Effects of Great Recession on Income Poverty in households with working age adult with disability

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**INTRODUCTION**

According to the National Bureau of Economic Research (NBER) (nber.org/cycles), the Great Recession officially lasted from December 2007 to June 2009. The Great Recession is considered one of the worst economic down times since the Great Depression of the 1930’s (Danziger and Danziger 2013), with historically the slowest recovery (Hoynes, Miller and Schaller 2012). The period was marked by three simultaneous adverse events – housing crisis, employment crisis, and financial crisis (Danziger, Chavez and Cumberworth 2012) that impacted various aspects of economic well-being. However, the intensity of the impact on different social groups was not uniform.

One such historically disadvantaged group is working-age adults with disabilities or households that have working-age adult(s) with a disability. There is some evidence that the recession inordinately impacted rates of employment and unemployment, and re-entry into the workforce (Kaye 2010; Livermore and Honeycutt 2012) of working age adults with disabilities compared to their counterparts. The recession also exposed mid-life and aging families caring for individuals with disabilities to higher rates of recession-related events (Song, Mailick and Greenberg 2017), compared to mid-life and aging parents not caring for their children with disabilities. However, the trend of poverty among households with working-age adults with disabilities during the recession is limited, although the US poverty threshold is an important determinant of Federal anti-poverty programs. Only one study estimated poverty among households with working-age adults with disabilities during the Great Recession (Livermore and Honeycutt 2012). But, analytically it did not investigate how the levels and trends of poverty evolved over time, during and post-recession, for households with working-age adults with disabilities compared to households with no working-age adults with disabilities. Neither did previous studies examine how certain subgroups of households with working-age adults with disabilities experienced poverty during the period. The current study by leveraging longitudinal data from the Survey of Income and Program Participation (SIPP) fits a mixed-effects regression model to address these limitations. Modeling poverty levels over time allows us to observe the continuous change poverty levels during and after the Great Recession. It enables estimation of poverty levels of different subgroups of households at any time point during the same period. Mixed-effects methods control for the differences between households, thus reducing bias and generating more robust estimates of poverty levels over time. Further, including interaction effects of the different demographic factors such as on race, ethnicity, gender and marital status of the household head, helps identify groups of households with working-age adults with disabilities who are most vulnerable to the economic shocks of the recession.

**Prior Literature**

*The impact of the Great Recession on individual and family level economic outcomes*

During the Great Recession, the US economy saw the loss of employment, income, wealth and assets (Pfeffer, Danziger and Schoeni 2013), and increase in unemployment and poverty rates (Hoynes, Miller and Schaller 2012). From 2008 to 2013 (four years after the official end date), the US economy saw a job decline of six percent and a drop in family income by 8% (Danziger and Danziger 2013). Four years post- recession, the official monthly unemployment rate remained high at 7.5% (June 2013), higher than the pre-recession rate of 4.7% in November 2007 (Bureau of Labor Statistics, https://data.bls.gov/pdq/SurveyOutputServlet). The rate of poverty increased from 12.5% in 2007 to 14.3% in 2009, and higher at 15% during 2011 and 2012, similar to poverty rates during the recessions of 1980’s and 1990’s (United States Census Bureau). US households also experienced loss of wealth (Pfeffer, Danziger and Schoeni 2013) and assets, and an increase in debts (Hurd and Rohwedder 2010) during the recession. At least a fourth of all American households lost 75% of their wealth, and a quarter lost 25% of their wealth between 2007 and 2011 (Pfeffer et al. 2013).

Although the Great Recession had an impact on the whole economy, its effect on individuals and households was not uniform (Hoynes, Miller and Schaller 2012; Pfeffer, Danziger and Schoeni 2012). For example, during the Great Recession, *unemployment* rates increased more among single women, those with a high school degree, African Americans and Hispanics, and those between ages 25 and 44, compared to their married, White, more educated and older male counterparts over age 44 (Hoynes, Miller and Schaller 2012). Similarly, *wealth* loss during the Recession was concentrated disproportionately among households headed by young and middle-aged Hispanics and African Americans, those with less education and income and those whose net worth was below 75th percentile of the wealth distribution (Taylor et. 2010; Wolff, Owens and Burak 2011; Bricker et al. 2012; Emmons and Noeth 2012; Pfeffer, Danziger and Schoeni 2013; Shapiro, Meschede and Osoro 2013). Similarly, *poverty* rate although increased through the Great Recession (12.5% to 15%, 2007-2011), the increase was particularly more significant among young adults between ages 18 to 24, who experienced an increase of 4.7% points compared to adults between ages 25 and 64, who experienced a 3% point increase (Danziger, Chavez and Cumberworth 2012). For adults between ages 24 and 64 with less than high school education, poverty grew by 5.5% compared to those with a college degree (1.1%). Charting racial differences in poverty rates, White non-Hispanics experienced a 2.2 % increase in poverty over 2007-2011, whereas African Americans and Hispanics each respectively experienced an increase in poverty by 3.7% and 4.5% points (Danziger, Chavez and Cumberworth 2012). Finally, households headed by single unmarried women experienced a greater increase in poverty compared to all the other groups. As expected, these historically disadvantaged groups also had a slow recovery rate post recession (Kochhar 2011). In conclusion, although the impact of the Great Recession was all pervasive, it particularly impacted groups who for decades have been socially and economically disadvantaged irrespective of economic cycles (Danziger, Chavezand and Cumberworth 2012), and further exacerbated existing disparities and inequalities (Danziger and Danziger 2013).

