family member completes the survey, providing information about himself/herself and other family members. The most detailed information is collected on family heads and their partners.[14] Individuals from the initial set of families (from 1968) are followed

[9] If optimism was set at birth, then all behaviorally chosen variables would be dependent on it.

[10] See the discussion regarding the Perry Preschool study. In short, interventions improved personality and motivation, which led to greater educational achievement.

[11] Non-cognitive skills represent capacities, similar to cognitive skills or physical ability, which affect productivity.

[12] It is important to note that due to compositional changes, driven by a much larger percentage of the population completing high school in the past few decades, the less than high school educated prior to 1970 approximate the less than college educated in more recent decades.

[13] Following the same individuals over time is important. Alternatively, group trends must rely on group aggregates that are comprised of different individuals, which limits their meaning – the composition of individuals can change substantially, greatly reducing comparability over time. For example, the underlying characteristics of high school dropouts in 1972 are unlike those in 2016 (as an increasing percentage of students completed high school over the time period). See (Blanchflower and Oswald, 2019, pp. 396–397) as an example study that recognizes this limitation in part of their analysis.

[14] Interviews were primary face to face from 1968 to 1972. Since then, nearly all of the interviews take place over the phone. Field dates are approximately: 1968-1980 March-July; 1981-1988 March-October; 1989-2015 March-December (PSID, 2017b, p. 23).

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Table 1
PSID sample 1968–1975.

Heads and Spouses	11,813
Family Heads	7912
Responding Heads	7582
Mortality Data Available	4840
Non-Missing Variables	4442

Table 2
Sample composition and mortality by 2015.

	Sample				Average Maximum Age	Deceased in 2015
	Unweighted		Weighted			
	N	%	N	%	(years)	%
Full Sample	4442	100.00	76,153	100.00	73.82	71.37
White	2820	63.48	66,051	86.73	74.29	70.85
Black	1506	33.90	8236	10.81	70.27	78.97
Hispanic	80	1.80	1322	1.74	73.09	60.44
Other	36	0.81	545	0.72	72.53	45.95
Men	2835	63.82	52,738	69.25	72.68	72.60
Women	1607	36.18	23,415	30.75	76.39	68.60
Pessimistic	2128	47.91	31,825	41.79	73.31	74.84
Optimistic	2314	52.09	44,327	58.21	74.19	68.88

Maximum observed age is the age at death or if alive, the respondents' age in 2015. Optimistic people are those individuals that reported one of the top two "Life Work Out" categories (4 or 5), discussed in Section 2.2.
Source: PSID and author estimates.

over time when splitting off to form new families, and individuals are added to the sampling frame when families expand through births, adoption, and marriage (PSID, 2017b, p. 21).

Our sample is initially comprised of family heads that personally responded to the survey (Responding Heads) in the years LWO was asked. LWO was asked in the years 1968–1972 and 1975. We only include Responding Heads because subjective questions reflect only the respondent's views. We make two further exclusions. First, we exclude people for which mortality data is unavailable.[15] In general, mortality is observed if it occurred before the survey was fielded in 2015 (the last year for which we have data), but the year of death is unknown for people that both attrite for reasons other than mortality and for which the PSID was unable to ascertain if or when they died.[16] This attrition is not a concern for our analysis because it is not selective – it does depend on our variable of interest.[17] Second, we exclude individuals for which variables are missing. These sample limitations are listed in Table 1. Our analyses are based on 4442 individuals. However, the total sample size depends on how many times LWO was observed for each person (e.g., up to six times during the years 1968–1972 and 1975) and method. Section 2.3 provides further sample details including the distribution of LWO observations over the years, according to the method used.

Table 2 lists the sample composition disaggregated by population subgroup. The sample is comprised largely of men because the PSID considered men to be the family heads in married couples. That means that only unmarried women are included and they are on average older than the national average because they are more likely to be divorced or widowed. The unrestricted and weighted sample is representative of family heads, not men or women generally.

Table 2 also presents two figures that relate to mortality, average maximum age and percentage deceased in 2015. The average maximum age is coded for an individual as the age at death, or if alive, the respondent's age in 2015. It is an imperfect measure of life expectancy because the age of death is unobserved for the portion of the sample that is alive in 2015. Deceased in 2015 reports the percentage of each sample that has died by 2015. Among the findings, approximately 71% of the full sample died by 2015 and a greater proportion of men died than unmarried women.[18] Optimistic people (defined in the next section) have both a greater maximum age and fewer of them died before 2015.

[15] Although these people could be included in one our analyses (the duration analysis, treating them as censored, described in Section 2.3), we maintained their exclusion throughout because they could not be included in our other analyses. In any case, duration analysis, including these attriters, resulted in qualitatively similar results (available upon request).

[16] In the 1980s information from the PSID surveys was supplemented with external mortality data from the National Death Index.

[17] We base this conclusion on a regression of an indicator of attrition on LWO and the standard controls used in our mortality regressions (discussed in Section 2.3). The results indicate LWO does not significantly (at five percent significance) predict attrition (results available upon request).

[18] The relatively smaller number of people from the "Other" racial groups that have deceased by 2015 (46% compared to 71% for the full sample) may be surprising. However, this figure can be explained by their relative age. Age is an important determinant of mortality and the Other group is relatively younger, on average 39 years old when initially observed, compared to 45 for the full sample.

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2.2. Optimism and Life Work Out

We use the "Life Work Out" (LWO) question to assess optimism: "have you usually felt pretty sure your life would work out the way you want it to, or have there been more times when you haven't been very sure about it?" Verbal responses were recorded by interviewers and coded by trained staff as follows: (5) "usually been pretty sure"; (4) "pretty sure, qualified"; (3) "pro-con, sure sometimes, not sure other"; (2) "more times when haven't been sure, qualified"; (1) "more times when not very sure about it".[19,20] The question was intended to contrast two alternatives ("pretty sure" or "haven't been very sure") (PSID, 1968, p. 57); consequently, the coded distribution is bimodal. Appendix Table A.1 provides a summary of the responses to this question, including the distribution, mean, and standard deviation (overall, across, and within individuals). Appendix Table A.2 presents the distribution of observations of LWO over the sample years. Two samples are displayed in Table A.2 corresponding with the method used, as described in the next section. In descriptive settings, individuals were deemed to be optimists if they fall in one of the top two LWO categories (4 or 5). In the regression analyses, we use the continuous variable "Life Work Out" (LWO), which is created from the five potential responses such that higher values correspond to greater optimism.[21]

In our view, the LWO question captures both of the traits discussed above that psychologists describe in the relationship between hope and optimism: a tendency to believe that good things will happen, and belief in the ability to plan and reach goals. In earlier work, we have used a question in which individuals are asked to assess where their life satisfaction will be in five years (Graham and Pinto, 2019a) as have other authors (Odermatt and Stutzer, 2019). Answers to both this and the LWO question reflect innate optimism on the one hand, and a positive belief structure about the future on the other.[22] One important difference with the former question compared to LWO is that it imposes a time frame on the answers which, not surprisingly tends to depress the optimism of elderly respondents. For our purposes, the LWO question is better suited towards assessing optimism – and how or if it changes – over the life course, without providing a time frame which biases the responses of older respondents. It is also the relevant question in the PSID data, which is the only data source that allows us to address each of our research questions – in part because the PSID allows us to follow the same respondents over the course of their lives beginning in 1968.

2.3. Methods to examine the relationship between life expectancy and optimism

To determine the relationship between life expectancy and LWO, we primarily use two approaches: duration analysis using Cox Proportional Hazard Models and probit regression models.[23] We also perform a robustness check to assess the sensitivity of the relation between LWO and mortality to omitted variables and other potential sources of endogeneity using instrumental variables (IV). The detailed IV methods and associated results are discussed in Section 3.2.

Cox Proportional Hazard Models have become standard for duration analysis (e.g., for life expectancy). The hazard models use duration alive, or time elapsed between the age in which LWO is observed and age at death to estimate the probability of death, given that the respondent is alive at time of observation. This probability is referred to as the hazard rate. Hazard models account for two important characteristics of the sample that other models do not (cf. ordinary least squares (OLS)). First, for nearly 30% of the sample, mortality is not observed during the sample period, which means, for these people the data are right censored, as described using duration terminology. Censored observations are still informative; they form part of the pool of people that are at risk of dying and as such we include them in all the regressions. Second, LWO is observed at different ages and individuals had to survive to this age in order to be included in the sample. In duration terminology, there are delayed entries. Appendix Table A.2 presents the average age when LWO is observed by year.

