**Depressed health and labor force participation of white women entering old age**

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Recent research has documented a trend of women working longer, into their 60s and even 70s, and has optimistically forecasted that this trend will continue as the baby-boom generation moves into old age (Goldin and Katz, forthcoming). Estimates of the dependency ratio and of the solvency of specific programs such as Social Security also often assume continuing linear improvements in the labor force participation of this group (eg. Maestas and Zissimopoulo 2010, CBO 2015). Women born in the 1950s have worked less in mid-life than preceding cohorts, but this has been ascribed to delayed childbirth and therefore has not dampened optimism about this cohort's future attachment to the labor force (Goldin and Mitchell, forthcoming).

A different literature on the health of the baby-boom cohort suggests a less rosy picture, at least for white Americans. Case and Deaton (2015) document increased mortality and morbidity among 45 to 54 year old non-Hispanic white Americans since 1999, and Gelman and Auerbach (2016) show that these increases are driven primarily by declining health of white women.

Not yet noted is the fact that the declining health in mid-life of white American women is driven by differences across birth cohorts. Specifically, I document that after decades of progress, cross-cohort improvements in the health of white women stagnated and reversed abruptly starting with the 1951 birth cohort. The mortality rate of white women between age 30 and 54 fell from 188 to 162 deaths per 100,00 between the 1930 and 1951 cohorts, but then rose to 177 by the 1960 cohort.[1] As shown in Figure 1, cohort mortality rates by age show a clear trend break when these women are in their 30s, 40s, and 50s. This is suggestive of true differences in health across cohorts worthy of further study.

These cross-cohort health declines may have already impacted labor force participation. As shown in Figure 2, the increasing cross-cohort trend in the labor force participation of 45 to 54 year-old white women stagnated abruptly starting with the 1951 birth cohort. As these unhealthy cohorts move into old age, will their labor force participation improve, following recent trends? Or does the depressed health and labor force participation of these cohorts in midlife presage even worse outcomes as they age, and a resulting drag on social programs and the economy?

My research will aim to answer these questions by: (i) further exploring cross-cohort declines in the morbidity of white women using the National Health Interview Survey, and (ii) examining the impact of poor health on the current and future labor force participation of these women using the Health and Retirement Survey. Additionally, I discuss a possible extension exploring heterogeneity in health and labor force participation by cohort.

## Morbidity

First, I plan to investigate whether the cross-cohort mortality trends in Figure 1 are also reflected in morbidity. Case and Deaton (2015) document declines in self-reported health and increases in disability, pain, and psychological stress between 1999 and 2015 among 45

[1] Authors calculations, sources described in notes for Figure 1. There is weaker evidence of a similar trend break for men starting in 1948, but cohort trends if present are overwhelmed by the AIDS epidemic.

to 54 year-old non-Hispanic white Americans. Research on the health of baby-boomers as a whole is more mixed and depends on the specific definitions of health used. (eg. Martin et. al 2009).

However, previous research does not focus on differences in morbidity between cohorts, and has not tested for a break in trend for white women starting with the 1951 birth cohort. I plan to do so using repeated rounds of the National Health Interview Survey, between 1968 and 2016. This survey is not a panel, but I can follow synthetic cohorts through multiple rounds of the survey who are drawn from the same population, such as white women born in 1951. I can then compare the health of these cohorts to one another at the same age, for example comparing the morbidity of the 1951 cohort at age 50 to that of the 1960 cohort at the same age, therefore accounting for the impact of aging on health.

I will be careful to distinguish between true cohort differences in health and misattributed period effects. Graphical evidence similar to that in Figure 1 is informative, but I also plan to apply formal econometric tools to distinguish between cohort and period effects. Flexible age, period, and cohort effects are not all identified in even a linear model, but I could estimate such a model with a reasonable restriction as in Deaton (1997) or by parameterizing age to have a smooth impact on health as in Foster (1990). Additionally, McKenzie (2015) presents a method to estimate second-differences in age-period-cohort models with no restrictions, and to therefore, for example, test for a structural break in cohort health trends. It also may be possible to extend the threshold regression framework of Hansen (1999) to test for structural breaks in both period and cohort trends, accounting for the particular covariance structure of errors in this setting.

**Labor force participation**

Poor health can reduce labor force participation by reducing earning potential and increasing the disutility of work. Empirical estimates of the impact of health on labor force participation in the United States are somewhat mixed and poorly identified (Currie and Madrian, 1999), but randomized studies in other countries show a large impact (eg. Thomas et. al 2006).