*The impact of the great recession on individuals and households with working-age adults with disabilities*

Working age adults with disabilities made up 10.4% of the US population between ages 21 and 64 in 2009 (Erickson, Lee and von Schrader 2011). It is known that disability has lifetime economic impacts both for the individual with the disability or households that are caring for individuals with disabilities.

Studies, not specific to the recession period show working-age adults with disabilities to report lower rates of employment, higher rates of underemployment, lower labor force participation and higher rates of poverty (Burkhauser, Houtenville and Rovba 2005; She and Livermore 2006) compared to their peers who do not have a disability. As such life-time poverty and dependence on family for financial support is common.

At the household level, those with working-age adults with disabilities report higher rates of poverty and material hardships (Brucker, Mitra, Chaito and Mauro, 2015; London, Heflin and Wilmoth, 2011; She and Livermore, 2008), compared to households that do not have a working-aged adults with disabilities. The poor financial wellbeing is associated with direct and indirect costs that families and individuals have to bear over the life-course (Mitra, Findley, and Sambamoorthi, 2009; Newacheck and Kim, 2005; Parish, Shattuck and Rose, 2009). For parents of children with a disability, real and perceived financial inadequacy or preparedness continues through life (Ghosh, Greenberg, and Seltzer, 2012; Parish, Rose, and Swaine, 2010; Parish, Seltzer, Greenberg and Floyd 2004). It is, therefore, likely that families with working-age adults with disabilities are more likely to be financially impacted, compared to families that do not have working-age adults with disabilities at the time of economic instabilities, such as the recession.

Several studies compared individual level outcomes, such as employment, and unemployment rates, exit and entry into the labor force (Kaye 2010; Fogg et al. 2010, Schneider 2011) of working-age adults with disabilities to non-disabled working-age adults. Another study specifically compared recession-related events experienced by mid-life and older parents of children with developmental disabilities (DD) and mental health problems (MHP) to a comparison group of parents who do not have children with disability (Song, Mailick and Greenberg 2017). Findings from each of these studies point to increased economic vulnerability of individuals with a disability and their households.

A very important marker of a country’s economic wellbeing is its official poverty rate. Although the US poverty thresholds used to estimate poverty rates are heavily criticized, it continues to be an important marker of determining eligibility to various means-tested programs, and government’s economic recovery efforts. In the context of disability, only one study specifically investigated household poverty change before, during and after the official end of the Great Recession by comparing working-age adults with disabilities to those not (Livermore and Honeycutt 2015). Using data from the Current Population Survey (CPS) Livermore and Honeycutt (2015) found the rate of poverty increase to be very similar for households with and without individuals with a disability between 2006 and 2010. The study used only two-time points (2006 and 2010), hence failed to capture the dynamic pattern of poverty levels that the working-age adults and their non-disabled counterparts experienced over time.

There is evidence that the impact of the recession was not uniform across among sub-groups of working-age adults with disabilities. For example, compared to White counterparts (14%), African American working-age adults with disabilities between ages 25 and 34 had significantly higher rates of unemployment (34%) in 2008, which remained steady till the first quarter of 2011 (Schneider 2011). Similarly, a study by Song, Mailick, and Greenberg (2017) found parents of children with mental illness to experience more recession-related events compared to comparison group parents. Interestingly, younger parents and those with poor pre-recessional financial history experienced greater recession-related events compared to their counterparts. In other words, some sub-groups were more impacted than others during the recession.