A sample estimator of the hazard rate is simply the number of people that die at age a, divided by the number of people at risk of dying at age a. Formally, the hazard rate at age a is: $\lambda(a) = \Pr(T = a_j | T \geq a_j) = f(a_j)/(1 - F(a_j))$, where $F(a)$ is the cumulative distribution function, or probability of death (T) at any point before age a, and $f(a)$ is the probability density function, the instantaneous probability of dying at age a. Censored respondents and delayed entries are used in determining the distribution $F(a)$. At a particular age, the number of people at risk includes everyone alive, censored and uncensored, and is increased by delayed entries. While the data for any one individual covers less than 50 years, the entire life cycle is modeled, covering more than 100 years, relying on the information from people that entered the sample at younger ages

[19] Staff performed the initial coding and a supervisor cross-checked a subgroup of interviews. These were further checked for reliability according to the procedure described on pages 186-187 of Morgan and Smith (1969).

[20] LWO is asked in the family questionnaire. The variable name changes over the years. As an example, it is recorded as variable V295 in 1968.

[21] Although LWO is inherently an ordinal variable and has a non-normal distribution (see Table A.2), we treat it as continuous to utilize all of the information. In either case the results are maintained – in a set of robustness tests we replicated all of the analyses instead using the binary variable used in descriptive settings and found the estimates' significance levels to be consistent and the magnitudes quite similar. These results are available upon request. Also, results when LWO is instrumented support the main results.

[22] Another example of a question reflecting a belief structure that things will turn out well is the General Expectancy for Success Scale, which is based on 30 items that all begin with the same stem phrase: "in the future I expect that I will….". The responses were internally correlated and not correlated with social desirability. For details, see Fibel and Hale (1978).

[23] We also considered using the maximum observed age (as displayed in Table 2) as the outcome variable. Although this approach has limitations, using the age in 2015 as the age of death, we used it as robustness check. Using this alternative outcome, an OLS specification, and excluding age as an independent variable (as a "bad control"), we obtained similar results to those from the main analysis.

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and also those for which mortality is observed. For illustration, a non-parametric survival function is presented in the next section. Formally the survival function is: $S(a_j) = 1 - F(a_j)$.

Cox Proportional Hazard Models are a subgroup of hazard models that allow for the inclusion of conditioning covariates. Eq. (1) specifies our model:

$$\lambda\left(a|LWO_{it}, \boldsymbol{x}'_{\boldsymbol{it}}\right) = \lambda_0(a)e^{\delta LWO_{it}+\boldsymbol{x}'_{\boldsymbol{it}}\boldsymbol{\theta}} \tag{1}$$

Where, $\lambda(a|LWO_{it}, \boldsymbol{x}'_{\boldsymbol{it}})$ represents the conditional hazard rate for individual i, at time t, and age a. This rate is estimated as proportional to $\lambda_0(a)$, the baseline hazard rate, according to $e^{\delta LWO_{it}+\boldsymbol{x}'_{\boldsymbol{it}}\boldsymbol{\theta}}$. *LWO* and the vector $\boldsymbol{x}$ represent the variables. Estimation is performed by maximum likelihood to obtain the parameters δ and $\boldsymbol{\theta}$. To ease interpretation we report their exponentiated values in the tables, which have the traditional interpretation. For instance a one unit change in LWO is related to a e^{δ} change in the hazard rate. In the Cox models we include each observation of LWO for a person. Although the year of death does not vary, we can include each observation of LWO by treating age of death as censored, for each year that LWO is observed, except the final year. In this way, repeated observations for an individual add information about the pool of people at risk. In the final year a LWO is observed, the age of death is also recorded.

The probit model estimates the probability of death by the year 2015 for individual i, given *LWO* and the vector of explanatory variables $\boldsymbol{x}$. It is specified as Eq. (2):

$$Pr\left(\text{deceased in 2015} = 1|LWO_i, \boldsymbol{x}'_{\boldsymbol{i}}\right) = \Phi(\propto + \gamma LWO_i + \boldsymbol{x}'_{\boldsymbol{i}}\boldsymbol{\beta}) \tag{2}$$

Where Φ represents the cumulative standard normal distribution.

The samples for the Cox and probit analyses are presented in Appendix Table A.2. The probit sample is restricted for two reasons. First, only one observation per person can be used in the probit analyses (we use the initial). Second, the probit models also exclude everyone aged 65 and above (at initial observation). We exclude them as a group because they perfectly predict the outcome variable (i.e., experience 100% mortality by 2015). The samples also affect our treatment of standard errors. The Cox analysis uses clustered standard errors at the individual level because the errors could be correlated within person. The probit analysis instead uses robust standard errors.

In both the probit and Cox models we condition on sets of demographic, socio-economic, and health characteristics that are observed at the same time as LWO. Specifically, four age categories (16–34, 35–49, 50–64, and 65+), gender, race, education status, a measure of health status, income, employment status, and location controls are included (see Appendix B for detailed definitions).[24] To control for health, a dummy variable for the presence of a mental or physical work limitation was used; although not ideal, it represents the only health variable that was available in 1968 and consistently throughout the sample. We would prefer alternative measures that are more common to the health literature, but in any case reassurance that this limitation does not drive our results is provided in Section 3.2, which is based on IV methods. We include location controls for current residence and where the respondent grew up, at the census division level.[25] In each approach it is not possible to include individual fixed effects, because death only occurs once for an individual.[26]

3. Results

3.1. Longer, more optimistic, lives

To illustrate the importance of LWO, Fig. 1 presents the survival function (Kaplan Meier) for optimists compared to pessimists. Without additional controls, optimists are statistically significantly less likely to die (at one percent significance using the log-rank test). At age 70 optimistic people have a 65% probability of surviving, while pessimistic people have only a 53% probability.

The statistical analysis confirms LWO is positively related to greater life expectancy. Presented in Table 3, the estimated LWO-mortality relations are consistent in terms of direction and significance. In column 7, someone reporting one category higher LWO is 0.37% less likely to die. The additional years lived associated with being more optimistic are not directly observable from the table; however, they can be calculated by comparing mean failure times (calculated as the integral of the survival function). We find that those who report an LWO of 3 (near the mean) live an average of 70.1 years, while those who report a 5, (approximately one standard deviation higher) live an average of 71.3 years – meaning a one standard deviation increase in LWO is associated with approximately of 1.2 years longer life (conditional on the other covariates). The coefficient in column 1, from an OLS model presented for comparison, also shows that greater LWO is associated with an older age of death.

Table 4 presents the probit results (displayed as marginal effects), which are generally consistent with those of Table 3. Death by 2015 is less likely for people reporting greater LWO. The magnitudes also do not directly translate into years

[24] Additional control variables are available in the data. For example, parents education, which is used as a determinant of LWO. They were excluded from the mortality regressions in order to be more parsimonious and brief. In either case the results (available upon request) that were obtained when including all of the mortality and LWO correlates do not qualitatively differ from the main results.

[25] Location is available at the state level too, but sample sizes were severely reduced within particular states.

[26] In the Cox analysis, one could include dummies for each individual or stratify by individual, but the former introduces an incidental parameters problem and the latter requires more than one event, death, for at least some of the sample.

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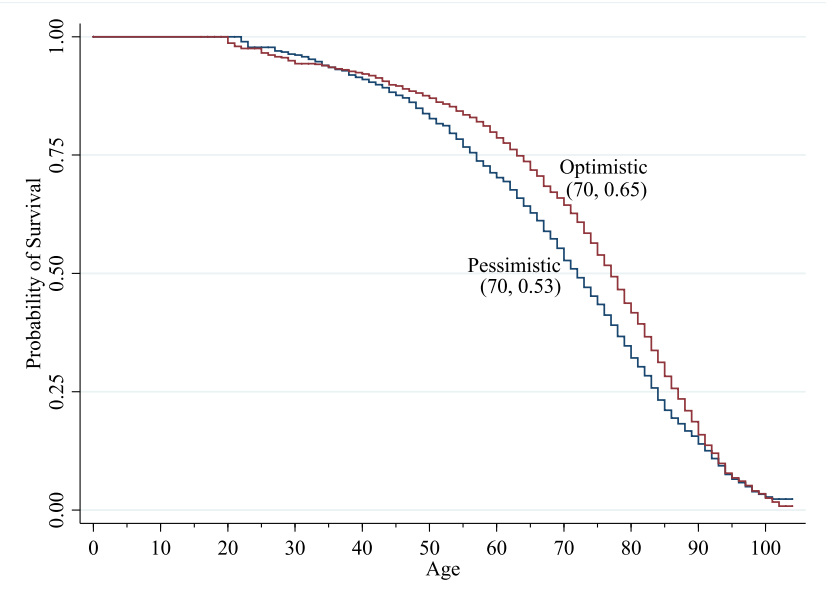

Fig. 1. Survival function by initial optimism. Kaplan-Meier non-parametric functions. Life Work Out is measured in the years 1968–1972 and 1975 and mortality is observed up until 2015. People reporting a 4 or 5 LWO are recorded as optimistic. For the early ages, the survival probability is not observed because the youngest person in the sample is 16. The average initial age is 45.4.
Source: PSID and author estimates.

