Race and Economic Well-Being in the United States

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Preliminary

Abstract

We construct a measure of consumption-equivalent welfare for Black and White Americans from 1984 to 2018. Our statistic incorporates life expectancy, consumption, leisure, and inequality in consumption and leisure. According to our estimates, the welfare of Black Americans started at only 49% of that for White Americans in 1984 and rose to 69% by 2018. The remaining gap in welfare is large, but there has been progress. This progress occurred because of increases in relative life expectancy and consumption of Black Americans relative to White Americans. Based on preliminary data for 2020, however, mortality from COVID-19 has reversed a decade's worth of progress, lowering Black welfare by about 8% relative to that for Whites.

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1. Introduction

An enormous literature has documented large and persistent differences in economic outcomes by race in the United States. Chetty, Hendren, Jones and Porter (2020) find persistent income and earnings disparities between Black and White Americans in recent decades. Case and Deaton (2015, 2017) emphasize the decline in life expectancy for White men, especially those with less then average education, relative to other groups in recent years. Chetty, Stepner, Abraham, Lin, Scuderi, Turner, Bergeron and Cutler (2016) correlate life expectancy and income over time, highlighting the role of race and other factors in this relationship.

We follow Jones and Klenow (2016) in combining many factors at once into a single, utility-based welfare metric. They examine a panel of countries, whereas we focus on race within the United States. We exploit micro data on consumption, leisure, inequality in consumption, inequality in leisure and life expectancy to estimate consumption-equivalent welfare by race in recent decades. Falcettoni and Nygaard (2020) look across U.S. states and embed education in a novel way, but do not concentrate on patterns by race.

Our sample is currently 1984 through 2018. We rely on data from the Consumer Expenditure Surveys for consumption and from the Current Population Survey for leisure. We use the U.S. Center for Disease Control's (CDC) National Vital Statistics System to count deaths by group, and estimate mortality rates by dividing deaths by Census Bureau population estimates.

We find a stunningly large gap in 2018: consumption-equivalent welfare for Black Americans was only 69% of the level for White Americans in 2018. The gap was even larger in 1984, so that Black Americans did show considerable progress in rising from 49% to 69% of White welfare over our sample. Both in terms of levels and changes, the largest contributors have been life expectancy and mean consumption — in that order. Of lesser importance were changes in mean leisure and in within-group inequality in consumption and leisure.

2. Framework

Our general formulation of lifetime expected utility for an individual of race i is

$$U_i = \mathbb{E} \sum_{a=0}^{100} \beta^t S_{ai} u\left(c_{ai}, \ell_{ai}\right).$$

Here $0 < \beta < 1$ is the discount factor, S is the survival rate, c is consumption and ℓ is leisure. To implement our consumption-equivalent welfare calculation, let $U_i\left(\lambda\right)$ denote expected lifetime utility for an individual of race i if consumption is multiplied by a factor λ at each age:

$$U_i\left(\lambda\right) = \mathbb{E} \sum_{a=0}^{100} S_{ai} u\left(\lambda c_{ai}, \ell_{ai}\right).$$

By what factor λ must we adjust the consumption of all White Americans to make them indifferent between living in the conditions prevailing for Black Americans and their own? That consumption adjustment must satisfy:

$$U_W\left(\lambda\right) = U_B\left(1\right). \tag{1}$$

Denoting the sampling weight of an individual j of race i and age t as w_{it}^j and the number of individuals of the same race and age as N_{it}, we can replace the expectation operator with the estimate provided by the sample mean:

$$U_i\left(\lambda\right) = \sum_{a=0}^{100} S_{ai} \sum_{j=1}^{N_{ai}} w_{ai}^j u\left(\lambda c_{ai}^j, \ell_{ai}^j\right).$$

We assume that flow utility takes the following form:

$$u\left(c, \ell\right) = \overline{u} + \log\left(c\right) + v\left(\ell\right).$$

And flow utility from leisure features a constant Frisch elasticity:

$$v(\ell) = -\frac{\theta\epsilon}{1+\epsilon}(1-\ell)^{\frac{1+\epsilon}{\epsilon}}.$$

Here $\epsilon > 0$ is the Frisch (compensated) elasticity of labor supply, and $\theta > 0$ is a weighting parameter. Flow utility for an individual of race i and age a can therefore be expressed as:

$$u_{ai} \equiv \overline{u} + \sum_{j=1}^{N_{ai}} w_{ai}^{j} \left[\log\left(c_{ai}^{j}\right) + v\left(\ell_{ai}^{j}\right)\right].$$

Solving for the scaling constant in equation (1), we obtain:

$$\log(\lambda) = \frac{1}{\sum_{a=0}^{100} S_{aW}} \times \sum_{a=0}^{100} \left[u_{Bt}\left(S_{aB} - S_{aW}\right) + S_{aW}\left(u_{aB} - u_{aW}\right)\right].$$

This equation tells us that White Americans would need to have lower consumption to have the same utility as Black Americans to the extent that the latter have lower quality-adjusted life expectancy as well as lower flow utility. To ease notation, define survival rates normalized by White life expectancy as:

$$s_{aB} \equiv \frac{S_{aB}}{\sum_{a=0}^{100} S_{aW}} \quad \text{and} \quad \Delta s_{aB} \equiv \frac{S_{aB} - S_{aW}}{\sum_{a=0}^{100} S_{aW}}.$$

Further denote average lifetime utility from consumption and leisure as:

$$\mathbb{E}\log(c_i) \equiv \sum_{a=0}^{100} s_{aB} \sum_{j=1}^{N_{ai}} w_{ai}^{j} \log\left(c_{ai}^{j}\right) \quad \text{and} \quad \mathbb{E}v(\ell_i) \equiv \sum_{a=0}^{100} s_{aB} \sum_{j=1}^{N_{ai}} w_{ai}^{j} v\left(\ell_{ai}^{j}\right).$$

Finally, denote average lifetime consumption and leisure as:

$$\bar{c}_i \equiv \sum_{a=0}^{100} s_{aB} \sum_{j=1}^{N_{ai}} w_{ai}^{j} c_{ai}^{j} \quad \text{and} \quad \bar{l}_i \equiv \sum_{a=0}^{100} s_{aB} \sum_{j=1}^{N_{ai}} w_{ai}^{j} \ell_{ai}^{j}.$$

With this additive separability, we obtain the following decomposition of consumption-equivalent welfare:

$$
\begin{aligned}
\log(\lambda) = & \sum_{a=0}^{100} \Delta s_{aB} u_{aB} && \text{Quality-adjusted life expectancy} \\
& + \log(\bar{c}_B) - \log(\bar{c}_W) && \text{Consumption} \\
& + v\left(\bar{\ell}_B\right) - v\left(\bar{\ell}_W\right) && \text{Leisure} \\
& + \mathbb{E}\log(c_B) - \log(\bar{c}_B) - (\mathbb{E}\log(c_W) - \log(\bar{c}_W)) && \text{Consumption inequality} \\
& + \mathbb{E}v(\ell_B) - v\left(\bar{\ell}_B\right) - \left(\mathbb{E}v(\ell_W) - v\left(\bar{\ell}_W\right)\right) && \text{Leisure inequality}
\end{aligned}
$$

3. Data

Our consumption-equivalent welfare calculation requires data on survival rates, consumption and leisure. We draw on from three main sources: the U.S. Centers for Disease Control and Prevention (CDC), the U.S. Department of Labor's Consumer Expenditure Survey (CEX) and the U.S. Census Bureau's Current Population Survey (CPS).