However, existing research on the recession and its economic impact on individuals with disabilities or their households are limited in several ways. First, although each of the studies cited above used longitudinal data, they did not necessarily follow the same households at regular intervals over time during the era of the Great Recession. Studies by Livermore and Honeycutt (2015) and Kaye (2010) used data from the CPS, which follows households for only four consecutive months in a year, and re-interviews them once again for four consecutive months before they exited the sample completely. Similarly, the study by Song et al. (2017) uses two time-points of the MIDUS data, which follows the same households. Although these studies give snapshots of the effects of the Great Recession by controlling for prior levels of economic wellbeing, they do not capture the dynamic nature of economic wellbeing over time during the Great Recession. The dynamic pattern can be analyzed more precisely by observing the same households at multiple time points. Second, most of the research has focused on work related disability or specific disabilities such as DD or MHP’s. These definitions fail to capture the entire gamut of people with disabilities, who are unemployed, never employed or underemployed, and assess their impact on individual or household economic wellbeing. Third, it is not adequately known how disability intersects with household socio-demographic characteristics to impact household poverty through the Great Recession and its long wake. While some assessed socio-demographic factors associated with recession related events (Song et al. 2017), others provided gross estimates of change in poverty among the various sub-groups (Livermore and Honeycutt 2015). This study estimates how poverty levels evolved over time for households with different sub-groups of working-age adults with disabilities.

The current study addresses the above limitations in the following ways. First, the study uses data from the Survey of Income and Program Participation, a panel data which tracks the same households over a four-year period, collecting data every fourth month and asking respondents to report on key economic measures for the previous four months. The 2008 panel coincides with the Great Recession, which allows for tracking of monthly income and income poverty. It helps in understanding levels and trends in income poverty in these households as they experience the recession and four years post the official end of the recession. By following the same household monthly over a four year period (2008-2013) also provides a more nuanced and comprehensive understanding of the impact of the recession on household economic wellbeing, when households have working-age adults with a disability. Second, SIPP has a separate module to assess adult disability, which encompasses a broad range of conditions and not limited to work-related disability or specific health conditions. Third, the study uses time as a continuous variable in a mixed effects regression model, compared to previous studies with either discrete time points (Livermore and Honeycutt 2015) or count of events over the whole period (Song et al. 2017). This study also uses interactions effects of socio-demographic factors. Using time as a continuous variable and adding interaction terms enables the analysis of poverty levels at any time point in the study period, along with declines and recovery patterns of poverty levels of different subgroups of household with working-age adults with disabilities.

Based on the review of literature, the study has the following two aims:

Aim 1: To analyze whether households with working-age adults with disability differed from households with no working-age adults with a disability, during the US Great Recession1[[1]](#footnote-1), on ‘Income Poverty’ levels, controlling for demographic factors such as gender, marital status, education, race, and ethnicity.

It is hypothesized (1) that households with working-age adults with a disability would experience worse income poverty ‘*levels* ’ through the great recession, controlling for demographic factors.

It is also hypothesized (2) that households with working age adults with disability would experience worse income poverty ‘*trends* ’ during the *US Great Recession*, controlling for demographic factors.

Aim 2 of the study is to analyze differences in income poverty profiles between demographic subgroups within households with working-age adults with a disability, during the *US Great Recession*.

**DATA AND METHOD**

DATA

Data was drawn from the Survey of Income and Program Participation (SIPP) 2008 panel. SIPP is administered by the US Census Bureau[[2]](#footnote-2) and is representative of non-institutionalized US households. The SIPP 2008 panel started from July 2008 and lasted until June 2013, including a total of 13 waves. The waves overlapped with twelve of the eighteen months[[3]](#footnote-3) of the Great Recession and its long wake. Households selected, were followed through the entire panel, and were interviewed very fourth month on a set of core questions, which inquired on household demographics, labor-force participation, participation in the various safety-net programs, asset ownership over the last three months, etc. In addition to the core questions, the SIPP also administered specific modules or topical questions, asked only once during the entire study panel. The topical modules varied by the waves and included questions on marital history, disability, material hardships, assets-liabilities, etc. The reference period for the modules varied. Of interest to this study was wave 6 of the 2008 panel, which specifically inquired on adult disability status.

To be included in the study sample, respondents had to meet a set of criteria. First, it was necessary for households to have at least participated in wave six of the study, the wave that had a specific module inquiring on adult disability. Second, the reference persons of the households had to be adults (18 years and older) throughout the household’s participation in the study. And third, the households should have participated in at least one calendar year. A total of 33,547 households met the sample inclusion criteria.

MEASURES

*Dependent variable*

Income poverty, the ratio of average quarterly household income and average quarterly federal poverty level (100% FPL) was used as the dependent variable in our analysis, henceforth referred to as FPL100-ratio. We used quarterly averages because quarters are the most widely accepted time windows when analyzing economic trends. The four quarters that make up the year are January, February and March (Q1); April, May, and June (Q2); July, August and September (Q3); and October, November, and December (Q4). To calculate quarterly averages total monthly household incomes and monthly federal poverty levels were averaged [[4]](#footnote-4)over three months in each quarter. An FPL100-ratio lower than one in any quarter indicated the household was below 100% of the federal poverty level in that quarter. In the sample, the quarterly income data ranged from -$27,180 to

$108,900, the average being $5240 and median $3,874. The negative incomes were associated with households owning a business that incurred losses in those quarters. The FPL100-ratio ranged from

-17.95 to 89.48, with the average being 3.817 and the median 2.924.