Table 3
Life expectancy regressions, ordinary least squares and cox proportional hazard.

	(1) OLS	(2) Cox	(3) Cox	(4) Cox	(5) Cox	(6) Cox	(7) Cox
Life Work Out	0.347*** (0.062)	−0.059*** (0.010)	−0.059*** (0.010)	−0.050*** (0.010)	−0.045*** (0.010)	−0.049*** (0.010)	−0.037*** (0.010)
Female	2.129*** (0.216)	−0.428*** (0.040)	−0.445*** (0.040)	−0.443*** (0.040)	−0.475*** (0.040)	−0.540*** (0.042)	−0.524*** (0.042)
Black	−0.476** (0.234)	0.235*** (0.043)	0.207*** (0.051)	0.158*** (0.052)	0.194*** (0.051)	0.148*** (0.052)	0.132** (0.053)
Hispanic & Other	1.057* (0.616)	−0.379** (0.153)	−0.247 (0.163)	−0.286* (0.163)	−0.305* (0.167)	−0.344** (0.168)	−0.393** (0.173)
Ages 35–49	−1.983*** (0.390)	−0.035 (0.070)	−0.033 (0.070)	−0.068 (0.071)	−0.076 (0.070)	−0.026 (0.070)	−0.082 (0.071)
Ages 50–64	−3.993*** (0.331)	0.217*** (0.070)	0.224*** (0.070)	0.161** (0.072)	0.140** (0.070)	0.170** (0.071)	0.080 (0.073)
Ages 65+	−6.084*** (0.314)	0.438*** (0.075)	0.448*** (0.075)	0.358*** (0.079)	0.286*** (0.077)	0.151* (0.087)	0.066 (0.092)
In School				0.046 (0.183)			−0.091 (0.186)
Edu < High School				0.124*** (0.045)			0.074* (0.045)
Edu > High School				−0.187*** (0.052)			−0.151*** (0.052)
Work Limitation					0.358*** (0.044)		0.243*** (0.047)
ln(Real Inc. FU pc)						−0.021** (0.009)	−0.006 (0.009)
Unemployed						0.425*** (0.108)	0.397*** (0.109)
Out of Labor Force						0.343*** (0.064)	0.274*** (0.067)
Location Controls	–	–	yes	yes	yes	yes	yes
Constant	11.450*** (0.361)						
Observations	16,489	16,489	16,489	16,489	16,489	16,489	16,489
# of People	4442	4442	4442	4442	4442	4442	4442
R-Squared	0.025						
Adj. R-Sq.	0.024						
Pseudo R-Sq.		0.005	0.006	0.006	0.007	0.008	0.009
Division Grew Up F			23.691	22.752	23.215	25.310	24.462
Current Division F			5.838	5.712	5.516	4.192	4.537

Notes: The OLS dependent variable is the same duration (maximum observed age less the initial age) that is used in the Cox Proportional Hazard model. Excluded categories include: male, white, ages 16–34, high school, and working.
Standard errors in parentheses (clustered by individual); * $p<0.10$ ** $p<0.05$ *** $p<0.01$.

lived. In Table 4 column 6, a one-point increase in LWO is associated with a 1.3 percentage-point decline in the likelihood of dying by 2015. However, the magnitudes appear reasonable. In the final columns of both tables, the LWO magnitude is approximately 15–23% of the work limitation magnitude. As a negative health condition, we expect work limitation to have a significant negative relation with life expectancy, which is not surprisingly larger than for LWO.

The LWO-mortality relation is affected by education, health, and economic status. This finding is illustrated in Tables 3 and 4 by the reduced coefficient magnitudes that are observed as additional controls are added. We expected this change in the LWO-mortality relation because LWO partially determines and is determined by the controls (as discussed above). Consequently, the way to understand our results is, optimistic people live longer in part because of optimism's in-

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Table 4
Probability of death by the year 2015, probit regressions, marginal effects.

	(1)	(2)	(3)	(4)	(5)	(6)
Life Work Out	−0.018*** (0.004)	−0.018*** (0.004)	−0.015*** (0.004)	−0.017*** (0.004)	−0.017*** (0.004)	−0.013*** (0.004)
Female	−0 141*** (0.017)	−0.145*** (0.016)	−0 144*** (0.016)	−0.146*** (0.016)	−0.159*** (0.018)	−0 149*** (0.018)
Black	0.123*** (0.019)	0.098*** (0.021)	0.085*** (0.021)	0.099*** (0.020)	0.092*** (0.021)	0.087*** (0.021)
Hispanic & Other	−0.090** (0.044)	−0.052 (0.047)	−0.068 (0.047)	−0.057 (0.047)	−0.059 (0.048)	−0.072 (0.047)
Ages 35–49	0.406*** (0.021)	0.408*** (0.021)	0.381*** (0.022)	0.401*** (0.021)	0.412*** (0.021)	0.379*** (0.022)
Ages 50–64	0.651*** (0.015)	0.651*** (0.015)	0.624*** (0.017)	0.641*** (0.015)	0.652*** (0.015)	0.615*** (0.017)
In School			−0.043 (0.030)			−0.069** (0.034)
Edu < High School			0.074*** (0.019)			0.070*** (0.019)
Edu > High School			−0.041** (0.020)			−0.039* (0.020)
Work Limitation				0.076*** (0.022)		0.057** (0.023)
ln(Real Inc. FU pc)					−0.003 (0.005)	0.007 (0.005)
Unemployed					0.077** (0.035)	0.070** (0.036)
Out of Labor Force					0.040 (0.027)	0.066** (0.030)
Location Controls	–	yes	yes	yes	yes	yes
Observations	3899	3899	3899	3899	3899	3899
Pseudo R-Sq.		0.333	0.342	0.336	0.335	0.347
Division Grew Up Chi2		18.684	15.413	18.676	17.981	15.172
Current Division Chi2		8.500	7.280	8.629	7.233	6.461

Notes: Excluded categories include: male, white, ages 16–34, high school, and working.
Robust standard errors in parentheses; * $p<0.10$ ** $p<0.05$ *** $p<0.01$.

dependent influence on mortality and because optimistic people are better educated, more likely to be employed, and are free from mental or physical work limitations.[27]

Across Tables 3 and 4, women live longer than men and African Americans less than whites. The magnitude on the coefficient for blacks decreases markedly when additional controls are added, beginning with location controls, followed by income and education controls. The variable "Black" may have picked up variation in these variables. For example, racial groups are not equally dispersed throughout the nation and there are higher mortality rates in areas with a higher concentration of poor black respondents – such as the southeastern cluster of states. Location dummies are also likely to be picking up the concentration of premature mortality among the less than college educated whites in certain regions of the heartland.[28]

The other controls are related to life expectancy in the expected directions and are generally statistically significant. The categorical age coefficients are monotonically increasing in size.[29] Compared to being in high school, those with less education have higher hazard rates, and those with more, lower. People with work limitations, mental or physical, have higher hazard rates, and so do people that are out of the labor force or unemployed. Having greater family income per capita does not translate into greater life expectancy once education, work limitations, and employment status are also accounted for. And once income is controlled, students live longer, but only based on the probit estimation. Lastly, where a person grew up and currently resides statistically significantly affects life expectancy. We tested the location controls – dummies by census division – jointly, and illustrate their significance by either the F or Chi-squared statistics.

3.1.1. Relationship heterogeneity by gender, race, and age

To test for heterogeneity in the LWO-mortality relation, gender, race, and age groups are interacted with LWO. As shown in Table 5, the LWO-mortality relation does not vary significantly with race (col. 2), but it does by gender and age (cols. 1 and 3). The interaction term between female and LWO is statistically significant and positive. The interaction magnitude is substantial too, nearly offsetting the main effect. Indeed women reporting greater LWO do not live statistically longer than women reporting lower LWO (the marginal effect of LWO for women is statistically insignificant). This result may arise because there is less to be gained from greater LWO for women. Relative to men, they already unconditionally live longer on average. In any case, the relation for women should be interpreted with caution because the sample of women is smaller than the sample of men and constrained to unmarried family heads, who are on average older. Older ages are especially likely to play a role. The female-LWO interaction term may reflect part of the difference in LWO relations that are due to age, and be reduced in size as a consequence, discussed next.