After exploring trends in morbidity for white women I plan to investigate their impact on labor force participation. An important aspect of my research will be distinguishing between women dropping out of the labor force due to childbirth or declining health. To assess these competing explanations I will use panel data from the Health and Retirement Survey.

I will primarily focus on individuals in the Early Boomer and Middle Boomer waves, who are born between 1948 and 1959. The survey includes extensive information on these individuals' health, income, labor force participation and retirement decisions and expectations. Individuals were first surveyed when they were 50 to 56 years old and are between 55 and 66 in the most recent survey. Additionally, the survey includes retrospective information on employment history at earlier ages.

First, I will examine the relationship between health status and labor force participation, and the degree to which differences in health across cohorts can explain differences in labor force participation. I will also assess whether the depressed and declining labor force participation of women born after 1951 is driven by women who have been out of the labor force since child-rearing ages, or whether instead these cohorts have an increased hazard of leaving the labor force at middle and older ages. As health deteriorates with age, the latter

would be suggestive of declining health causing individuals to drop out of the labor force due to inability to work or decreased earning potential.

**Heterogeneity and inequality**

I propose an extension to my research examining whether cross-cohort increases in morbidity and declines in labor force participation for white women are the result of a shift in the entire distribution of health and earnings potential or just a thickening of the left tail. Income inequality has increased over recent decades and there are large and widening differences in health between individuals of different income levels (Chetty et. al 2016). Exiting the labor force and mid-life disability can be understood as the result of low "draws" from earnings and health distributions, respectively. Therefore, depressed labor force participation and increased disability are driven by the left tails of these underlying distributions and may not necessarily reflect declines in mean or median health and earnings potential.

Using the NHIS, I can examine whether health conditions and disability are increasingly concentrated among individuals or distributed broadly. In the HRS, I can assess the degree to which health declines and decreased labor force participation are concentrated among low-income individuals, and decompose declines in labor force participation into a portion explained by widening income inequality and an unexplained residual.

This analysis of heterogeneity and inequality would also impact predictions of the future labor force participation of these cohorts. If the increased morbidity of women in late baby-boom cohorts is driven by an increase in health inequality then women still in the labor force may be *healthier* on average than women in preceding cohorts who were in the labor force at the same age. However, if these cohorts have worse health across the entire distribution, women currently in the labor force may soon face a high risk of health problems impacting their ability to work.

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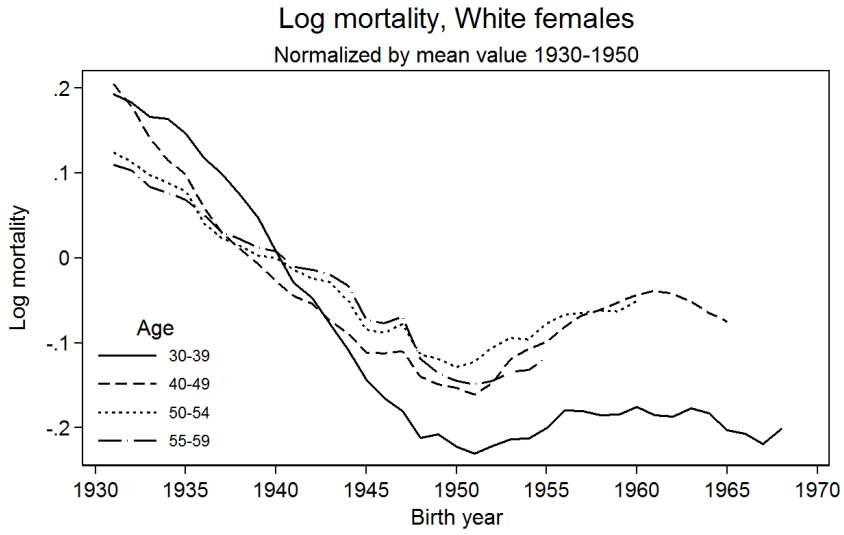



Figure 1: Each series shows the mortality rate experienced by different birth cohorts in a given age group, normalized by subtracting the mean mortality rate for that age group for cohorts born between 1930 and 1950. Mortality is calculated using the Multiple Cause of Death File from the Center for Disease Control and Intercensal Population Estimates from the Census Bureau. Deaths and population for single-ages in each year are distributed to years of birth based on population shares from the 1970 Census.