*Predictors*

There were two key predictors in our analysis: time and adult disability. Time, measured in quarters and treated as a continuous variable. Data from 2008-Q3 and 2013-Q1 were analyzed in the study. Wave 6 of the 2008 panel included detailed questions to assess adult disability. Adult Disability was assessed by asking the household reference person, whether there was any adult in the household who had experienced difficulties with activities of daily living, or have been using assistive devices, or had mental retardation, learning disability, developmental disability, or Alzheimer’s or any disease that impacted memory, resulting in loss of memory, forgetfulness. Once identified, only those households were selected where at least one person between ages 18 and 64 had a chronic illness/disability of the duration of at least one year, to capture the severity of the disease or illness. A total of 7,443 households (22.16%) met the inclusion criteria. A dichotomous variable indicated whether the household had a working age adult with a disability or whether it did not.

*Control variables*

We controlled for four demographic factors: gender, marital status, education, race/ethnicity of the reference persons of the households in our analysis. Gender was a dichotomous variable (male and female), and so was marital status. Household reference persons who were divorced, widowed and never married were categorized as ‘not married.' Education had three categories, ‘high-school or less,' ‘some college, diploma, associated degrees’ and ‘bachelors or higher.' We also included a variable labeled race/ethnicity, which was based on two variables, ethnicity, and racial origin. The SIPP assessed ethnicity using a dichotomous variable, which assessed whether the householder was or was not of Hispanic or Latino origin. Racial origin was assessed by asking respondents to identify themselves as ‘White alone,' ‘Black alone’, ‘Asian’ and ‘Others’, including Native Hawaiian and Pacific Islanders. Asians and Others were collapsed into one category. Combining racial origin and ethnicity resulted in a measure race/ethnicity, which had four categories ‘non- Hispanic White’, ‘non-Hispanic Black’, ‘Hispanic’ and ‘Others’ who are henceforth referred to as ‘White’, ‘Black’, ‘Hispanic’ and ‘Others’

ANALYTIC STRATEGY

Descriptive statistics was used to identify the key demographic characteristics of the study sample. Longitudinal household weights[[5]](#footnote-5) provided by SIPP were used for all analytic purposes.

For aim 1, a mixed (fixed and random) effects model was fit to analyze how households with working-age adults with disabilities differed from households with no working-age adult with a disability, on Income Poverty, controlling for demographic factors. Since this dataset was longitudinal in nature, to account for ‘between household’ differences, a mixed effect model was used.

Suppose *Yij* denote the FPL100-ratio of household *I* at period *to*, *Xi* denotes the demographic factors (gender, marital status, education level, race/ethnicity and their interactions) associated with household *i*. Then, a simple mixed-effects model for the analysis could be written as in equation 1.

*Yij* = *β*0 + *βtj* + *Xi*Θ + *bi* + *Eij* (1)

The model in equation 1 would estimate the following parameters: (1) *β0*, the overall intercept, (2) *β*, the fixed effect of time, (3) Θ, the vector of fixed effects of demographic factors, (4) *bi*, the household level random effect (random intercept) and (5) *eij*, the residual, or the ‘within household’ variability. In this model, the response from the ith household at time *tj* is estimated to differ from the overall mean *β0 + βtj + XiΘ* by a household effect *bi* and a within household measurement error *eij*. The within household and between household errors are assumed to be normal and independent.[[6]](#footnote-6)

The trough of the great recession was reached in the second quarter of 2009 (marking the technical end of the recession, defined as at least two consecutive quarters of declining GDP)[[7]](#footnote-7). According to NBER, June 2009 was the final month of the recession. We checked if this was reflected in the FPL100-ratio as a downward trend in the initial quarters followed by an upward trend. A linear term in ‘time’ was insufficient to capture this effect. Therefore, we added a second order term time-squared (*t2*) to test the change in direction of trend. The second order term was created after centering the original ‘time’ variable, to avoid introducing multicollinearity. An indicator variable *ID* was used to denote the presence of working age adult with disability in a household *i*. An interaction term between *ID* and time was also included to estimate the difference in slopes between households with and without a working age adult with a disability. Below is the final model that was fit for aim

*Yij = β0 + β1tj + β2tj2 + βDID + βt(ID \* tj) + XiΘ + bi + εij*  (2)

The model in equation 2 estimated the following parameters: (1) *β0*, the overall intercept, (2) *β1*, the fixed effect of time, (3) *β2,* the fixed effect of time-squared, (4) *βD* , the effect of disability on income poverty (hypothesis 1) (5) *βt*, the effect of interaction between disability and time on income poverty (hypothesis 2), (6) Θ, the vector of fixed effects of demographic factors and their interactions, (7) *bi*, the household level random effect (random intercept) and (8) *Eij* , the residual, or the ‘within household’ variability. Significance of coefficients *β1* and *β2* were tested to analyze the overall trends of FPL100-ratio over the study period. In addition, interactions between demographic factors, and between disability and demographic factors were also tested. The demographic factors and their interactions were all considered as fixed effects.

