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The Impact of the Great Recession on SSDI Awards: A Birth-Cohort Analysis

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ABSTRACT

Project Number

D-MP-18-Q1

Title

The Impact of the Great Recession on SSDI Awards: A Birth Cohort Analysis

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Key findings and policy implications

Awards of Social Security Disability Insurance (SSDI) benefits to disabled workers experienced a rapid increase, then decline, in the decade following the start of the Great Recession (2007–2016). We hypothesize that the recession might have initially led to an acceleration of awards to workers who would have worked longer and entered SSDI much later had the economy remained stable. If so, the acceleration would have reduced awards during the recovery because some workers had entered SSDI earlier, instead. We used SSA administrative data and cross-state variation in how the business cycle evolved between 2007 and 2016 to estimate the extent to which the 2007–2009 recession accounts for the rapid growth in awards in the early part of the 10-year period as well as the extent to which the business cycle can explain the more recent decline. We examined the award experience of individual-year birth cohorts, by sex, to assess the extent to which they follow the hypothesized pattern of accelerated awards in the early period followed by deceleration later in the period, thereby controlling for the effects of contemporaneous changes in the age-sex composition of the disability-insured population that are confounded with business cycle effects in more aggregate award series. We also account for a no-recession counterfactual—an estimate of the expected awards in the absence of the Great Recession.

Our key findings are:

- For males born between 1941 and 1986, increases in awards, relative to the counterfactual, from 2008 to 2011 approximately equal declines in awards from 2011 to 2014. This is consistent with the possibility that the business cycle explains all of the difference between their awards and their counterfactual awards. Further, predictions of differences in actual and counterfactual awards based on state variation in business cycle characteristics account well for the overall pattern of the actual differences. Estimates for cohort groups, defined by birth year, are less consistent with the business cycle hypothesis, however.
- For females born in the same years, business-cycle impacts peaked later than for males and continued to be positive through the end of 2014. This surprising finding may be rooted in

the counterfactual series, which for both sexes were based on a period when female awards grew at a much faster rate than male awards.

The policy implications of our findings are:

- The findings for males suggest that the bulk of the unexpectedly large declines in SSDI awards since 2011 are due to the business cycle, including the recession's acceleration of awards to workers who would otherwise have applied later in the period. They also suggest that cohort analysis can potentially be used to reduce the volatility of projections in the financial status of the DI Trust Fund when recessions occur. The enigmatic findings for females and for some male birth cohort groups illustrate a need for further development of the approach.

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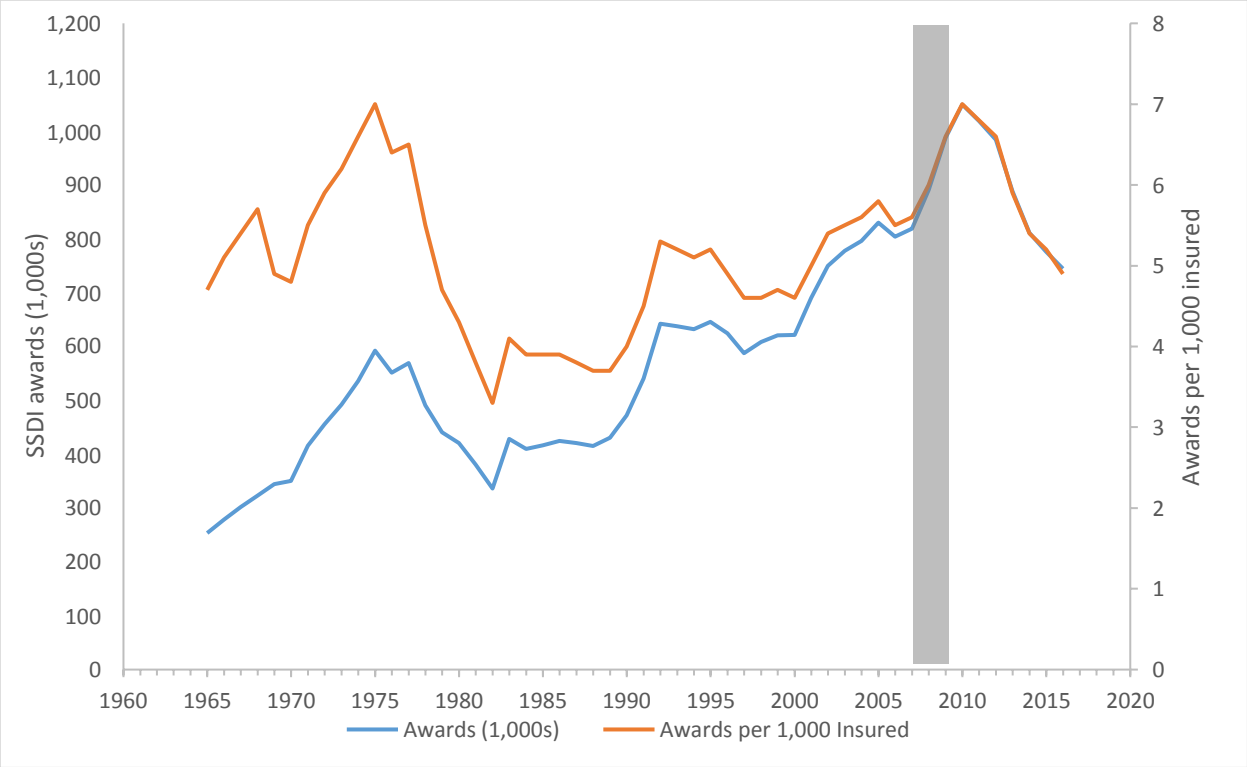
I. INTRODUCTION

