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Discussion

Discussion of Clayne Pope's "Measuring the distribution of material well-being: US trends"

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The majority of studies on inequality focus on measures of income. There are obvious reasons for this. The data are relatively available. Moreover, income typically defines the budget sets (once adjusted for prices), so we can rank outcomes without having to model preferences. A popular alternative measure is consumption, which has the advantage of capturing income combined with the available technology for sharing risk and inter-temporal trading. This paper expands the measures of inequality to include outcomes such as mortality, educational attainment, and leisure.

In some sense, these additional outcomes can be viewed as alternative measures of consumption. Obviously, leisure is consumption good. One can make an argument for education having a consumption component as well as being an investment. Moreover, health and longevity also have utility and should be counted in measures of consumption. In this regard, the paper is adopting consumption as the relevant measure of inequality, but expanding the consumption basket. This is a reasonable approach to inequality and extends our knowledge of consumption inequality. However, the paper makes a broader, and more important, point. Goods such as health and education are not only consumption goods, they are (at least in part) due to the provision of public goods. The consumption of such goods will, by definition, be less sensitive to income inequality than rival and excludable goods. The relative consumption of such goods will also be poorly measured using household survey data on consumption expenditures. For this reason, looking at outcomes such as life expectancy is important.

In this discussion, I will perform some "back of the envelope" calculations to try to put dollar values on the changes in life expectancy for men over the last century. In particular, I will value the *relative* gain due to changes in life expectancy of black men. The numbers are large, on the order of $15–30 \times 10^3$ \$/year, or roughly half a million dollars over a lifetime in present value terms. That is, all else equal, the gain in life expectancy for black men between 1900 and 2000 is worth $\$15–30 \times 10^3$ a year more than the gain in life expectancy for white men, all else equal. While rough, this estimate suggests that the dollar values of these non-traditional inputs into consumption are large, even relative to income and market expenditures. Therefore, it is quantitatively important to broaden our usual measures of inequality beyond income and market consumption and try to gauge the impact of non-market consumption, including consumption of public goods like improved public health and fundamental medical advances.

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The value of changes in life expectancy

Table 2 of Pope documents trends in life expectations by sex and race. There have been significant gains in life expectancy across all demographic groups. However, the non-white population has experienced a relative gain. For example, a white male at birth had a life expectancy of 53 years in 1910 and 72.7 years in 1990, a gain of 19.7 years. A non-white male had a life expectancy at birth of 41.8 years in 1910 and 67 years in 1990, or a gain of 25.2 years, a relative gain of 5.5 years over white males. Overall, there has been a significant decline in life expectancy inequality over the last 150 years.

Comparing white versus non-white populations over time is subject to the critique that the ethnic mix of the non-white population has changed over the last century and a half. To get a cleaner comparison, we compare life expectancy for white and black men. The 2003 NCHS Life Tables for the US report a life expectancy at birth of 75.3 years for white men and 68.9 years for black men. These numbers are reproduced in Table 1. The respective life expectancies in 1900 are 48.2 and 32.5 years. These latter numbers are low relative to those reported by Haines and Michael (1994). Haines reports several estimates using different methodology. Table 1 reports his estimates based on backward projection from the census. The respective life expectancies are higher, and the black–white gap smaller, using the Haines estimates. Depending on the estimates used, the life expectancy differential declined by 3.5–9.3 years.

To put a dollar value on this decline in life expectancy inequality, we adapt the "willingness to pay" methodology of Murphy and Topel (2006). First, consider a model of "perpetual youth" with a constant hazard of dying. This is obviously unrealistic, but generates transparent calculations. We will re-do the analysis using age-specific mortality below. The corresponding hazard rates, denoted λ, can be computed as the inverse of life expectancy. Let v denote the flow value of life each period, and V the present discounted value of life at the time of birth. The relationship between the two can be expressed as

$$V = \frac{v}{r+\lambda},$$

where r is the real interest rate. Murphy and Topel (2006) estimate the value of life at birth to be \$6 million. An interest rate of 4 percent and a $\lambda = 1/75.3 = .013$ for white males in 2003 suggests a flow value of life equal to \$320,000.

We can now answer the question how valuable is it to move from a hazard rate of λ to a lower rate of λ', holding constant the flow value of life $v = \$320{,}000$. The "holding constant" assumption is important, as our exercise compares two people with identical incomes, consumption, and health, but different life expectancies. The fact that black men have on average lower income and poorer health will reduce the dollar value of (or willingness to pay for) any relative gain in life expectancy. We abstract from wage and health differentials and focus only on changes in life expectancy. To calculate the value of a gain in life expectancy, we use the fact that $V'-V = v(1/(r+\lambda'))-(1/(r+\lambda))$. Table 2 panel A reports the respective calculations. In row 1, column 1, for example, if whites had the 1900 life expectancy of 48.2 years, the value of a life would be \$5.3 million, a net difference of \$736,000. Using the alternative 1990 life expectancy, the net gain between 1900 and 2003 life expectancies is \$660,000.