Preliminary analysis revealed that over time the differences in FPL100-ratio *trends* were much smaller than the differences in FPL100-ratio *levels* between the demographic subgroups. A pattern evident in figures 1 and 3.Hence, in order to keep the final model simpler, we did not include interaction terms of time with demographic factors.

The final model was selected using ‘backward elimination’. Elimination of the fixed effects were done by the principle of marginality, that is: the highest order interactions are tested first: if they are significant, the lower order effects were included in the model without testing for significance. The p-values for the fixed effects are estimated from the F statistics, with ‘Satterthwaite’ approximation (Satterthwaite 1946) denominator degrees of freedom. The p-values for the random effect were computed from likelihood ratio tests (Morrell 1998).

For aim 2, a separate mixed-effects model was fit, with FPL100-ratio as the dependent variable, time, time-squared and demographic factors as the predictors, only for households that had working age adults with a disability. To carefully analyze differences in income poverty profiles between demographic subgroups within these households, interactions between the factors were included in the model. Post-hoc tests were conducted between categories of all demographic factors and their interactions, by calculating differences of ‘Least Squares Means’ using R package ‘lmerTest’ (Kuznetsova et al. 2015), with ‘Satterthwaite’ approximation (Satterthwaite 1946) of the denominator degrees of freedom. Since there were multiple categories of these factors, the size of the tests could be inflated, hence inflating type I errors. Holm’s sequentially rejective Bonferroni procedure (Holm 1979) and Benjamini-Hochberg procedure (Benjamini and Hochberg 1995) remain the two most popular multiple testing correction techniques to address type I error inflation. Holm’s sequentially rejective Bonferroni procedure controls the family-wise type-I error rate (FWER) and is more powerful than the classical Bonferroni procedure. Benjamini-Hochberg controls the false discovery rate (FDR) which is the expected value of false discovery proportion. Controlling FWER usually proves to be too conservative. Hence, we used the Benjamini-Hochberg procedure, which is less conservative, but more powerful than Holm’s sequentially rejective Bonferroni correction. All posthoc test p-values reported were Benjamini-Hochberg corrected.

All analysis were conducted using the statistical software R (R Core Team 2016, version 3.3.1. The mixed effects models were fit using the R-package ‘lme4’ (Bates et al. 2014), and all hypothesis tests were done using the R package ‘lmerTest’ (Kuznetsova et al. 2015).

*Insert Table 1*

**RESULTS**

Table 1 describes the sample from wave six of the 2008 panel. As seen in Table 1, 22.19% of households who participated in wave six had at least one working-age adults with a disability. In

54.62% of the households with a disability, the reference persons were females, 46.67% of the reference persons were ‘not married’, the majority of the reference persons were White (66.71%), 40.23% of the reference persons had high school or less education and 21.31% had bachelors or higher degrees. In 51.63% of the households with no disability, the reference persons were females, 48.07% of the reference persons were ‘not married’, majority of the reference persons were White (71.89%), 32.55% of the reference persons had high school or less education and 33.30% had bachelors or higher degrees.

*Insert Table 2*

Results for Aim 1 of the study are presented in Table 2. Households with working age adults with disability, on an average, experienced significantly worse income poverty (FPL100-ratio, *βD*  =

−0.725, p < 0.001) compared with households with no working-age adults with a disability, through the great recession, when controlled for demographic factors. This average difference between the two types of households is illustrated in figure 1. The findings supported hypothesis 1.

*Insert Figure 1*

Results showed that the trends of income poverty were not significantly different between households with and without working age adults with disability, over the study period (*βt*  =

0.015, p = 0.9994). This is evident from the trend lines in figure 1, which shows that although income poverty worsened in the early stages of the great recession and experienced gradual recovery, the average difference in income poverty profiles between the two household types has remained similar. Hence, we could not substantiate hypothesis 2.

Table 2 also showed that FPL100-ratio, on an average, decreased by 0.054 every year (*β1* =

−0.054, p < 0.001). The coefficient of the quadratic term of Time (*β2* = 0.0073, p < 0.01) indicated that the rate of change of slope was positive. In other words, although the FPL100-ratio decreased over time (as β1 < 0), it flattened out and started increasing, in the latter parts of the study period (figure 1).