Awards of Social Security Disability Insurance (SSDI) benefits to disabled workers rapidly increased, and then declined, in the decade following the start of the Great Recession (2007 to 2016, Figure 1). The same pattern emerges when awards are measured using the incidence rate—that is, the awards relative to the size of the population of disability-insured workers (Figure 1's right-hand scale). This experience has heightened the uncertainty about the financial status of the Disability Insurance Trust Fund. A better understanding of the factors behind these dynamics could help improve future projections of SSDI incidence rates and awards and inform policymakers' efforts to retain workers with substantial medical conditions in the workforce during significant downturns in the economy.

Figure 1. SSDI awards and awards per 1,000 insured, 1965 to 2016



Source: Social Security Administration 2019.

Note: The gray bar indicates the Great Recession.

To illustrate the uncertainty about the Disability Insurance Trust Fund, consider the trustees' projections for the year in which the fund would be fully depleted, starting with the 2007 projection (the last before the recession started), through the most recent projection (The Board of Trustees, Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds 2007, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019). The 2007 report projected depletion in 2026. By 2012, the projected depletion year had fallen to 2016. The projected date remained at 2016 through the 2015 projection, instigating a major effort by policymakers to stave it off. It jumped to 2023 in 2016, primarily because of provisions in the 2015 Bipartisan

Budget Act to temporarily redirect a portion of payroll taxes from the Old Age and Survivor's Insurance Trust Fund to the Disability Insurance Trust Fund. By 2018, the projected depletion year had increased to 2032, and it jumped to 2052 in 2019.

This paper seeks a better understanding of the extent to which the 2007 to 2009 recession accounts for the unexpectedly rapid growth in awards in the early part of the 10-year period as well as the extent to which the more recent decline in awards is explained by the recovery from the recession. The recession might have initially led to an acceleration of awards to workers who would have worked longer and entered SSDI much later had the economy remained stable. This sort of acceleration would lead to a temporary reduction in the incidence rate during the recovery, relative to a no-recession counterfactual (that is, relative to what the rate would have been if there was no recession). Thus, accelerated entry would lead to both an initial increase in awards above the level that would be expected under a stable economy during the downturn and a decrease in awards to below the stable-economy level at some point after the downturn ended. Other factors, discussed in the next section, also complicate the dynamics of the effect of the business cycle on awards.

This study represents the first use of a birth-cohort approach to gain a better understanding of the impact of the Great Recession on SSDI awards. An important advantage of the birth-cohort approach is that it avoids the problem of confounding the effects of the recession with changes in the composition of the disability-insured population (that is, because of aging and changes in labor force participation). Using SSA administrative data, we exploit cross-state variation in how the business cycle evolved between 2007 and 2016 to estimate the effects of the recession on SSDI awards made to single-year birth cohorts of workers, separately by sex. Our estimates account for a no-recession counterfactual—an estimate of the expected awards in the absence of the Great Recession. Specifically, we address the following research questions:

1. To what extent can the pattern of new SSDI awards from 2007 to 2016 be attributed to the business cycle?
2. Is there evidence that the recession accelerated SSDI entry of individual workers relative to a no-recession counterfactual, thereby increasing awards in the early portion of the recession and decreasing awards during the recovery?