[27] We do not know if they were more likely to make investments in their education and health because they were more optimistic ex ante, or if less optimism is due to bad luck from the early years on. The causality likely runs in both directions and is a subject for future research.

[28] Along the same lines, in our later work on minority optimism versus poor white pessimism (Graham and Pinto, 2019a), we also find that regions with a higher concentration of minorities – such as the Southern cluster of states – are more optimistic and less stressed, controlling for a host of mediating factors. This is remarkable as these places have poor indicators on the poverty and health fronts (not suicide though). See also: https://www.brookings.edu/research/the-geography-of-desperation-in-america/

[29] Recall that the survival distribution also accounts for the entry age of each participant. The broad age categories are not perfectly collinear because there are people that shift from one category to the next during the sample period.

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Table 5
Life Expectancy regressions with added interactions, cox proportional hazard models.

	(1)	(2)	(3)
Life Work Out	−0.052*** (0.012)	−0.038*** (0.012)	−0.080*** (0.027)
Female X Life Work Out	0.044** (0.020)		
Black X Life Work Out		−0.002 (0.022)	
Hisp & X Life Work Out		0.054 (0.081)	
Ages 35–49 X Life Work Out			−0.002 (0.033)
Ages 50–64 X Life Work Out			0.065** (0.032)
Ages 65+ *X* Life Work Out			0.076** (0.031)
Female	−0.653*** (0.077)	−0.525*** (0.042)	−0.529*** (0.042)
Black	0.130** (0.053)	0.135* (0.080)	0.121** (0.053)
Hispanic & Other	−0.404** (0.174)	−0.553* (0.332)	−0.386** (0.171)
Ages 35–49	−0.080 (0.071)	−0.083 (0.071)	−0.070 (0.124)
Ages 50–64	0.078 (0.073)	0.080 (0.073)	−0.123 (0.125)
Ages 65+	0.057 (0.092)	0.066 (0.092)	−0.174 (0.132)
Socio-Economic Controls	yes	yes	yes
Observations	16,489	16,489	16,489
# of People	4442	4442	4442
Pseudo R-Sq.	0.009	0.009	0.009
Division Grew Up F	24.049	23.964	24.584
Current Division F	4.467	4.515	4.637

Notes: Excluded categories include: male, white, and ages 16–34. Socio-Economic Controls include the same education, work limitations, income, and employment status variables as in Table 1. Standard errors in parentheses (clustered by individual); * $p<0.10$ ** $p<0.05$ *** $p<0.01$.

The LWO interaction term for older age groups is positive, significant, and large. For people of ages 50 years and older (at the time of LWO observation), greater LWO has no significant relationship with the probability of dying – the marginal effect of LWO by age group is statistically insignificant for people aged 50–64 and 65 or more. There are a couple possible explanations for this finding. First, it is possible that young optimistic people invest more in their lives than less optimistic people, for example by exercising more (in addition to education and the other moderators already mentioned), which has a cumulative positive compounding effect, while older optimistic people have already made these investments and are benefiting from them. Second, recall that life satisfaction typically follows a U-shaped curve over the life cycle (cf., Rauch, 2018). Higher optimism likely protects psychological well-being in the mid-life years – which contributes to resilience (Fredrickson, 2004) – but is less important in the latter half of the U-shape (after about age 50). Lastly, age is an important determinant on its own. Recall that the probit analysis necessarily excludes people 65 and older because each of them die by 2015. As a consequence, LWO has less room to contribute.

3.2. Causal effect of optimism on mortality?

Establishing causality in studies using subjective data is particularly challenging. Exogenous variation is not likely to operate solely through one variable, especially given how optimism and life circumstances are often jointly determined. There are experimental studies that induce positive feelings to demonstrate their effect on short-run outcomes such as productivity (Oswald et al., 2015), but to induce feelings sufficiently persistent to affect mortality in a general population setting is less feasible. One of the first studies to discuss the difficulty of obtaining an instrument in the subjective well-being literature is Di Tella et al. (2003) (see page p. 820); however, a relatively new approach that can be used to generate instrumental variables was not documented at the time (Lewbel, 2012).

To estimate the causal impact of LWO on mortality, we employ two-stage least squares (2SLS) using generated instruments according to the Lewbel method. In the first stage, we rely on variation in the generated instruments (discussed in detail below) to predict LWO. In the second stage, we replicate the probit analysis (Table 4), but instead use predicted LWO and a linear probability regression.[30] In this way, predicted LWO is considered exogenous and we account for any omitted variables, reverse causality, or measurement error. Using generated instruments according the Lewbel approach is becoming more common; Lewbel (2012) documents papers as early as 2007. Often it is used to supplement alternative approaches, as in Arampatzi et al. (2018), Denny and Oppedisano (2013), Le Moglie et al. (2015), Sarracino and Fumarco (2018), while others have relied on it as the primary method (Kesavayuth and Zikos, 2018). What is more, both Kesavayuth and Zikos, 2018 and Le Moglie et al. (2015) predict objective outcomes with subjective well-being data. The STATA user written command ivreg2h can be used to generate the instruments and perform the IV analysis (Baum and Schaffer, 2012). The following provides more detail, largely based on Baum et al. (2013) and Lewbel (2012).

[30] We assume linearity to be consistent with the Lewbel method. This choice is not uncommon. Le Moglie et al. (2015) also use a linear second stage model for a binary dependent variable when using the Lewbel method.

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Table 6
Probability of death by the year 2015, two stage linear probability regressions.

	(1)	(2)	(3)	(4)	(5)	(6)
Life Work Out	−0.022*** (0.006)	−0.022*** (0.006)	−0.016*** (0.006)	−0.021*** (0.006)	−0.022*** (0.006)	−0.017*** (0.006)
Female	−0.140*** (0.017)	−0.142*** (0.017)	−0.138*** (0.017)	−0.143*** (0.017)	−0.154*** (0.018)	−0.143*** (0.018)
Black	0.129*** (0.021)	0.107*** (0.023)	0.096*** (0.023)	0.105*** (0.023)	0.102*** (0.024)	0.097*** (0.024)
Hispanic & Other	−0.091* (0.049)	−0.054 (0.051)	−0.070 (0.050)	−0.056 (0.051)	−0.058 (0.052)	−0.071 (0.051)
Ages 35–49	0 411*** (0.020)	0.413*** (0.020)	0.393*** (0.021)	0.409*** (0.020)	0.418*** (0.020)	0.395*** (0.021)
Ages 50–64	0.658*** (0.015)	0.655*** (0.015)	0.621*** (0.017)	0.644***(0.016)	0.655*** (0.015)	0.610*** (0.018)
In School			−0.066* (0.038)			−0.086** (0.040)
Edu < High School			0.064*** (0.018)			0.062*** (0.018)
Edu > High School			−0.046** (0.021)			−0.043** (0.021)
Work Limitation				0.057*** (0.018)		0.041** (0.019)
ln(Real Inc. FU pc)					−0.000 (0.004)	0.008* (0.004)
Unemployed					0.098** (0.044)	0.089** (0.044)
Out of Labor Force					0.041* (0.025)	0.062** (0.026)
Location Controls	–	yes	yes	yes	yes	yes
Constant	0.432***	0.415***	0.420***	0.409***	0.413***	0.352***
	(0.029)	(0.046)	(0.047)	(0.046)	(0.056)	(0.058)
Observations	3899	3899	3899	3899	3899	3899
Adj. R-Sq.	0.356	0.358	0.366	0.360	0.360	0.368
Kleibergen-Paap F Stat.	324.208	311.392	280.465	301.628	288.441	264.216
Hansen J p-value	0.853	0.948	0.966	0.922	0.939	0.972

Notes: Excluded categories include: male, white, ages 16–34, high school, and working.
Robust standard errors in parentheses; * $p<0.10$ ** $p<0.05$ *** $p<0.01$.