Survival rates

To calculate survival rates at every age, we first use individual death records from the mortality data files of the CDC's National Vital Statistics System (NVSS) for each year between 1984 and 2018.[1] Each record contains information on the deceased's gender, race, and age. Starting in 1989, the NVSS also started reporting the deceased's educational attainment. However, the quality and coverage of the educational attainment records was relatively poor until 2003. We then use the U.S. Census Bureau's intercensal population estimates to determine the population at risk by gender, race and age.[2] Since the intercensal population estimates

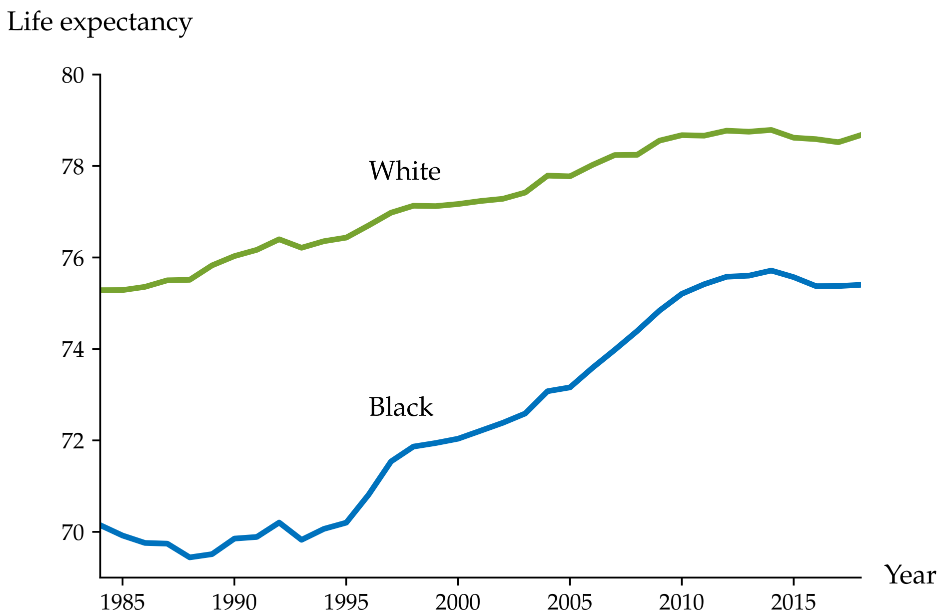
[1] https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm#Mortality_Multiple
[2] https://www.census.gov/programs-surveys/popest/data/data-sets.html

do not provide breakdowns by education, we use the sampling weights of the U.S. censuses and American Community Surveys (ACS) to approximate the educational attainment distribution within each gender, race and age cell.

Figure 1 plots life expectancy at birth for Black and White Americans from 1984 to 2018. The gap narrowed from about 5.5 years in 1984 to around 4 years in 2018. There was actually divergence until the mid-1990s, with most of the catch-up occurring in the 15 year period from 1995 to 2010. Life expectancy has leveled-off or fallen for both White and Black Americans in the last few years. Case and Deaton (2015, 2017) attribute this stagnation in no small part to "deaths of despair" (suicide, opiod overdoses, and alcohol-related chronic illnesses).

In Table 1 we report life expectancy for Black and White Americans by gender and education in 2018. The race gap in longevity is larger among men (4.3 years) than among women (2.5). For the education breakdown, we report life expectancy at age 30 since educational attainment is most likely not realized for everyone below that age. Black Americans have 2.3 to 3.1 lower years life expectancy at age 30, even within education groups.

Figure 1: Life expectancy at birth by race



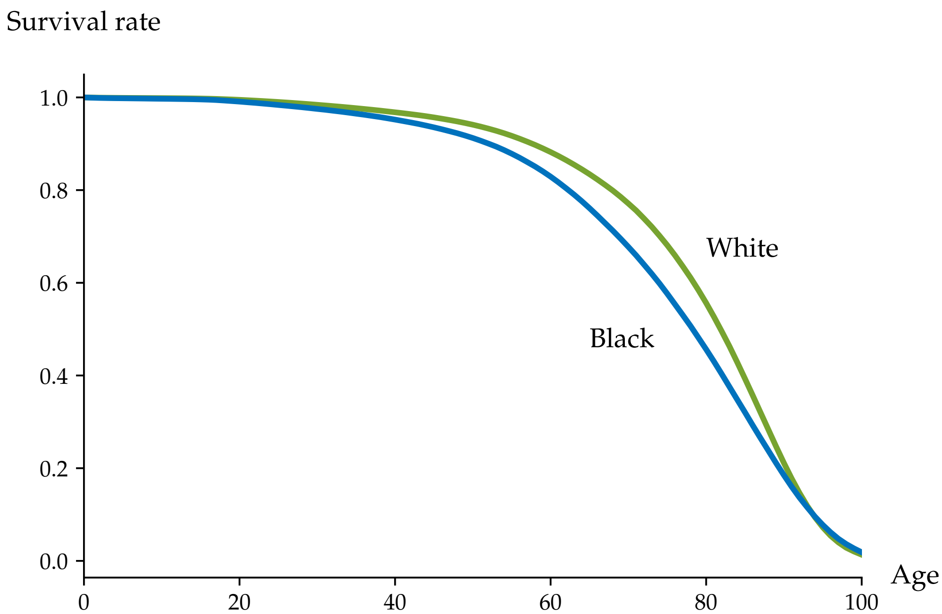
Note: Author calculations using CDC data from the National Vital Statistics System (NVSS).

Table 1: Life expectancy by race, gender and education in 2018

	At birth		At 30 years old		
	Males	Females	$\leq$ High school	Some college	$\geq$ Bachelor's degree
Black	72.0	78.6	44.8	46.1	51.4
White	76.3	81.1	47.1	49.2	53.9

Source: CDC data from the National Vital Statistics System (NVSS).

Figure 2: Survival age profile



Note: Author calculations using CDC data from the National Vital Statistics System (NVSS).