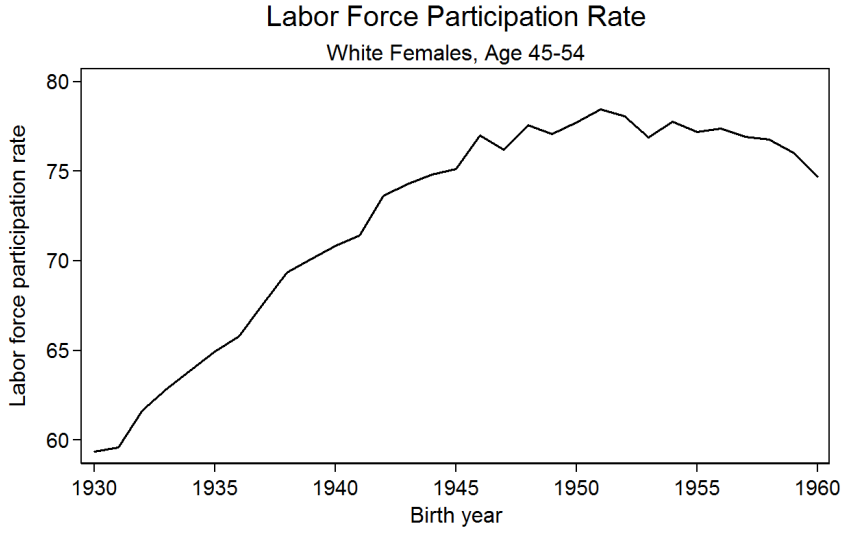



Figure 2: Plot shows the labor force participation rate of white females born in different cohorts, when individuals in each cohort were 45-54 years old. Calculated from the March Supplement of the Current Population Survey. Each individual's birth year is treated as the year of the survey minus her reported age minus 1.

**Curriculum Vitae**


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## PhD Candidate in Economics
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### Prior Education
Brown University, Providence, Rhode Island
M.A., Economics, 2014
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B.A., Economics, 2011
High Honors
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### Experience
Teaching Assistant for Graduate Macroeconomics, Brown University, 2015-2016
Senior Research Assistant, Federal Reserve Bank of Philadelphia, 2012-2014

### Awards and Fellowships
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Economics Graduate Teaching Award, Brown University, 2015-2016
Economics Senior Thesis Prize, Haverford College, 2011

### Working Papers
The Paper Trail of Knowledge Flows: Evidence from Patent Interferences (with Jeffrey Lin and Ina Ganguli), May 2015.

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David Weil (primary), Anna Aizer, Andrew Foster, and Emily Oster

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Born: October 13, 1988
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December 9, 2016

Ms. Elisa Pepe
NBER
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Dear Elisa (and committee),

I am writing to recommend Nicholas Reynolds for a NBER Pre-Doctoral Fellowship on Labor Market Activity by Older Workers. Nick is a third year student in Brown's Ph.D. program. His work is in the areas of applied micro, health, and demography. In addition to me, he is being supervised by Emily Oster, Anna Aizer, and Andrew Foster. His work this year is being supported on an NICHD T-32 institutional training grant through our Population Studies Training Center.

The research that Nick plans to conduct under this fellowship examines changes over time in health and labor force participation for white women moving through middle age, and draws implications for the trends in labor force participation and mortality as these cohorts enter older ages His preliminary analysis, described in his proposal, uses the Multiple Cause of Death File from the CDC, along with population estimates from the Census. The former has every death in the US over the period since 1968. Nick uses this data to show that there is a trend break, and even a reversal, of mortality measured in mid life starting with the 1951 birth cohort for white women. Looking over multiple age categories, he shows that this looks much more like a cohort effect than something associated with particular time periods.

Nick's finding runs counter to the view of embodied current SSA forecasts that labor force participation of women at older ages will continue to rise in a relatively linear fashion. Indeed, with the unhealthy cohorts only now starting show up in the data, his work suggests that we are right at the point where the there will be a break in the trend. Such a change would have enormous implications for the financing of Social Security, and for economic growth more generally (as well as welfare).

Of course, Nick's preliminary work leaves many questions unanswered, both regarding how mortality changes will map into health and labor force participation of the living, and regarding the sources of the change in cohort mortality. To address health and labor force participation, he plans to bring to bear data from the HRS and NHIS. He also plans to examine the extent to which the poor mortality outcomes observed for the 1951+ cohorts represent a leftward shift of the entire health distribution, rather than something specific to the lower tail of that distribution. Nick's thinking about what might

be causing the changes in health across cohorts is much less developed, but I think that this is fine at this point. Indeed, I think that the fact that he is pursuing is important enough that there are plenty of papers to write, even if the first few don't nail down what is causing it.

In sum, I think that Nick would be a fantastic candidate for this fellowship. He is pursuing a question of great relevance to the future of labor force participation by older workers, and he has already found some very exciting results.

Sincerely,



David N. Weil
James and Merryl Tisch Professor of Economics
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