3.2.1. Lewbel method

Using the Lewbel (2012) method, instruments can be generated using the internal structure of the data. The method relies on two key conditions. First, heteroskedasticity, which can be tested using the standard Breusch–Pagan test. The second condition is untestable and relies on an assumption analogous to the IV assumptions. To be precise, consider the structural equations presented below in which Y_1 and Y_2 are endogenous variables.

$$Y_1 = \boldsymbol{X}'\boldsymbol{\beta}_1 + Y_2\gamma_1 + \varepsilon_1 \tag{3}$$

$$Y_2 = \boldsymbol{X}'\boldsymbol{\beta}_2 + \varepsilon_2 \tag{4}$$

In traditional IV settings, for a subset of $\boldsymbol{X}$ the corresponding elements of $\boldsymbol{\beta}_2$ are non-zero, but in $\boldsymbol{\beta}_1$, they are assumed to be zero. For the Lewbel (2012) method, the key assumption is: for a subset of $\boldsymbol{X}$, noted as $\boldsymbol{Z}$, that $cov(\boldsymbol{Z}, \varepsilon_1\varepsilon_2) = 0$.[31] In the case of an omitted common factor U, where $\varepsilon_1 = \alpha_1 U + V_1$, $\varepsilon_2 = \alpha_2 U + V_2$, the assumption holds under the condition $cov(\boldsymbol{Z}, V_1V_2) = 0$. In our case, the two Lewbel conditions for identification are: mortality or LWO must be heteroskedastic and $\mathbf{Z}$ must be unrelated to the LWO residual interacted with the mortality residual. We use the variables gender and race for $\mathbf{Z}$ to generate instruments (as discussed below) because they are exogenously determined. Age is not used because the instruments based on age are not excludable as suggested by an overidentification test. The generated instruments based on gender and race pass the standard tests suggesting that they are not weak and are excludable (shown in Table 6, discussed below).

The instruments are generated as follows: (1) estimate Eq. (4) by OLS and store ε_2, (2) de-mean $\mathbf{Z}$ by subtracting the average of the variable (over all observations) from each observation of that variable and then multiplying by ε_2, i.e., instrument $\boldsymbol{Z}_j^* = (\boldsymbol{Z}_j - \bar{\boldsymbol{Z}}) * \varepsilon_2$. By construction, the covariance between $\boldsymbol{Z}_j$ and ε_2 is zero, and on average the covariance between $\boldsymbol{Z}_j^*$ and ε_2 will be zero, but with heteroskedasticity the elements of $\boldsymbol{Z}_j^*$ will take meaningful values.

3.3.2. Lewbel results

The results presented in Table 6 indicate LWO has a positive causal effect on life expectancy – greater LWO leads to a reduction in mortality. The IV diagnostics indicate, the Lewbel instruments are excludable and relevant – the Hansen J p-values and F-stats are quite large. Additional test results consistently indicate that mortality is heteroskedastic in each specification (necessary for relevance).[32] The magnitudes are meaningful. A one-point increase in LWO corresponds with a 1.7 percentage point reduction in the probability of dying by 2015. Years gained cannot be determined from this analysis, but like the probit estimates (Table 4), the LWO magnitude corresponds to a fraction of the work-limitation magnitude (41% in column 6). Indeed, the instrumented-LWO magnitudes are quite similar to those of the analogous probit results,

[31] For identification, the standard assumption $E(\boldsymbol{X}\varepsilon_1) = E(\boldsymbol{X}\varepsilon_2) = 0$ is also maintained.

[32] We tested the residuals from regressions of mortality on LWO, both as observed and predicted – the latter corresponding to the regressions presented in Table 6. In each case the test statistics rejected homoscedasticity (respectively, Breusch–Pagan and Pagan-Hall).

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Table 7
OLS Life Work Out regressions.

	(1)	(2)	(3)	(4)	(5)
Lag Life Work Out				0.374*** (0.015)	0.368*** (0.015)
Ages 35–49	0.014 (0.062)	0.140** (0.060)	0.140** (0.063)	0.084 (0.058)	0.084 (0.058)
Ages 50–64	−0.096 (0.066)	0.132** (0.066)	0.121* (0.070)	0.012 (0.064)	−0.016 (0.063)
Ages 65+	0.050 (0.074)	0.532*** (0.088)	0.482*** (0.095)	0.295*** (0.089)	0.253*** (0.086)
Female	−0.874*** (0.060)	−0.737*** (0.059)	−0.346*** (0.088)	−0.263*** (0.087)	−0.297*** (0.085)
Black	−0.845***(0.073)	−0.561*** (0.072)	−0.397*** (0.080)	−0.251*** (0.078)	−0.228***(0.074)
Hispanic	−0.581*** (0.166)	−0.366** (0.169)	−0.252 (0.182)	−0.132 (0.166)	−0.186 (0.169)
Other	−0.339 (0.320)	−0.485 (0.312)	−0.401 (0.345)	−0.277(0.306)	−0.237 (0.299)
In School		0.266** (0.109)	0.272** (0.124)	0.032 (0.133)	0.017(0.118)
Edu < High School		−0.274*** (0.060)	−0.166** (0.078)	−0.187*** (0.070)	−0.189*** (0.053)
Edu > High School		0.376*** (0.060)	0.262*** (0.071)	0.140** (0.064)	0.164*** (0.056)
Work Limitation		−0.468*** (0.059)	−0.420*** (0.059)	−0.247*** (0.058)	−0.249*** (0.056)
ln(Real Inc. FU pc)		0.075*** (0.012)	0.067*** (0.012)	0.037*** (0.013)	0.040*** (0.012)
Unemployed		−0.450*** (0.132)	−0.762** (0.316)	−0.811** (0.398)	−0.466** (0.205)
Out of Labor Force		0.084(0.076)	−0.318 (0.292)	−0.345 (0.350)	−0.065 (0.079)
Rents Home			−0.233*** (0.055)	−0.116** (0.053)	−0.108** (0.052)
Neither Own or Rent			−0.214** (0.104)	−0.044 (0.105)	−0.036 (0.105)
N/A No Job			0.376(0.287)	0.279 (0.343)	
Works Two Jobs			0.084 (0.055)	0.071 (0.054)	
Married			0.077 (0.100)	0.044 (0.099)	0.057 (0.098)
Widowed			−0.236** (0.113)	−0.088 (0.108)	−0.020 (0.107)
Divorced			−0.812*** (0.117)	−0.563*** (0.112)	−0.528*** (0.111)
Separated			−0.514*** (0.128)	−0.131 (0.141)	−0.110(0.137)
Max Parent's Educ.			0.108*** (0.038)	0.062* (0.035)	0.044** (0.018)
Relative Educ.			0.045(0.057)	−0.004 (0.051)	
Avg. Inc. Pars.			0.167*** (0.053)	0.147*** (0.047)	0.169*** (0.046)
Well to do Pars.			0.231*** (0.074)	0.145** (0.066)	0.184*** (0.065)
DK/NA Pars.			−0.135 (0.266)	−0.097 (0.259)	−0.088 (0.263)
Year Controls	–	yes	yes	yes	–
Constant	3.906*** (0.051)	2.819*** (0.126)	2.489*** (0.204)	1.686*** (0.201)	1 795*** (0.170)
Observations	16,489	16,489	15,666	8634	9079
R-Squared	0.069	0.131	0.153	0.270	0.266
Adj. R-Sq.	0.068	0.130	0.150	0.266	0.263
# of People	4442	4442	4156	3235	3426
Division Grew Up F			0.797	1.614	4.117
Current Division F		6.438	1.654	0.662	

Notes: omitted categories include: men, white, ages 16–34, working, owns home, works one job, married, poor parents. Standard errors in parentheses (clustered by individual); * $p<0.10$ ** $p<0.05$ *** $p<0.01$.

though somewhat larger. Larger magnitudes are likely due to measurement error in LWO, which the IV approach accounts for. The controls exhibit similar relations to the earlier results. Being in school and income (column 6) become statistically significant, but only at ten percent.

The results presented in Table 6 suggest that education may operate as a mechanism through which LWO affects mortality. When LWO is exogenous (as in Table 6), adding controls should not affect the magnitude, yet it is reduced when adding education (contrast columns 2 and 3). This finding is consistent with the view that people with greater LWO pursue more education, which increases life expectancy. Note, however that the reduction in magnitude is not statistically significant and should not be in interpreted too strongly. The other controls do not appear to operate as mechanisms.

3.3. Who are the optimists?

LWO varies over time for the population as whole and varies systematically across groups of people. LWO also varies over time for a given individual. Indeed the within-person standard deviation of LWO is similar to the between-person standard deviation (1.3 compared to 1.6 on a scale of 1–5, presented in Appendix Table A.1). However, the aim of this section is to learn about the correlates of LWO between people. We are interested in explaining LWO broadly, similar to past studies that assessed the correlates of happiness (as summarized in Blanchflower and Oswald, 2004; Dolan et al., 2008; and Layard et al., 2012). We do not intend to identify the causal determinants of LWO because causal studies necessarily have a narrower focus, typically concerning one channel, without much regard for the overall explanatory power. From the estimated correlations we learn who exhibits greater LWO, which provides a starting point for future research and a model for predicting historical trends.