For black men, the value of a life using the 2003 life expectancy figures is \$5.9 million. This is lower than that of whites due to the lower life expectancy of black men. The value at 1900 life expectancy is \$4.5 million or \$4.9 million, depending on the hazard rate used. The net gain therefore ranges between \$0.9 and \$1.3 million. In this scenario, the relative gain in life expectancy for black men versus white men ranges between \$265,000 and \$608,000. In flow terms, the net gain is equivalent to an annuity that pays \$14,000–\$33,000 each year of one's life. That is, at equal wages and health status, black men would be willing to pay $\$14\text{–}33 \times 10^3$ a year more than white men to enjoy the last century's gains in life expectancy. These numbers are very large relative to incomes and the income gap between blacks and whites.

While simplifying the calculations, a constant hazard model is unrealistic. To gain a better estimate, we can use the Life Tables' age-specific survivorship rates. Fig. 1 plots the survivorship rates for black and white men in 1900 and 2003. The 1900 numbers are from Haines (1994). The survivorship rates are the estimated fraction of a birth cohort that will survive to each age. Survivorship rates have shifted up for both whites and blacks, but more so for blacks. Moreover, the shift for blacks relative to whites has been concentrated at young ages. This can be seen in Fig. 2, where we plot the change

Table 1
Life expectancy at birth for men by race and year.

Year	White men	Black men	Gap
1900[a]	48.2	32.5	−15.7
1900[b]	50.4	40.5	−9.9
2003	75.3	68.9	−6.4
Gain[a]	27.1	36.4	9.3
Gain[b]	24.9	28.5	3.5

Note: Source for 1900[a] and 2003 is CDC NCHS US Life Tables available at www.cdc.gov/nchs/data/lifetables/. 1900[b] refers to estimates reported in Haines (1994). Gain is net increase in life expectancy. Gap is life expectancy (or gain) for black men minus that of white men.

Table 2
Value of life at birth (10^3 of dollars).

Life expectancy from year:	Life expectancy of white men	Life expectancy of black men	Gap	
	Present value	Present value	Present value	Annuity value
Panel A: perpetual youth model				
1900[a]	5264	4520	−744	
1900[b]	5340	4939	−401	
2003	6000	5864	−136	
Gain[a]	736	1345	608	33
Gain[b]	660	925	265	14
Panel B: age-dependent survival model				
1900[b]	4714	4031	−683	
2003	6000	5810	−191	
Gain[b]	1286	1779	492	27

Note: Superscripts a and b refer to the whether US Life Tables (a) or Haines (b) was the source for 1900. All figures in 10^3 of US$. Present value of life (V) for white men in 2003 normalized to $6 million based on Murphy and Topel (2006), Fig. 3. In panel A, we calculate the value of life assuming constant hazard of death ("perpetual youth"), which we calculate as $\lambda = 1/E(T)$, where $E(T)$ is life expectancy at birth from Table 1. In panel B, we use actual age-dependent survivorship rates from Fig. 1. For panel A, we begin with the benchmarked $6 million figure for White Men in 2003. From this, we calculate a flow value of life of $v = V/(r+\lambda) = \$320{,}000$, using $E(T) = 75.3$ from Table 1 and $r = 0.04$. Remaining cells of panel A are calculated using $v = \$320{,}000$ and the corresponding life expectancy from Table 1. Note that the flow value of a life does not vary across years or races. The only difference is in life expectancy. The gap is black minus white. The annuity value of the gap is the present value of the gap multiplied by $(r+\lambda)$ using the $\lambda = 1/69$ of black men in 2003 from Table 1. Panel B values use an age-dependent v from Murphy and Topel (2006) Fig. 2. Present values at birth are then the discounted sum, where the discount rate is the interest rate plus the survival probability. The annuity value of the gain in panel B is calculated by converting the present value into a constant payment stream using a four percent interest rate and a term of 69 years, the life expectancy for black men in 2003.

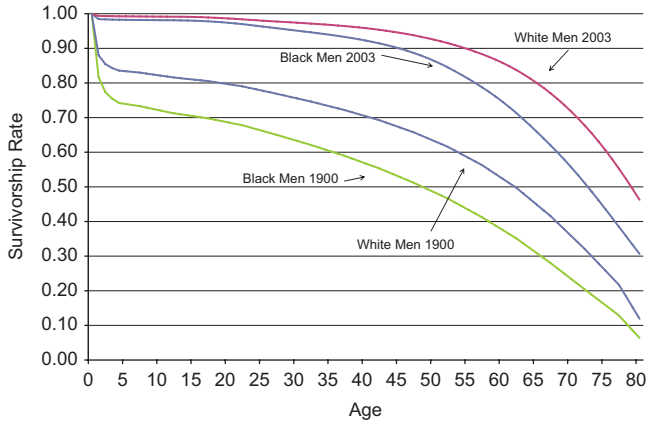

Fig. 1. Survivorship probabilities for black and white men: 1900 and 2003. *Note*: Each line depicts the probability of surviving from birth to the respective age, by race and year (1900 or 2003). Source for 1900 data is Haines (1994) and source for 2003 data is CDC NCHS US Life Tables (www.cdc.gov/nchs/data/lifetables/).

in survivorship rates between 1900 and 2003 for each race. Most of the relative gains of blacks occurred early in life, and almost all before late middle age. This is important as these younger years have the highest incomes, consumption, and health, implying a large effect on the present value of a life at birth.