Of the main effects of demographic factors on the FPL100-ratio, households with ‘female’ reference persons had on an average 0.368 lower FPL100-ratio (*β* = −0.368, p < 0.001) compared to households with ‘male’ reference persons. Marital status was statistically significant; households with ‘not-married’ reference persons had on an average 0.611 lower FPL100-ratio (*β* = −0.611, p < 0.001) compared to households with ‘married’ reference persons. The impact of race/ethnicity on FPL100- ratio were statistically significant; households with Black reference persons had on an average 1.28 lower FPL100-ratio (*β* = −1.284, p < 0.001) than households with White reference persons, but the difference was greater between households with Hispanic and White reference persons (*β* = *−*1*.*505*, p <* 0*.*001). The impact of education on FPL100-ratio was also statistically significant; households with reference persons with education ‘high school or less’ had on an average 2.204 (*β* = −2.204, p < 0.001) lower FPL100-ratio than households with reference persons with education ‘bachelors or higher’. In addition to these main effects, table 2 also shows the significant interactions between disability and demographic factors and among the demographic factors themselves.

*Insert Figure 2*

Based on the interaction effects reported in table 2, figure 2 illustrates the composite effects of the various interacting factors on income poverty profiles. We present profiles of the two most contrasting household types on a combination of demographic factors that show the best show the best and the worst profiles on FPL100-ratios. We compare households where the reference persons are White, married, male, with education bachelors or higher and with no working age adults with disability (type 1) to households where the reference persons are Black, not married, female with education high school or less, with a working age adult with disability (type 2). As evident, households of type 2 had, on an average, income poverty worse than 200% FPL throughout the study period, starting at 1.52 and reaching lower than 1.3 FPL100-ratio. In comparison, household type 1 always had their FPL100-ratios higher than 6.3.

*Insert table 3*

Aim 2 of this study was to analyze differences in income poverty profiles between demographic subgroups within households with working-age adults with a disability, during the great recession. Results from Table 3 show that gender, marital status, education, race/ethnicity and some of their interactions have statistically significant associations with income poverty for households with a disability during the great recession. The main effects of the demographic factors are illustrated in Figures 3a for gender, 3b for marital status, 3c for race/ethnicity and 3d for education. The difference in associations of marital status with FPL100-ratios between tables 2 and 3 is worth highlighting. The association is almost double in households with disability (*β* = −0.611 in Table 2 and *β* = −1.119 in Table 3).

*Insert Figure 3a, 3b, 3c & 3d*

For example, 3a shows that households with ‘female’ reference persons had consistently worse income poverty compared to households with ‘male’ reference persons. Figure 3b shows that households with ‘not married’ reference persons had consistently worse income poverty compared to households with ‘married’ reference persons. Figure 3c shows that households with ‘Hispanic’ reference persons had the worst income poverty throughout the study period. Also illustrated in figure 3c are the different shapes of the income poverty profiles of the four races. Households with ‘White’ reference persons had a gradual and steady improvement in their average income poverty after 2011. However, this behavior was not observed in households with ‘Black,' ‘Hispanic’ or ‘others’ reference persons. In figure 3d, households where the education levels of their reference persons were ‘high school or less’ experienced a decline in their FPL100-ratios, just like the other groups, but never experienced any improvement in the latter parts of the study. To conclude, subgroups of households headed by Hispanic, not married females, and with education high school or less experienced worst income poverty throughout the great recession consistently.

**DISCUSSION**

Limitations (We listed out some of the limitations)

1. Although a linear mixed effects regression model discovered some conventional and some interesting patterns in the relationships between response and demographic factors, along with disability, the trajectory of income poverty over the study period for some households were not linear. This modeling approach did not capture trajectory shapes of individual households. A non-parametric fitting of the income poverty trajectories could be tried as a pre-processing step before testing for differences in behavior between different groups of households.
2. Some households in the sample did not participate over all the waves. Since households that participated in wave six were included there were some households that were first interviewed in wave six and some that were no longer interviewed after wave six. There were no means of determining the reasons for dropping out from the survey, nor the reasons for late inception into the survey. Since the great recession was a significant economic and social event, we included households without complete participation in order to maximize the sample size, and incorporate the effect of the recession on more households. If, however, the reasons for dropping out or late joining had an association with the outcome of the study (income poverty), including those households could increase bias in the estimates, in spite of the estimates being more stable (less variance). Chapter 2 in SIPP users guide[[8]](#footnote-8) mentions that the survey weights are adjusted to account for some types of household non-response with the objective of ameliorating the non-response bias.