Consumption

Our consumption data comes from the CEX survey's interview sample. For each year from 1984 to 2018, a rotating panel of over 20,000 households are interviewed about their expenditures on hundreds of items for up to four quarters. All expenditures are recorded at the household level, but the survey contains detailed information on each household member such as gender, race, age, and educational attainment.

We aggregate all expenditures into a single consumption measure, but since expenditures on durable goods do not necessarily reflect their associated service flows, when possible, we approximate the latter. For instance, we approximate expenditures on housing services as rent paid for renters and as self-reported rent equivalence for home owners. However, for other durable goods, it is unclear how one should approximate the associated service flows. We therefore exclude those durable expenditures, but present our results when using direct expenditures instead. Then, to get a measure of individual consumption, we divide household consumption evenly among household members.

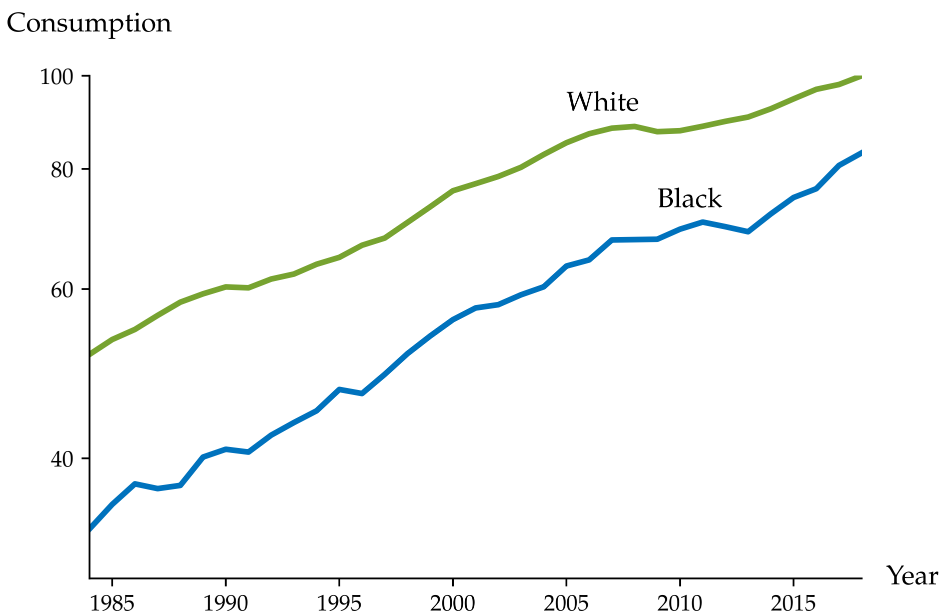
It is well-known that consumption expenditures from the CEX do not aggregate to personal consumption expenditures in the national income and product accounts (NIPA). See Aguiar and Bils (2015) for example. We therefore re-scale individual consumption in the CEX such that it aggregates to the non-health NIPA personal consumption expenditures per capita in each year from 1984 to 2018.

Figure 3 plots consumption per capita for Black and White Americans when White consumption is normalized to one hundred in 2018. Consumption per person was about 33% lower for Black Americans in 1984, but was only 16% lower in 2018. Most of the catch-up occurred by 2000.

Figure 4 displays the standard deviation of log consumption across individuals by year. Dispersion is choppy, especially for Black Americans due to their modest sample sizes. There is no clear pattern, but within-race dispersion is if anything lower for Black Americans. The standard deviations hover around 0.6.

If consumption is lognormally distributed, then such inequality within groups would lower consumption-equivalent welfare by 18%.[3]

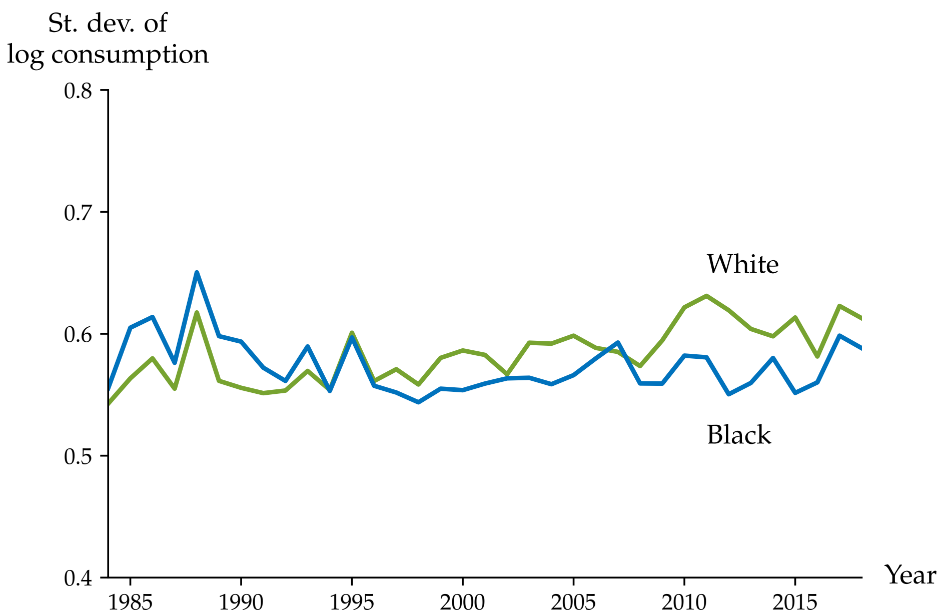
Figure 3: Consumption per capita by race



Note: Author calculations using data from the U.S. Consumer Expenditure Surveys (CEX). Consumption for White Americans is normalized to 100 in 2018.

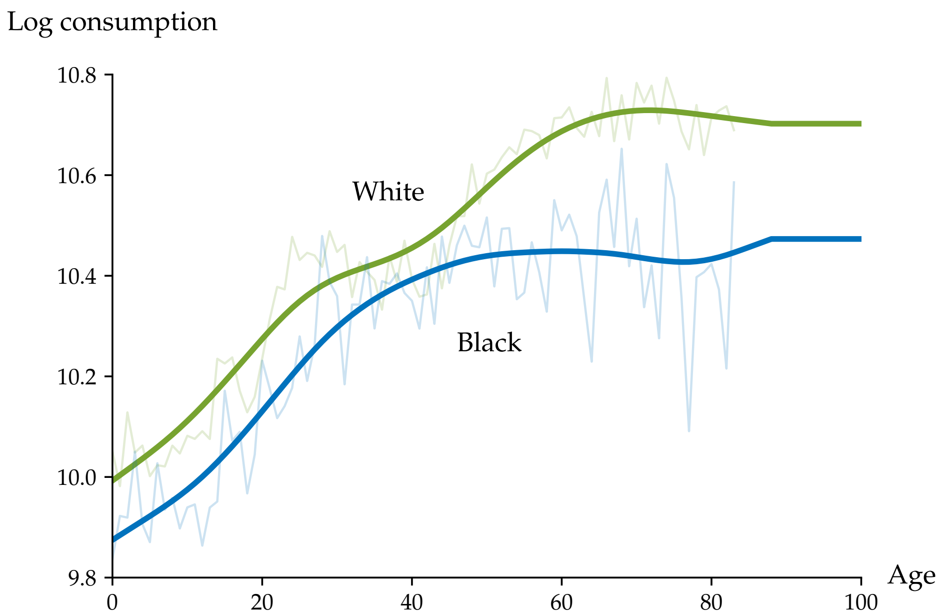
[3] In the case of additively separable utility from consumption and lognormally distributed consumption, the loss in consumption-equivalent welfare from behind-the-veil inequality is the coefficient of relative risk aversion times the variance of log consumption divided by two. In our baseline case of log utility this is the variance divided by two.