The correlates of LWO are presented in Table 7, based primarily on OLS regressions of LWO on various demographic and socio-economic characteristics (fixed effects and ordered probit models were also considered). Observations from each year that LWO was observed are used – the initial sample corresponds with the Cox sample presented in Appendix Table A.2. Column 1 presents relations for exogenously determined variables. Columns 2 and 3 each add sets of individual characteristics,

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including location controls (only measures of their joint significance are presented for brevity). Column 4 adds in lagged LWO. Column 5 forms the basis of the prediction model by dropping year effects and insignificant variables that limit the sample.

The variables associated with higher socio-economic status and health are positively associated with LWO, i.e., high education, income, being employed, owning your home (the omitted category), and good health (lacking a work limitation). Getting divorced or separated and becoming widowed are each negatively associated with LWO relative to being single (though the association of being widowed or separated diminishes when accounting for lagged LWO). Men have greater LWO than women, and whites more than blacks but not Hispanics.[33] LWO is greater for people over 65, which is reminiscent of the latter part of the U-shaped life satisfaction relation with age. The various explanations for the U-shape range from changing aspirations (as discussed in the Introduction), to increased emotional wisdom as individuals age, to selection bias as happier (and more optimistic) people live longer, which is particularly relevant in this case.[34]

Parents' status is also important. LWO is positively associated with parents' educational achievement and whether the individual perceived their parents to be well off (in terms of income). We also expected educational attainment relative to one's parents to be an important correlate, because we believed individuals' educational expectations to be partially set by their parents' achievements. However our expectations were not confirmed in the present case – educational achievement relative to one's parents' is not statistically significant.

Lagged LWO is highly significant and together with the other variables explains more than 25% of the variation in individual LWO, which is high for individual subjective variables like life satisfaction.[35] In column 5, we drop both the year controls and insignificant controls, which increases the sample size and decreases the R-squared only slightly. We dropped the year controls because they are not helpful for prediction.

We considered fixed effects and ordered probit specifications but omitted them for brevity and the following reasons. The correlates in the fixed effects specification are generally insignificant and do not explain the variation very well. What is more, fixed effects estimations preclude us from addressing our research question. Individual fixed effects are beneficial for estimating causal relationships, but they can only be used to identify relations associated with within-person changes. We are interested in the characteristics of people that correlate with LWO, including both time-varying and fixed characteristics, such as gender and race. The latter of which can only be observed when excluding fixed effects. Concerning the ordered probit estimation, we found it to be inferior based on both the Akaike and Bayesian information criteria, which were each substantially higher for the same sample and variables. For these reasons we chose the autoregressive specification for prediction (column 5).

4. Prediction of Life Work Out trends

The finding that optimism predicts the probability of being alive 40 years later indicates why understanding optimism is important. What is more, optimism is related to the inverse of despair and despair is believed to strongly contribute to the present epidemic of premature mortality in the U.S. Recent work by one of us (referenced above) matched trends in optimism and lack there-of with deaths of despair. We find, the respondents that are most vulnerable to deaths of despair are significantly less optimistic than their comparator cohorts (Graham and Pinto, 2019a).

The rise in deaths of despair began in the 1990s, yet, as discussed above, many studies suggest it is a symptom of longer-term structural forces which resulted in a decline of hope among vulnerable cohorts. To our knowledge, previous work has not explicitly assessed the specific correlates of despair. It is possible to directly observe trends in numerous factors that may have led to the rise in despair, but it is unclear whether and to what degree these factors contributed. In this section, we address this question through the prediction of trends in LWO for various demographic groups over the period 1976–1995. As demonstrated in the previous section, LWO is a function not only of the economic forces theorized to affect deaths of despair (such as: education, wages, and employment), but also, non-economic forces (e.g., marriage). Consequently, the predicted trend in LWO summarizes the collective, possibly offsetting, influence of each factor over time.

The importance of predicted LWO, as a summary measure, is illustrated in part by observing the underlying characteristics. Table 8 presents characteristics of people with less than high school education and contrasts them with those of the full sample for the years 1970 and 1995. The figures are based on the "Expanded" sample, defined below.

[33] The relation for blacks has likely changed since then, as in later data from the Gallup Healthways poll for 2008 onwards, we find that blacks in general and poor blacks in particular have the highest levels of optimism (defined here as how they predict their life satisfaction will be in the future) of all racial groups, even though their current life satisfaction is lower than that of both whites and Hispanics (Graham and Pinto 2019a; see also Witters 2017). It may have also changed for women, as they are both more optimistic and satisfied with their lives than are men in this period (Graham and Pinto, 2019a). For over time trends in happiness and the narrowing gap between women and African Americans and men/whites, see (O'Connor, 2017a; Stevenson and Wolfers, 2008).

[34] For a review of the explanations for the age curve, see Graham and Ruiz Pozuelo (2017); for an excellent review of all the bodies of research that seek to explain the age curve, see Rauch (2018).

[35] The World Happiness Report reports among the highest R-squareds we have observed, explaining individual life satisfaction, ranging from 0.09 to 0.28 (Layard et al., 2012).

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Table 8
Sample average characteristics, two samples in 1970 and 1995 full sample corresponds to the "Expanded" sample.

	Less Than High School			Full Sample	
	Unit	1970	1995	1970	1995
Age	years	55.30	57.56	49.08	49.88
Female	Share	0.29	0.59	0.24	0.43
White	Share	0.82	0.72	0.87	0.82
Black	Share	0.16	0.26	0.10	0.16
LessthanHS	Share	1.00	1.00	0.44	0.15
Work Limitation	Share	0.39	0.39	0.27	0.23
Real Inc. (FU pc)	1968 $s	1745	1085	2760	3677
Unemployed	Share	0.01	0.06	0.01	0.04
Homeowner	Share	0.65	0.51	0.67	0.62
PoorParents	Share	0.64	0.68	0.52	0.53
Married	Share	0.61	0.27	0.67	0.40

Expanded sample is comprised of all family heads without missing data that personally responded to the survey in the year listed, including attriters and those that were added to the PSID over time.
Source: PSID and author calculations.

Declining or deteriorating conditions are especially apparent for the less than high school group. Perhaps the most obvious change is the decline in real taxable income per household member (Real Inc. (FU pc)) from 1745 to 1085. During a period of sustained economic growth, this decline or stagnation, repeated in many other studies, is striking. Additionally, the married population share more than halved! The unemployment rate also increased. Many of the characteristics also worsened for the full sample, but to a lesser degree. The collective influence of these forces is theoretically ambiguous. Perhaps the increase in wages in the full sample offset the decline in marriage rates. However, the trends in predicted LWO summarize the influence of each factor.

4.1. Method of prediction

We predict LWO using the autoregressive model from the previous section (Table 7, column 5), with an adjustment for population groups (described below). We predict by applying the estimated coefficients to the covariates' concurrent values. We use lagged predicted LWO when LWO is not observed (1973, 1974, 1976–1994). In particular we undertake the following steps: (1) the model is estimated using the years 1969–1972; (2) LWO is predicted for 1969–1973; (3) LWO is predicted for 1974; and (4) LWO is predicted for each of the years 1976 to 1995 separately. The final year is 1995 because the PSID starts interviewing every two years in 1997 and there is no individual weighting variable in 1996. In order to predict LWO separately by subgroup we make an adjustment to the model of LWO. Specifically, the coefficient on each time-varying variable is allowed to take different values by population subgroup using interactions with an indicator of subgroup (time-invariant controls are not interacted in order to limit the total number of variables).

We selected subgroups based on characteristics that are exogenously determined in order to maintain subsample composition over time, including: gender, race, and birth cohort. We also include two groups by education level as a particularly important characteristic. Two groups were selected to increase within-group sample size, specifically: less than a high school education, and high school or more education. To maintain consistent samples, education group membership was determined based on educational achievement in 1975 and then held constant in subsequent years (in the Balanced sample, as defined below).[36] It is also for this reason that birth cohorts are used instead of age. In particular the group born during the years 1906–25 is contrasted with those born during 1926–45. Later cohorts were excluded due to sample size.[37]

Selection of the full sample is also important for predicting LWO. We chose to estimate the model and present predicted LWO for two different samples, "Balanced" and "Expanded". The Balanced sample is comprised of individuals that were observed in every year from 1972 to 1995.[38] No additional individuals were added for replenishment and attriters for any reason were excluded. Eight hundred and twenty two people met these restrictions. The Expanded sample is comprised of all family heads that personally responded to the survey, including attriters and those that were added to the PSID as long as the important characteristics (e.g. education) were observed. Predictions of LWO for the Expanded sample are out of sample, both in terms of time and individual, whereas predictions for the Balanced sample are based on the same people and only out of sample in time. Note that the mean level of LWO is higher in the Balanced sample than in

[36] In the Expanded sample (defined below), education group membership was determined by the level of education in the year observed because education was not observed in 1975 for those people added to the sample afterwards.
[37] Remember that the sample is constrained to family heads. In 1968 the oldest of the Baby Boomers (1946-1964) are 22.
[38] Individuals were added after 1968 up until 1972 because 1972 is necessary to complete step two of the prediction process.