**Figures**

Figure 1: Income poverty profiles of households, by disability status

Disability ● no yes

4.25

4.00

Average FPL100−ratio

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● ●

●

●

●

●

● ● ● ● ● ● ● ●

●

● ● ● ● ● ●

3.75

3.50

3.25

2008 2009 2010 2011 2012 2013

Figure 2: Income poverty profiles of two most contrasting household types

6.7

6.6

Married Male White Bachelors or higher Disability no

● ●

● ●

●

6.5

Average FPL100−ratio

6.4

●

●

● ●

● ●

●

● ● ●

● ● ●

● ●

●

2008 2009 2010 2011 2012 2013

Not married Female Black High School or less Disability yes

1.50

1.45

1.40

1.35

1.30

2008 2009 2010 2011 2012 2013

*Note* : The y-axes of the two subplots have different ranges.

Figure 3: Income poverty profiles for households with working age adults with disability (a) by gender (b) by marital status (c) by race and ethnicity (d) by education, of reference person

Reference person ● Female Male

Reference person ● Married Not married

3.7

3.5

Average FPL100−ratio

4.0

● ● ●

●

●

● ● ●

● ● ● ● ● ● ● ● ● ● ● ● ● ●

3.5

Average FPL100−ratio

3.3 ●

3.1

2.9

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●

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● ● ● ● ●

● ● ●

● ● ● ● ● ●

3.0

2.5

2008 2009 2010 2011 2012 2013

2008 2009 2010 2011 2012 2013

(a)

(b)

Reference person ● Black Hispanic Others White Reference person ● Bachelors or higher High School or less Some college, diploma, assoc

3.5

Average FPL100−ratio

● ● ● ● ●

● ●

5

●

● ● ● ● ● ● ● ● ● ● ● ● ● ●

3.0 4

Average FPL100−ratio

2.5

● ● ●

● ● ●

● ● ● ● ● ● ● ●

● ● ● ● ●

3

● ● ●

2008 2009 2010 2011 2012 2013

2008 2009 2010 2011 2012 2013

(c)

(d)

**TABLE 1**

DESCRIPTION OF THE STUDY SAMPLE FROM WAVE SIX OF THE 2008 SIPP PANEL

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Households with no working age adult with disability** | | **HH with working age adult with** **Disability** | |
|  | **Number** | **%** | **Number** | **%** |
| Total number of households | 26,104 | 77.81 | 7,443 | 22.19 |
| Gender of the reference person |  |  |  |  |
| Male | 12,626 | 48.37 | 3,378 | 45.38 |
| Female | 13,478 | 51.63 | 4,065 | 54.62 |
| Marital status of the reference person |  |  |  |  |
| Married | 13,555 | 51.93 | 3,968 | 53.31 |
| Not Married | 12,549 | 48.07 | 3,474 | 46.67 |
| Race and ethnicity of the reference person | | | | |
| White | 18,765 | 71.89 | 4,965 | 66.71 |
| Hispanic | 2,996 | 11.48 | 908 | 12.20 |
| Black | 2,912 | 11.16 | 1,092 | 14.67 |
| Others | 1,431 | 5.48 | 479 | 6.44 |
| Education of the reference person | | | | |
| High school or less | 8,496 | 32.55 | 2,994 | 40.23 |
| Some college, diploma, associate’s  degree | 8,916 | 34.16 | 2,863 | 38.47 |
| Bachelors or higher | 8,692 | 33.30 | 1,586 | 21.31 |

Note: Weighted estimates are provided

**TABLE 2**

Mixed effects regression showing the difference in income poverty between families with and without a working-age adult with disability