Figure 4: Standard deviation of log consumption by race



Note: Author calculations using data from the U.S. Consumer Expenditure Surveys (CEX).

Figure 5: Consumption age profile by race



Note: Author calculations using data from the U.S. Consumer Expenditure Surveys (CEX). The age profile of consumption is HP-filtered with a smoothing parameter of 1,600 and kept constant for all ages above the last available age in the CEX data.

Leisure

Our data on leisure comes from the CPS for each year from 1984 to 2018. It is calculated as the fraction of total available hours that are not spent on market work over the year. That is,

$$\ell = \frac{5,840 - \text{hours worked in the year}}{5,840}$$

We obtain 5,840 total hours available as the product of 16 hours per day and 365 days.[4] In an attempt to account for non-market work discrepancies between genders, we divide hours worked per year equally among individuals between

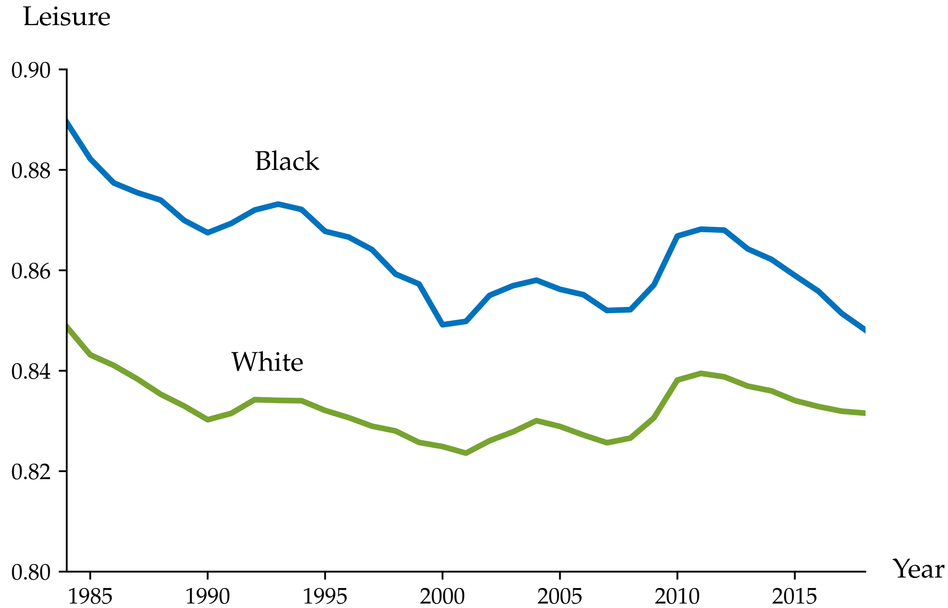
[4] We use 366 days for leap years.

25 and 64 years old within each household. For household members outside of this age range, we make no adjustment. The resulting split in leisure time between men and women is similar to that found in Aguiar and Hurst (2007), who carefully delineate leisure from home production work in time-use surveys.

Figure 6 shows that leisure is about four percentage points higher for Black Americans than White Americans in 1984, but only around two percentage points higher in 2018. There are sizable fluctuations in between, with leisure rising notably for both groups in the wake of 2009 Great Recession. In our robustness checks below, we consider the possibility that unemployment yields less utility than other non-work time. This may matter for our comparisons given that unemployment rates are uniformly higher in the CPS for Black Americans over our sample. Incarceration rates are also higher for Black men than for other groups, so we will check robustness to treating incarceration as providing lower flow utility.

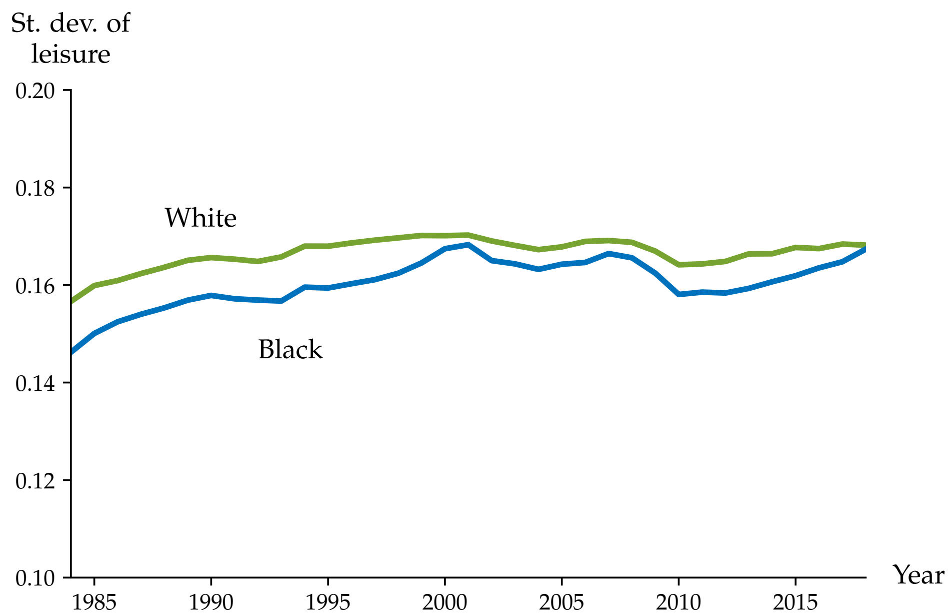
Figure 7 compares the standard deviation of leisure across individuals over time. Just as for consumption, unequal leisure lowers average utility from leisure due to diminishing marginal utility. Leisure inequality is similar across racial groups, especially at the end of the sample.