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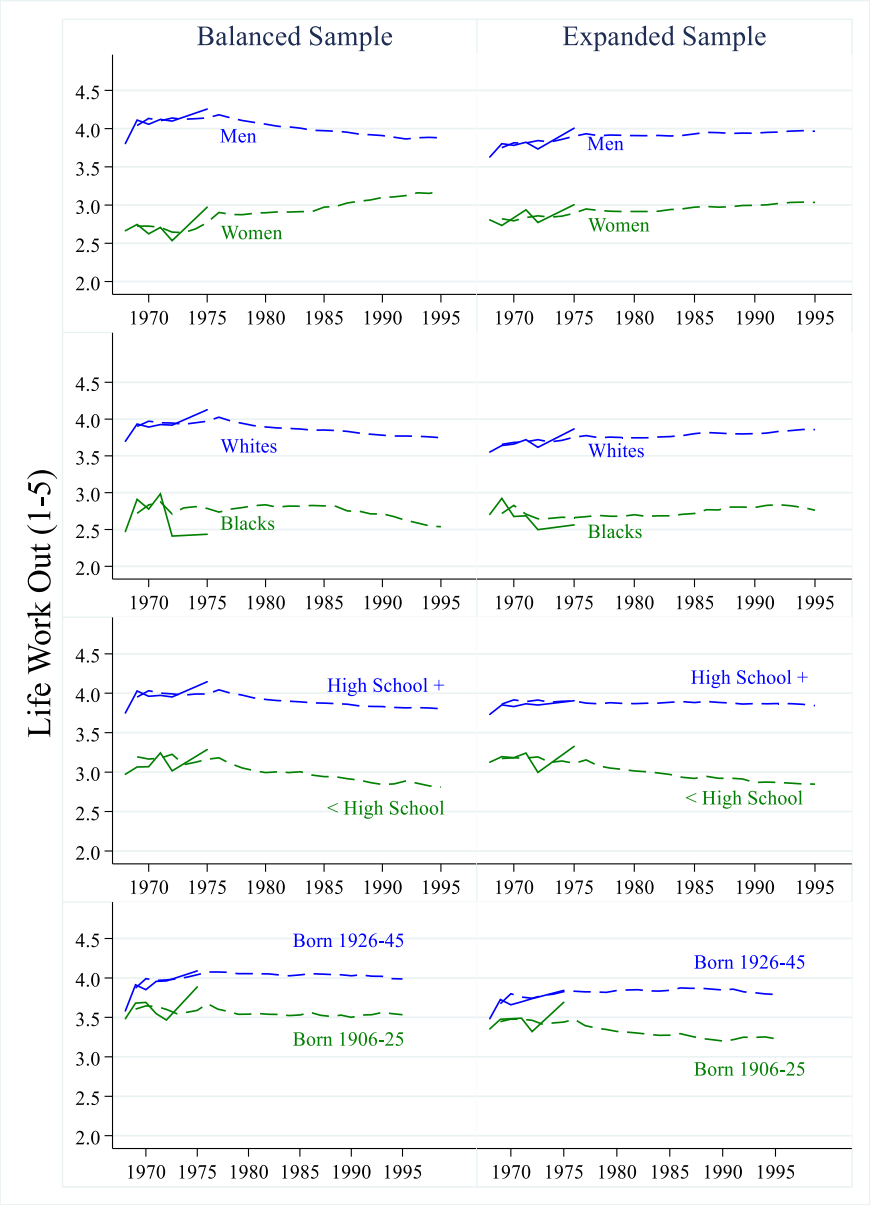

Fig. 2. Predicted "Life Work Out" by Gender, Race, Education, and Birth Cohort two samples, 1968-1995.
Notes: Solid lines are observed annual sample means. Dashed lines are predicted.
Source: PSID and author estimates.

the Expanded sample because attriters due to mortality were excluded from the former sample and optimistic people live longer.

4.2. Predicted historical trends in Life Work Out

The predicted LWO trends, presented in Fig. 2 as dashed lines, reveal two groups with consistent trends. For most subgroups, the trends are inconsistent across samples. The clearest pattern is how poorly the Less than High School group fared since 1975, in general and relative to other groups. They show declining LWO over the period (within both samples), which suggests that the trends affecting despair and leading to substance abuse and suicide started long before the 1990s. This decline is supported by the characteristics presented in Table 8. What was unclear before was that no other group would exhibit such a consistent decline because many characteristics of the full sample also worsened.

The success story appears to be female family heads (who are unmarried in the PSID) because they are the only group that show increasing LWO over the period within both samples. This finding seems consistent with improvement in women's

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rights; however, mean happiness for nationally representative samples of women tell a different story. It generally fell in the U.S. from the 1970's (O'Connor, 2017a; Stevenson and Wolfers, 2009), although there are some exceptions. For example, single mothers reported increasing happiness starting in the late 1980s (largely consistent with our findings), in part due to new employment opportunities (Ifcher 2011). Also, based on the most recent data (2008–2016), women are consistently happier (and more optimistic) than men (Graham and Pinto, 2019a).[39] Additional research is necessary to understand the trend for women in a broader context.

In general the LWO trends do not exhibit a singular pattern. The most consistent pattern is largely flat, with a greater downward tendency in the Balanced sample.[40] More specifically, in the Balanced sample, three groups experienced declines, one increased, and for the remaining four, the trends are either flat or unclear. In the Expanded sample, LWO is predicted to be fairly flat or increasing for most groups. Other than the less than high school group, the only other group to show a decline is the birth cohort 1906–25. This finding is not difficult to understand. Individuals in the 1906–25 birth cohort are 70–89 years old in 1995. While studies of subjective well-being over the life-cycle show an increase in later life happiness, the increase occurs only up to approximately the age of 70 (depending on the study). Concerning the relative levels of LWO across groups, the ranks are consistent over time and across samples.

The average predicted values visually correspond fairly well with the observed values (solid lines) with two exceptions. First, the predictions for 1975 are not matched as well, perhaps because the survey mode changed from face to face to telephone after 1972, or because it was an unusual year. The entirety of 1974 was recorded as a recession and there was a recession in 1970 as well (NBER, 2014). Second, the predictions for Blacks in the Balanced sample do not correspond with the observed data as well. Concerning observed LWO, the solid lines are as expected consistent with the regression results; men, whites, and better-educated people report higher LWO than their counterparts. The 1926–45 birth-cohort also reports higher LWO than the 1906–25 cohort.

The most important finding from this section is that those with less than a high school degree show a declining trend in LWO over the period 1968–1975. This trend is the result of trends in several underlying factors such as declining income, homeownership and marriage rates, and increasing unemployment. This group is also prone to deaths of despair, while those with more education did not fare so poorly – suggesting that the symptoms of a low level of education include lower optimism and greater mortality. Greater education is a promising policy target. Interventions training character skills to improve educational outcomes are particularly promising, likely reducing mortality through both greater education and optimism (recall the Perry Preschool study discussed in footnote 10).

5. Conclusion

Building from the nascent body of research that finds that respondents with higher levels of happiness and hope tend to have better future outcomes, both within and outside the U.S., we test the proposition that more optimistic people live longer, based on data from the U.S. Panel Study on Income Dynamics. We find evidence to support this proposition, with family heads who reported higher levels of Life Work Out (LWO) during the period 1968–1975 more likely to be alive in 2015 than those with lower LWO. However, there is significant relationship heterogeneity; it only holds for men and family heads less than 50 years old.

We also find that LWO can change over time, and its relationship with longevity is partially accounted for by health, education, and employment status. This is consistent with the findings of earlier studies that suggest more optimistic people are more likely to invest in their futures (as in the case of education) because they are more confident in those futures. And while people with more income and education can more easily make such investments, optimism plays an additional and independent role. Indeed our findings concerning causality (Section 3.2) indicate greater LWO causally increases life expectancy, and greater education likely explains a portion of the effects.

We find that the greatest predicted decline in LWO over the period 1975–1995 occurred for those respondents with less than a high school education, the same cohorts (especially non-Hispanic whites) who are driving premature mortality trends today. It was clear before that this group suffered relative to the population at large (especially in terms of wages), but not the degree to which they suffered especially when including the contribution of other factors (e.g., marriage rates). Of any group, female family heads (unmarried women in the PSID) fared the best over this period. African Americans and whites fared similar to each other. These trends are largely consistent with evidence from recent years. At the time that LWO was measured (1968–75), women and blacks reported lower LWO than men and whites, but in recent years, women

[39] In addition, the general gap between men and women may have also changed with increasing equality in gender rights over the period. Later studies find that women are on average happier than men in countries with relatively good gender rights and certainly in rich countries (Graham and Chattopadhyay, 2013).