|  |  |  |  |
| --- | --- | --- | --- |
| **Predictor and Control variables** | *β* | **Std. Error** | **p-value** |
| Intercept | 5.896 | 0.037 | 0.0000 |
| Time (*t*) | -0.054 | 0.002 | 0.0000 |
| Time-squared (*t*2) | 0.007 | 0.001 | 0.0000 |
| Adult Disability | -0.725 | 0.068 | 0*.*0000(e) |
| Adult Disability x Time | 0.015 | 0.004 | 0*.*9994(e) |
| Gendera: (Female) | -0.368 | 0.043 | 0.0000 |
| Marital statusb: (Not married) | -0.611 | 0.034 | 0.0000 |
| Race2: (Black) c | -1.284 | 0.086 | 0.0000 |
| Race3: (Hispanic) c | -1.505 | 0.088 | 0.0000 |
| Race4: (Others) c | -0.355 | 0.087 | 0.0000 |
| Education2: (Some college, diploma, assoc) d | -1.516 | 0.045 | 0.0000 |
| Education3: (High School or less) d | -2.204 | 0.048 | 0.0000 |
| Adult Disability x Gender | 0.195 | 0.050 | 0.0001 |
| Adult Disability x Education: |  |  |  |
| Adult Disability x Education2 | 0.112 | 0.068 | 0.1002 |
| Adult Disability x Education3 | 0.219 | 0.072 | 0.0022 |
| Gender x Marital status | -0.523 | 0.032 | 0.0000 |
| *Gender* x *Education*: |  |  |  |
| Gender x Education2 | 0.102 | 0.051 | 0.0448 |
| Gender x Education3 | 0.255 | 0.052 | 0.0000 |
| *Marital status* x *Race*: |  |  |  |
| Marital status x Race2 | 0.209 | 0.051 | 0.0000 |
| Marital status x Race3 | 0.529 | 0.046 | 0.0000 |
| Marital status x Race4 | 0.182 | 0.069 | 0.0081 |
| *Marital status* x *Education*: |  |  |  |
| Marital status x Education2 | 0.125 | 0.037 | 0.0008 |
| Marital status x Education3 | 0.234 | 0.038 | 0.0000 |
| *Race* x *Education*: |  |  |  |
| Race2 x Education2 | 0.337 | 0.087 | 0.0001 |
| Race3 x Education2 | 0.401 | 0.092 | 0.0000 |
| Race4 x Education2 | -0.208 | 0.104 | 0.0460 |
| Race2 x Education3 | 0.371 | 0.093 | 0.0001 |
| Race3 x Education3 | 0.499 | 0.092 | 0.0000 |

Note: Only significant interactions (p-value < 0.05) have been reported.

a Base category of gender is “Male”

b Base category of marital status is “Married”

c Base category of race is “White”

d Base category of education is “Bachelors or higher”

e Note that these are p-values of one-sided tests based on hypotheses 1 and 2.

**TABLE 3**

Mixed effects regression testing the associations of demographic factors with income poverty, for families with a working-age adult with disability

|  |  |  |  |
| --- | --- | --- | --- |
| **Predictor and Control variables** | *β* | **Std. Error** | **p-value** |
| Intercept | 5.361 | 0.076 | 0.0000 |
| Time (t) | -0.039 | 0.003 | 0.0000 |
| Time-squared (t2) | 0.006 | 0.002 | 0.0127 |
| Gender a: (Female) | -0.254 | 0.088 | 0.0039 |
| Marital status b: (Not married) | -1.119 | 0.070 | 0.0000 |
| Race2: (Black) c | -1.121 | 0.167 | 0.0000 |
| Race3: (Hispanic) c | -1.295 | 0.159 | 0.0000 |
| Race4: (Others) c | -0.325 | 0.162 | 0.0442 |
| Education2: (Some college, diploma, assoc) d | -1.668 | 0.088 | 0.0000 |
| Education3: (High School or less) d | -2.155 | 0.089 | 0.0000 |
| Gender x Marital status | -0.371 | 0.058 | 0.0000 |
| *Gender* x *Education:* |  |  |  |
| Gender x Education3 | 0.223 | 0.100 | 0.0263 |
| *Marital status* x *Race:* |  |  |  |
| Marital status x Race3 | 0.636 | 0.082 | 0.0000 |
| Marital status x Race4 | 0.288 | 0.115 | 0.0124 |
| *Marital status* x *Education:* |  |  |  |
| Marital status x Education2 | 0.641 | 0.074 | 0.0000 |
| Marital status x Education3 | 0.759 | 0.074 | 0.0000 |

*Race* x *Education:*

Race2 x Education2 0.350 0.174 0.0438

Note: Only significant interactions (p-value *<* 0*.*05) have been reported.

a Base category of gender is “Male”

b Base category of marital status is “Married”

c Base category of race is “White”

1. Business Cycle Dating Committee, National Bureau of Economic Research (NBER) [↑](#footnote-ref-1)
2. For more information on the SIPP 2008 panel schedule, please refer to this [US Census Bureau website](http://www.census.gov/programs-surveys/sipp/data/2008-panel.html) [↑](#footnote-ref-2)
3. NBER Recession cycles [↑](#footnote-ref-3)
4. These averages were weighted by monthly longitudinal survey weights [↑](#footnote-ref-4)
5. https://www.census.gov/programs-surveys/sipp/methodology/weighting.html [↑](#footnote-ref-5)
6. (bi  ̴ *N* (0, *σb2*), *εij*  ̴ *N* (0, *σ2*), *bi* ╨ *εij*, for all, i, j) [↑](#footnote-ref-6)
7. Business Cycle Dating Committee, National Bureau of Economic Research (NBER) [↑](#footnote-ref-7)
8. https://www2.census.gov/programs-surveys/sipp/guidance/SIPP 2008 USERS Guide Chapter2.pdf [↑](#footnote-ref-8)