Figure 6: Leisure by race



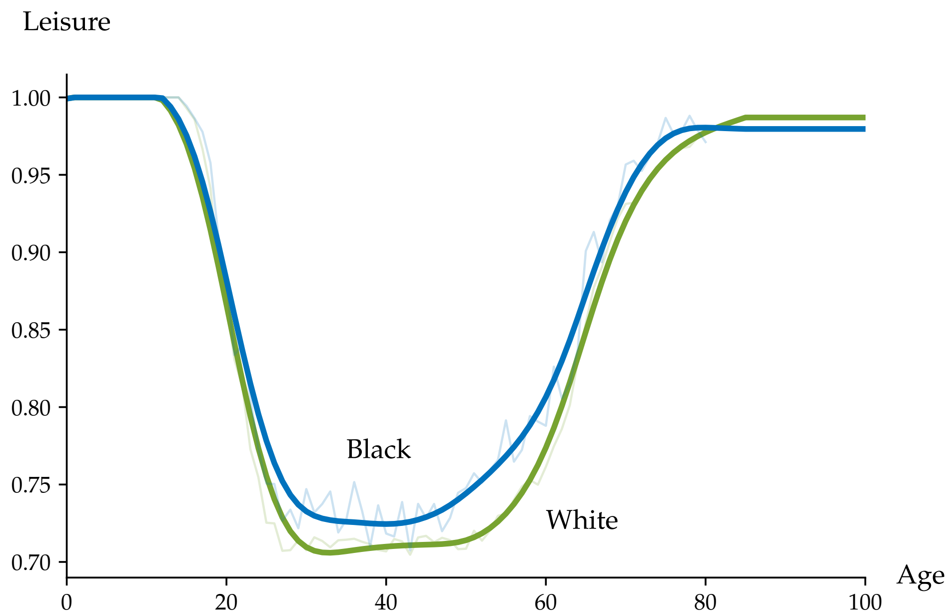
Note: Author calculations using data from the U.S. Current Population Survey.

Figure 7: Standard deviation of leisure by race



Note: Author calculations using data from the U.S. Current Population Survey.

Figure 8: Leisure age profile by race



Note: Author calculations using data from the U.S. Current Population Survey. The age profile of leisure is HP-filtered with a smoothing parameter of 100 and kept constant for all ages above the last available age in the CPS data.

4. Calibration

We follow Jones and Klenow (2016) in our strategy for setting the key parameter values. The five parameters to be calibrated are: the discount factor β, the Frisch elasticity ϵ, the utility weight on leisure θ, and the intercept in flow utility $\bar{u}$.

We abstract from growth and discounting by setting $g = 0$ and $\beta = 1$. Note that there is still discounting due to survival probabilities.[5]

We consider a Frisch elasticity of 1.0 for our benchmark calibration, which implies that the disutility from working rises with the square of the number of hours worked. This is a compromise between Hall (2009) who advocates for a Frisch elasticity of 1.7, and Chetty, Guren, Manoli and Weber (2012) who recom-

[5]We will check robustness to a growth rate of 2% per year and a discount factor of $\beta = 0.99$.

mend a value closer to 0.5.

We use the first-order condition for the labor-leisure choice to calibrate the weight on leisure in the utility function. The static first order condition is $u_\ell / u_c = w(1-\tau)$, where w is the real wage and τ is the marginal tax rate on labor income. With log utility from consumption and a constant Frisch elasticity, this implies $\theta = w(1-\tau)(1-\ell)^{-1/\epsilon}/c$. We assume this first-order condition holds for the average worker in the U.S. in 2018. We use the marginal tax rate in Barro and Redlick (2011), who report a value of 0.35 in their most recent year. We take into account the ratio of earnings in the CPS to BEA consumption per capita, and obtain $\theta = 14.2$.

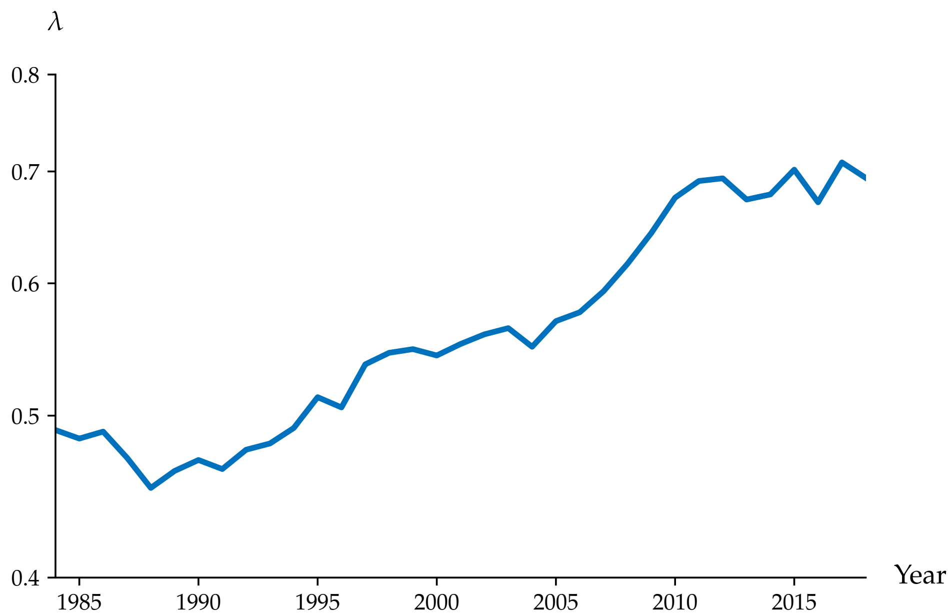
The intercept in flow utility, $\bar{u}$, is critical for valuing differences in mortality and morbidity. The U.S. Environmental Protection Agency (2020) recommends \$7.4 million for the value of remaining life in 2006 dollars for those age 25 to 55. Hall, Jones and Klenow (2020) use this figure when valuing lives at risk from COVID-19. Matching this number leads to $\bar{u} = 6.41$ when consumption per capita is normalized to 1.0 in 2018. This means that $\bar{u}$ has a natural interpretation for our utility function: one year of life is worth $\bar{u} = 6.41$ years of consumption in 2018.[6]

5. Welfare

We now combine all five ingredients into a single measure of consumption-equivalent welfare as laid out in Section 2. Figure 9 draws Black vs. White welfare from 1984 through 2018. The initial level in 1984 is surprisingly low at only 49%. It does rise to around 69% from the mid-1990s to the early 2010s. But even the ending level of about 2/3 relative welfare for Black Americans strikes us as a disappointingly wide remaining gap.

[6]An individual with constant consumption by age is indifferent between a 1 percent change in life expectancy and a 6.41 percentage point (log point) change in lifetime consumption. But since we scale both life expectancy and lifetime consumption by total years of life, this yields the interpretation in the main text.