[40] Aging may affect the LWO trends in the Balanced sample, however the effects are likely to depend on what point the individuals are in the life cycle. Fig. C1 plots lowess smoothed LWO by age for the two birth cohorts for which we predicted LWO. The cohort trends contrast each other, declining in the younger group and increasing in the older, but across cohorts, life-cycle LWO resembles the oft-cited U-shape. A greater proportion of the less than high school group belongs to the older birth cohort than the better educated group, suggesting that any effects of aging should more positively affect the lower educated group.

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are on average happier and more optimistic than men, and blacks are also more optimistic, though still not as happy as whites.

The study of optimism is a fairly new and uncharted territory, at least for economists. Yet our results, as well as those of some previous studies, suggest that it plays an identifiable role in more positive future outcomes and, in this case, longer lives. Our finding on the early declines in LWO among the less than high school educated population, and their long-run links to premature mortality and deaths of despair in the U.S., meanwhile highlight the importance of better understanding optimism's causes and consequences. While beyond the scope of this paper, there is a growing body of literature, based on small scale interventions to improve well-being in deprived communities, which could provide a basis for interventions designed to revive hope among populations where it has been lost (Graham and MacLennon, forthcoming).

Declaration of Competing Interest

None

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2019.10.018.

Appendix A. Additional sample characteristics

Table A.1 provides a summary of the responses to the LWO question including the distribution, mean, and standard deviation (overall, across, and within individuals). Table A.2. shows the sample composition by year for the Cox and probit models. As discussed, the Cox model uses every available observation, while the probit model uses only the initial observation per person and also excludes everyone aged 65 and above, which explains why for the probit model in 1968, there are fewer individuals who are also younger. Observations for the Cox model would increase year on year as new people are observed (e.g., 334 people aged less than 65 were added in 1969 – as seen in the probit column), but decreases are also possible when data is missing or when people permanently attrite. Recall, however, that mortality data is known for each observation included. Attriters without mortality data were excluded (see Table 1 for details).

Table A.1
Life Work Out summary statistics (cox sample).

Response Options	Value	N	%
usually been pretty sure	5	8873	54%
pretty sure, qualified	4	399	2%
pro-con, sure sometimes, not sure other	3	317	2%
more times when haven't been sure, qualified	2	176	1%
more times when not very sure about it	1	6724	41%
Total		16,489	100%
Number of People		4442	
Average Obs. Per Person		3.71	
Life Work Out		Mean	Std. Dev.
Overall		3.27	1.93
Between People			1.56
Within Person			1.25

Source: PSID and author estimates. Cox Sample is defined in Section 2.3.

Table A.2
Sample observations and average current age by year and model.

	Cox		Probit	
Year	Obs.	Age	Obs.	Age
1968	2838	45.7	2500	42.2
1969	2365	46.4	334	41.4
1970	2252	46.5	239	35.1
1971	2703	47.0	206	35.0
1972	3086	47.4	186	31.8
1975	3245	47.4	434	29.1
Total	16489	46.8	3899	39.3

Appendix B. Variable definitions and interview details

Variable names from the original 1968 PSID questionnaires are listed in parentheses as examples, when relevant. The variable names change in subsequent years.

Age of death (ER32050 Individual Data)

Precise year of death from the 1968–2013 PSID Death File. The exact year of death and age at that time death is recorded. We also used data from "WHY NONRESPONSE" (ER30041 in 1969):

41: This individual died between the 1968 and 1969 interviews.

Age (ER30004 - Individual data); **Sex** (ER32000 - Individual data); **Race** (V181 - Family Data)

Education (e.g., ER30010 Individual Data)

Four categories based primarily on how many years or grade completed: in school, less than high school (<12 years), high school (12 years), more than high school (greater than 12)

Work limitation (V216 - Family Data)

Do you have a physical or nervous condition that limits the type of work or the amount of work you can do? If Yes - How much does it limit your work?

No Work Limit.: No

Work Limitation: Yes, but no limitation on work

Yes, some limitation on work (must rest, mentions parttime work, occasional limit on work, can't lift heavy objects, reports periods of pain, sickness, etc.)

Yes, severe limitation on work

Yes, complete limitation; can't work at all

Variable compressed to two categories to maintain consistency across years with less information.

Employment Status (V196 - Family Data)

Three categories: Working, unemployed, and out of the labor force

ln(Real Inc. FU pc) (V76 and V115 - Family Data)

Natural log of real taxable income per family member (1968 $s). Income is the sum of family head and spouse's income from labor and assets (V76) divded by family size (V115). Inflation is adjusted using a deflator based on **Urban Cons. Infl**. The deflator is adjusted so that 1968 serves as the base year.

Urban Cons. Infl. (Bureau of Labor Statistics.)

Disaggregated by U.S. regions: Northwest, Midwest, South, and West. CPI-All Urban Consumers (1982–84=100)

Own Home (V103 - Family Data)

Do you (FU) own this home or pay rent or what?

Owns home (or trailer, fully or jointly); Rents (or shares rent); Neither (owns nor rents)

Works Two Jobs (previous year) (V660 - Family Data)

Did you have any extra jobs or other ways of making money in addition to your main job in 1968? (1969 Question)

Marital Status (V239 - Family Data)

Five categories: Single, Married, Widowed, Divorced, Separated,

Max Parent's Educ. (V318 and V3634 (1974) - Family Data)

Maximum of mother and father's education. Categories: (1) 0 - 5 grades; (2) 6–11 grades; (3) 12 grades; (4) 12 plus but no degree; (5) College BA and no advanced; (6) College and advanced; (7) NA or DK

Relative Educ. (calculated)

Subject education relative to maximum of parents' education category. (−1) subject has less the max of their parents; (0) subject has the same; (1) subject has more education.

Head's Parents' wealth (V317 - Family Data)

Were your parents poor when you were growing up, pretty well off, or what?

(1) Poor; (3) Average, it varied; (5) Pretty well off; (9) DK, didn't live with parents

Census division grew up (V311 - Family Data)

Where did you grow up? Recorded by state, but collapsed to census division.

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Appendix C. Life-cycle figure

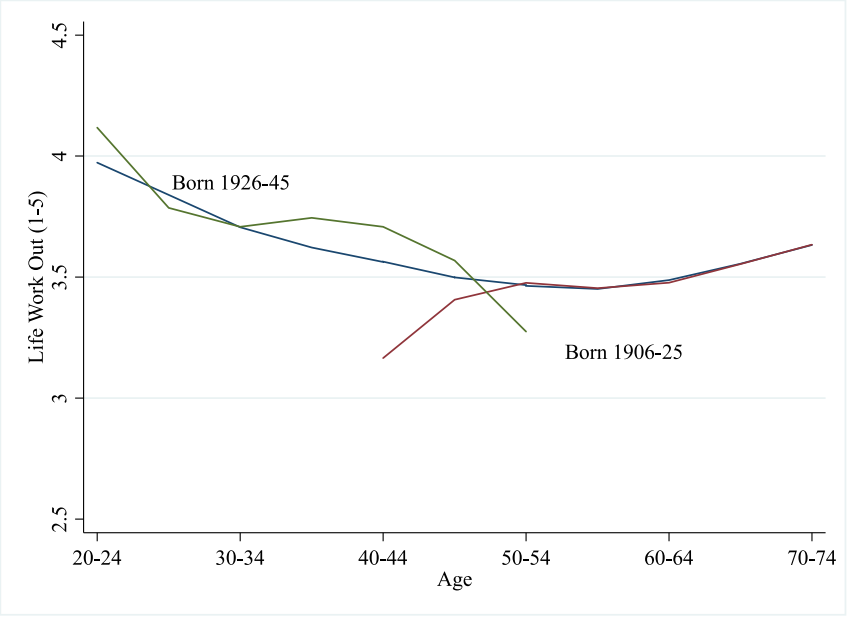

Fig. C1. Life-Cycle Life Work Out for Two Birth Cohorts, Lowess Smoothed.
Notes: Average (over cohort) values of predicted LWO for each age group are used for the Lowess plots. LWO predictions are based on regressions of LWO on five-year age dummies, year effects, and individual fixed effects. The data are from the main sample that is used in the analysis for Tables 4-8 and restricted to the two birth cohorts.
Source: PSID and author estimates.

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