Using these survivorship rates and a v function that varies with age,[1] we can perform the same calculations as above. A white male in 2003 is benchmarked to $6 million, as before. Using the 1900 mortality rates for white males, the value of a life would be $4.7 million, for a gain of $1.3 million. This gain is somewhat smaller than the $2 million calculated by Murphy and Topel (2006), Fig. 4a, probably due to the approximations I have made in computing the flow value of life.

[1] Specifically, we approximate the v function of Murphy and Topel (2006) depicted in their Fig. 2, using a fifth-order polynomial. We benchmark the intercept so that the value of a life at birth is 6 million in 2003 for a white male.

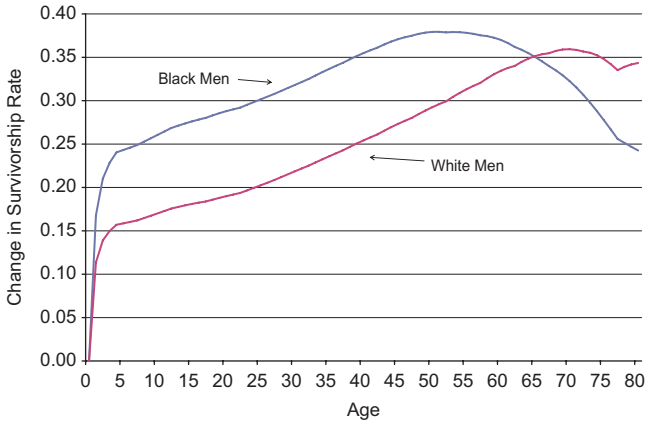

Fig. 2. Gain in survivorship probability 1900–2003. *Note*: Each line is the difference between the survivorship rates by race in 2003 versus 1900 by race, where the underlying survivorship rates are depicted in Fig. 1.

For blacks, the value of a life at 2003 survivorship rates is $5.8 million, a little lower than the $6 million benchmark. At 1900 mortality rates for black men, the value of a life is $4.0 million, for a gain of $1.8 million. Therefore, black men had an additional gain of $500,000 in life expectancy. This corresponds to a constant payment stream of $27,000 a year for 69 years (the life expectancy of a black man in 2003). This estimate uses the life tables of Haines (1994), and so is comparable to the constant hazard number of $14,000 from panel A. The perpetual youth model under-predicts the relative gain of blacks due to the fact that most of the relative gains occur early in life, when the flow value of life is higher than average.

In both calculations, the gain in life expectancy is large, and the gain for black men is particularly large. The large values should not be a surprise. Murphy and Topel (2006) calculate substantial values for gains in life expectancy between 1900 and 2000 (on the order of $2 million at birth). The fact that blacks have particularly large gains, and these gains are concentrated early in life, implies a particularly large dollar value for the decline in inequality. Murphy and Topel (2005) perform a similar calculation for the period 1968–1998. They find that the value of life at birth increased by $245,454 for white men and $391,022 for black men between 1968 and 1998. The net gain favoring black men is therefore $145,568 in present value terms. Viewed another way, the value of the longevity gap at birth was $408,752 in 1968 and then fell to $263,185 in 1998, implying the same value for the relative increase of $145,568.

If the gains in life expectancy reflect individual expenditures on health services, data on consumption expenditures already incorporate the value (or willingness to pay) of improvements in life expectancy. Similarly, gains in income will simply map into more consumption of health services and thus longer life expectancies. However, it is plausible that changes in life expectancy reflect the consumption of public as well as private goods.[2] In particular, the fact that life expectancy gains for black men are large early in life (see Fig. 1) suggests the importance of public goods, such as immunization programs, education campaigns, and improved water and air quality. Similarly, progress on middle age ailments such as heart disease may initially be consumed predominantly by the rich, say through the purchase of new pharmaceuticals or medical procedures. However, as pharmaceuticals come off patent, these advances essentially become public goods as well.

The relative consumption of such public goods, by definition, is hard to measure directly. By focusing on household purchases of standard market goods, the usual measures of consumption inequality overlook the fact that public goods are consumed by all households. The rough calculations in this discussion indicate that these public goods have large implied dollar values. Moreover, at least in terms of life expectancy, the marginal public good expenditure may have a larger impact on poor households, further biasing up our traditional measures of consumption inequality.

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[2] By public goods, I mean non-rival and non-excludable goods, rather than publicly provided health insurance such as Medicare and Medicaid. However, the latter are likely to be important as well.