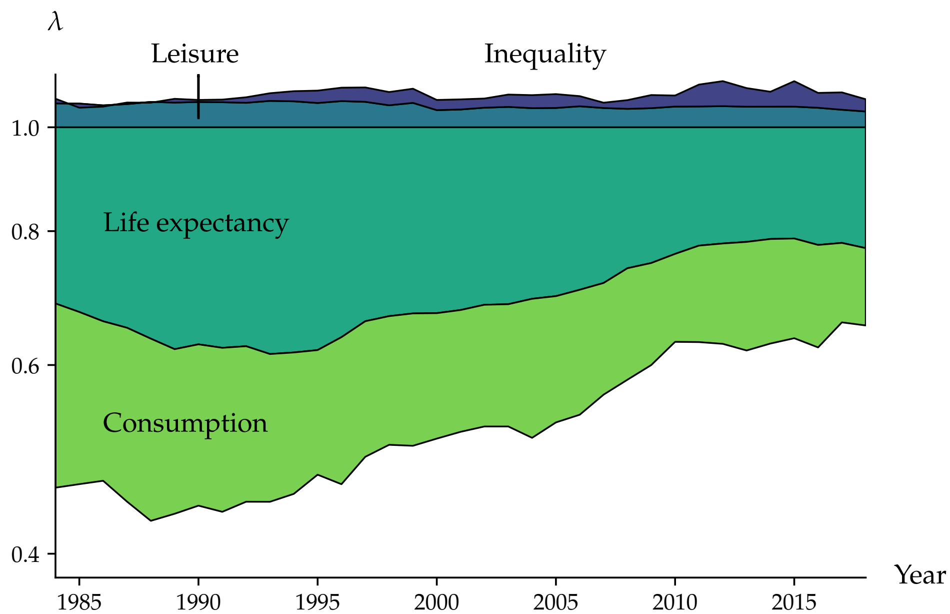
Figure 9: Consumption-equivalent welfare gap



Note: Author calculations using a combination of data from the CDC's NVSS and the Department of Labor's CPS and CEX Surveys.

Figure 10 decomposes the drivers of the overall welfare differences. As shown, the biggest contributor to levels and trends is life expectancy, followed by consumption. The other three factors — leisure, inequality in consumption, and inequality in leisure — contribute surprisingly little.

Figure 10: Welfare gap decomposition



Note: Author calculations using a combination of data from the CDC's NVSS and the Department of Labor's CPS and CEX Surveys.

Table 2: Welfare gap decomposition

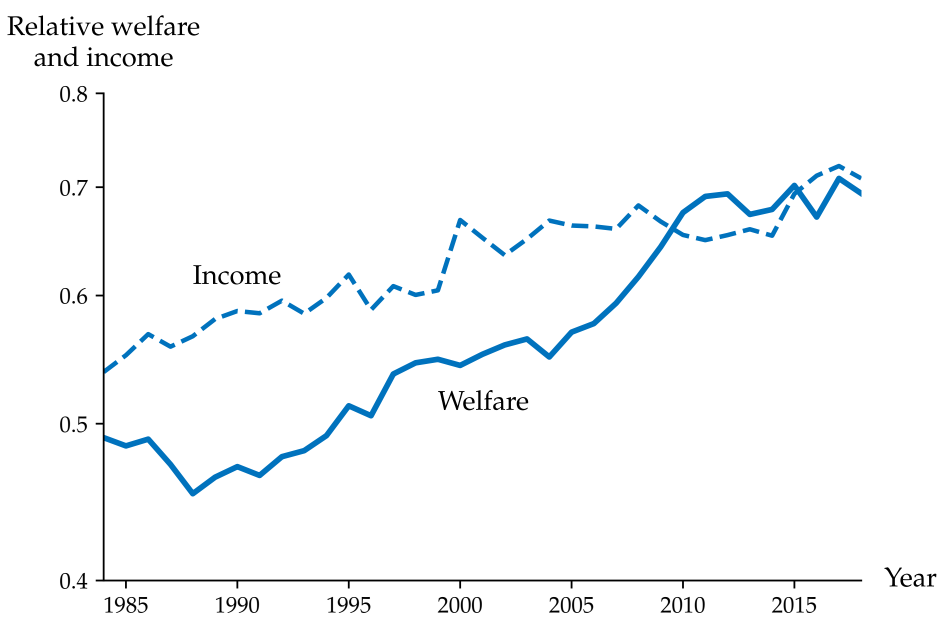
	$\log(\lambda)$	LE	C	$\sigma(C)$	L	$\sigma(L)$
2018	-0.37	-0.26	-0.17	0.02	0.03	0.00
2000	-0.61	-0.40	-0.27	0.01	0.04	0.01
1984	-0.71	-0.38	-0.40	-0.01	0.05	0.02

Note: Author calculations using a combination of data from the CDC's NVSS and the Department of Labor's CPS and CEX Surveys.

Figure 11 plots income and consumption-equivalent welfare for Black relative to the White Americans in the CPS for comparison. Our CPS income measure wage, salary, business, farm, interest, dividend and rental income, but excludes all taxes and transfers. The Figure shows that relative income levels were notably higher than relative welfare until the 2010s. Like welfare, income rose faster for Black Americans than for White Americans. But the progress was more modest. This drives home that inequality in life expectancy compounds differences in income and consumption to result in much bigger gaps in living standards by race.

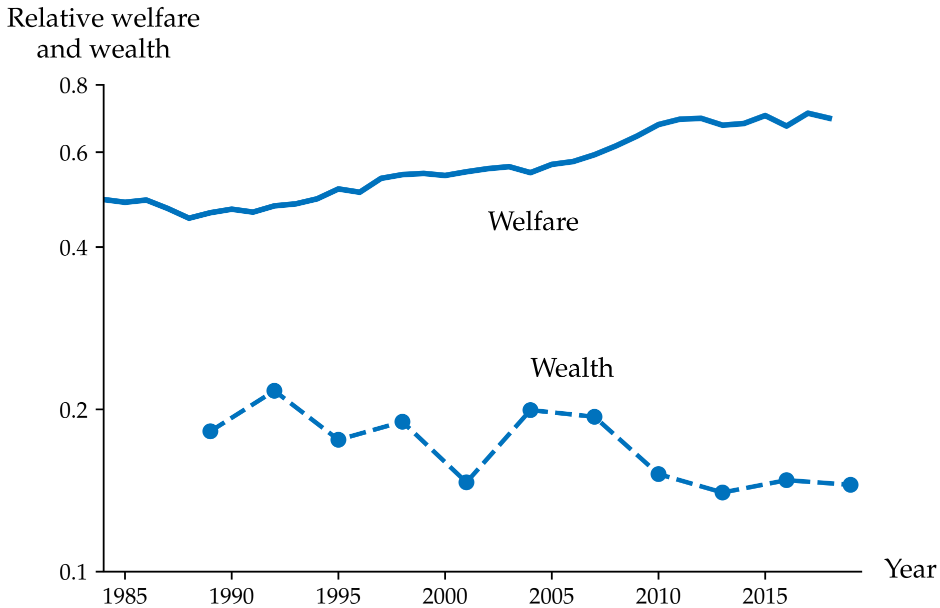
Figure 12 contrasts relative welfare with relative wealth in the Federal Reserve's Survey of Consumer Finances in various years. Wealth gaps are very larger relative to welfare gaps, and actually widened over our sample.

Figure 11: Welfare and income gap



Note: The income series we use from the CPS includes wage, salary, business, farm, interest, dividend and rental income, but excludes all taxes and transfers.

Figure 12: Welfare and wealth gap



Note: The wealth series we use is net worth from the Survey of Consumer Finances (SCF) between 1989 and 2019.

We next examine growth rates in consumption-equivalent welfare in Table 3. From 1984–2018, Black welfare grew 3.4% per year, faster than their income growth of 2.3% per year. For White Americans welfare also rose more quickly than income, but the contrast was not as stark (2.4% vs. 1.6% per year).

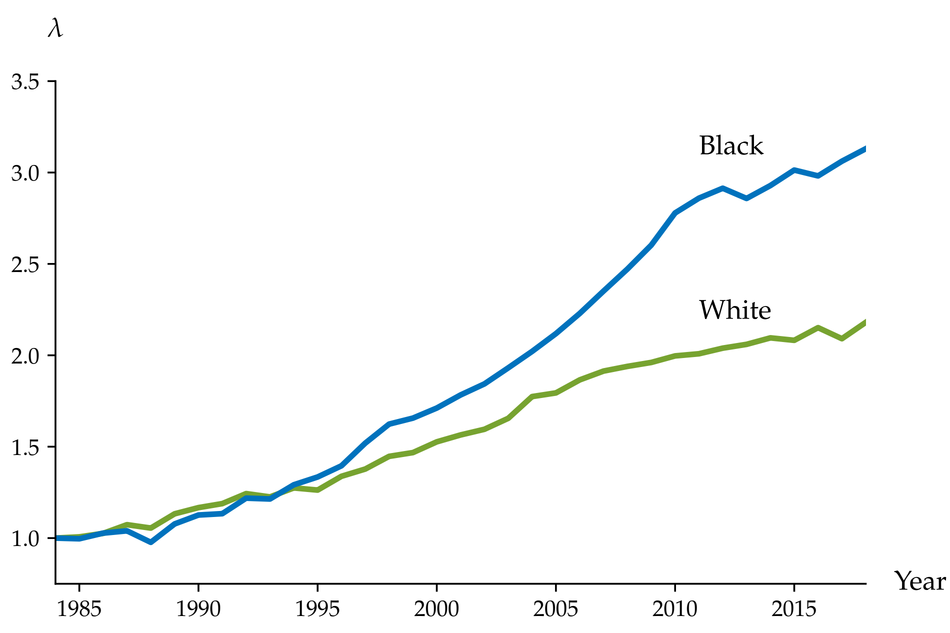
Table 3 also decomposes the contributions to growth rates. From 1984–2018 the biggest contributor was consumption growth at 2.5% for Black Americans and 1.8% for White Americans. Life expectancy was the next most important at 1.2% per year for Black Americans and 0.8% for White Americans. Though dwarfed by other factors, rising inequality subtracted 16 and 20 basis points a year from growth for Black and White Americans, respectively. Falling leisure lowered growth 15 basis points a year for Black Americans and 11 basis points a year for White Americans.

Table 3: Welfare growth between 1984 and 2018

	Welfare	Income	LE	C	$\sigma(C)$	L	$\sigma(L)$
Black	3.35	2.40	1.17	2.48	-0.04	-0.15	-0.12
White	2.28	1.59	0.76	1.84	-0.12	-0.11	-0.08
Gap	1.06	0.80	0.41	0.65	0.08	-0.04	-0.04

Note: Author calculations using a combination of data from the CDC's NVSS and the Department of Labor's CPS and CEX Surveys.

Figure 13: Cumulative welfare growth by race



Note: Author calculations using a combination of data from the CDC's NVSS and the Department of Labor's CPS and CEX Surveys.

6. COVID-19

Some of the convergence in life expectancy has been interrupted, at least temporarily, by COVID-19. Table 4 reports information gleaned from CDC estimates of deaths from COVID-19 by race and age. Over one in a thousand Black Americans died from COVID-19, versus about 0.6 in a thousand White Americans. Black victims have been younger at around 72 year olds on average, compared to 80 years old for Whites. This outweighs the lower life expectancy of Black Americans so that Black victims lost 15 years of remaining life whereas White victims lost 10 years on average.[7] We estimate that the drop in welfare from COVID-19 was equivalent to a 11% drop in consumption for all Black Americans and a 4% drop for all White Americans. By this metric, Black Americans have been hit more than twice as hard by COVID-19.

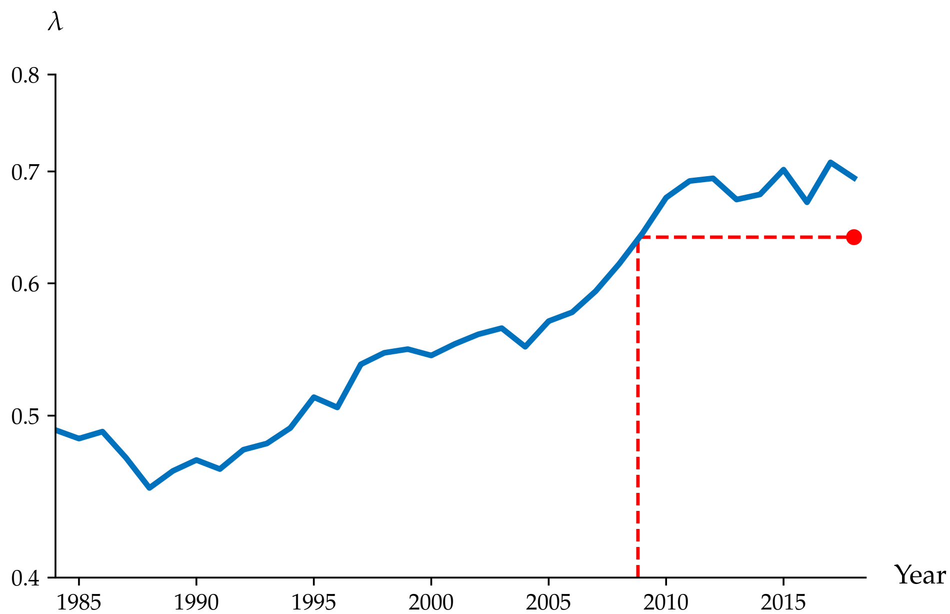
Table 4: COVID-19 welfare statistics

	Deaths per thousand	Age of victims	Years of life lost per victim	Group welfare loss (%)
Black	1.04	71.7	15.0	11.1
White	0.57	80.1	10.2	3.7

Note: As of October 24, 2020, the CDC reports 212,328 total COVID-19 deaths.

[7] Both of these figures may be too high because of comorbidities facing COVID-19 victims.

Figure 14: Welfare gap and COVID-19 mortality



Note: As in Figure 9, we plot the welfare gap. By adding COVID-19 mortality to the 2018 mortality, the dashed red lines indicate the resulting level of the welfare gap and the last year at which it reached this value.

In Figure 14 we illustrate that COVID-19 reversed, at least temporarily, about 10 years of convergence in Black vs. White welfare.

7. Robustness

In the next draft of this paper, we plan to investigate how several alternative choices affect welfare trends by race. First, we will look at incarceration rates, which are several percentage points higher for Black men than for White men, and rose over our sample. To the extent that flow utility from "leisure" is much lower while incarcerated, this will subtract from both levels and growth rates of welfare for Black men.

Second, we will consider treating unemployment as equivalent to working.

Krueger et al. (2011) conduct surveys of the unemployed and employed, and even transitions between unemployment and employment. They find that the same leisure activities yield less enjoyment when unemployed. They also find that those unemployed had similar hours worked in their previous jobs as employed individuals. Based on this we will consider the possibility that the unemployed have no more leisure time than the employed. Given the unemployment rates are chronically higher for Black Americans than for White Americans, this will erase some of the higher leisure of Black Americans depicted in Figure 6.

Third, we will see what happens when we incorporate morbidity in the form of activity limitations reported the national health surveys by the CDC.

8. Conclusion

We estimated consumption-equivalent welfare by race in the U.S. from 1984–2018. We factored in consumption, leisure, mortality, and morbidity. We found that the welfare of Black Americans was only 49% as large as for White Americans in 1984. It then rose to 69% in 2018. The sources of convergence were consumption and life expectancy.

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A Appendix

Survival rates

To calculate survival rates at every age, one must first calculate the corresponding mortality rates. Death records are obtained from the CDC's NVSS and in particular, we omit foreign residents and recode the age of individuals above 100 years old to 100. We then count death occurrences by year, age, race, gender and education. In fact, starting in 1989, the NVSS started reporting the deceased's educational attainment. However, the educational attainment records' quality was relatively poor until 2003, which is therefore the year at which we start reporting mortality statistics by education.

We then use the U.S. Census Bureau's intercensal population estimates to determine the population at risk by year, age, race and gender. However, the availability of those counts by single years of age is not consistent across decades. For the 1990s, population estimates are instead broken down by 5-year age groups. Similarly, for the 2000s, population estimates of individuals older than 84 years old are grouped in a single age category. Since single years of age estimates are available for the 1980s and 2010s at all ages, and for the 2000s below the age of 85, we use this information to linearly interpolate the population share of each age across years within the binned age groups of the 1990s and 2000s by race and gender. The U.S. Census Bureau's intercensal population estimates, however, do not provide breakdowns by education. We therefore use the sampling weights of the U.S. censuses and ACS to approximate the educational attainment distribution by age, race and gender. Since censuses are decadal and ACS were introduced in 2000, we linearly interpolate this distribution across years for the 1980s and 1990s, by age, race and gender.

Consumption

To obtain our consumption measure, we closely follow the work of Aguiar and Bils (2015). In fact, our consumption aggregate corresponds to the sum of the nondurable consumption categories reported in their work, with three exceptions. First, we do not constrain our sample to 4-interview households and complete income reporters. Instead, we use the CEX's full sample and multiply a household's consumption by the inverse of the fraction of interviews in which it participated. However, to ensure that the standard deviation of consumption for below 4-interview households is not artificially high, we slightly adjust their consumption. In fact, we re-scale it such that within each race, gender and education group, its standard deviation is equal to that of 4-interview households. Then, we impose a lower bound on consumption equal to $2,000 in 2012 USD in each year. Third, we also re-scale consumption expenditures such that they aggregate to the nondurable NIPA real personal consumption expenditures per capita. To do so, we first divide consumption equally among each household member. Finally, since the CEX's sample size is relatively small, we smooth the the age profile of consumption within each year using a HP-filter with a penalty term of 1,600.

Leisure

To calculate leisure, we use information on usual hours worked per week and weeks worked per year from the CPS to obtain an estimate of hours worked per year. Then, assuming that a maximum of 16 hours per day and 365 days per year are available for work, we obtain leisure as the fraction of hours that are not spent in market work. To also account for non-market work discrepancies between genders, we divide hours worked per year equally among individuals between 25 and 64 years old within each household. The resulting split in leisure time between men and women is similar to that found in Aguiar and Hurst (2007). As for consumption, since the CPS' sample size is still somewhat small, we smooth the the age profile of leisure within each year using a HP-filter with a penalty term of 100.

Calibrating the intercept in the flow utility: $\bar{u}$.

This section describes how to calibrate $\bar{u}$ when we are using only part of consumption (such as non-durables). Consider an extreme version of this, where we observe Starbucks coffee purchases c_{sb} and are using this to proxy for consumption. In particular, suppose

$$c = \mu c_{sb}$$

That is, true consumption is a "markup" μ over measured Starbucks consumption.

Suppose utility is

$$\begin{aligned} V &= \sum_a \beta^a S(a) u(c_a, \ell_a) \\ &= \sum_a S(a)\beta^a(\bar{u}_0 + \log c_a) + v(\ell_a) \\ &= \sum_a S(a)\beta^a(\bar{u}_0 + \log \mu + \log c_{sb,a} + v(\ell_a) \\ &= \sum_a S(a)\beta^a(\bar{u} + \log c_{sb,a} + v(\ell_a) \end{aligned}$$

where $\bar{u} \equiv \bar{u}_0 + \log \mu$.

The VSL=\$7.4m $= V/muc$ in the model where $muc = 1/c$ denotes the marginal utility of all consumption. rearranging

$$
\begin{aligned}
V &= 7.4m \cdot muc \\
&= \frac{7.4m}{c} \\
&= \frac{7.4m}{\mu c_{sb}}
\end{aligned}
$$

That is, we have to use "true" consumption to convert the VSL into utils, so that V has the units (when log utility) of "years of consumption".

Now, we can combine these two sets of equations for V and solve for $\bar{u}$:

$$
\bar{u} = \frac{7.4m/c2006 - \sum_a \beta^a S(a) \log c_{sb,a} + v(\ell_a)}{\sum_a \beta^a S(a)}
$$

We use a value of c2006 of \$25,288, which is nominal per capita NIPA consumption exenditures (PCE) net of medical care.