Improving our understanding of the contributions of the effects of the business cycle on awards is critical for improving actuarial projections. It is also critical for gaining a better understanding of the extent to which the recent decline in awards must be attributable to other causes and what those causes might be.

II. BACKGROUND

A. The business cycle and SSDI application dynamics

Two well-known causes of SSDI award growth in recent decades are also the main drivers of long-term growth in the actuarial projections reported by the trustees: the aging of the large baby boomer generation (those born in years 1946 to 1964) and the growth in female labor force participation (Pattison and Waldron 2013; Goss 2014; Liebman 2015). Although the baby boomer generation is gradually aging out of SSDI eligibility, and the growth in female labor force participation has leveled out in recent years (Krueger 2017), these relatively recent trends are gradual, predictable, and therefore unlikely to be the major reason for the differences between projected and actual awards that are behind the volatility in the projected year of Trust Fund depletion. Hence, it appears that other factors must explain much of the award growth and subsequent decline from 2007 to 2016.

The business cycle is the most obvious candidate for explaining much of the award growth early in the period. There is evidence from prior research that disability incidence rates increase during economic downturns (Rupp and Stapleton 1995; Burkhauser et al. 2001/2001; Black, et al. 2002; Autor and Duggan 2003; Duggan and Imberman 2009; Maestas et al. 2018). The business cycle might also explain a portion of the recent decline in awards. Although the actuarial projections take account of the effects of the business cycle to some extent, the dynamic nature of business-cycle effects makes predicting the effects of a recession and subsequent recovery on future awards much more challenging than predicting the impacts of aging and past trends in labor force participation.

The dynamic effects of business cycles on SSDI awards are complex. When a recession first occurs, layoffs may lead some workers to apply for SSDI benefits immediately, and some of these workers may be entitled to benefits as soon as six months after they are laid off. Other laid-off workers may wait until their unemployment benefits are exhausted, perhaps attempting to return to work at the same time, but eventually giving up and applying for SSDI. During the Great Recession, these dynamics were complicated by extensions to the maximum duration of unemployment benefits, first under the American Recovery and Reinvestment Act of 2009 and again under the Unemployment Compensation Extension Act of 2010, to a maximum of 99 weeks for some workers. Further, some laid-off workers may only experience the onset of disability later, or may only meet SSDI eligibility criteria after they have crossed one of the age thresholds at which the medical-vocational criteria for eligibility become less stringent. For these reasons, when workers induced to apply to SSDI because of a recession are awarded benefits, their first month of entitlement may be much later than the sixth month after they were laid off.

Another factor that affects the timing of recession-induced awards is recession-induced changes in the duration of the disability determination process. Rapid growth in applications typically leads to larger backlogs of pending claims and, therefore, longer processing times. Consistent with the hypothesis that many of those induced to apply by the recession did not apply until well after they were laid off. Maestas et al. (2015) found that the median duration from month of alleged onset to month of application increased after the first few months of the Great Recession.

Economic recovery eventually leads to declines in awards for several reasons, some of which are more obvious than others. The more obvious reasons are that reductions in layoffs reduce the number of awards to those newly laid off, and more unemployed workers at risk for SSDI are able to find jobs. A less obvious reason is that the recession likely accelerated SSDI awards made to at least some workers who would have, in the absence of the recession, been awarded benefits during what turned out to be the recovery period. The actuaries' projections of the SSDI incidence rate at least partially capture this last effect by defining those at risk for entry as the "disability exposed" population—that is, the disability-insured population net of those already in current pay status—by age and sex. The projections recognize that those induced by the recession to enter previously cannot enter again unless they have already left the rolls. However, this methodology does not explicitly consider the possibility that recession-induced entry into SSDI reduced the number of high-risk workers among those remaining in the labor force during the recovery period.

The complexity of these dynamics suggests that past efforts by SSA and others to model the effects of business cycles on SSDI awards may not capture impacts on the size and timing of awards very well. Past efforts have focused on estimating econometric models for awards and applications directly (for example, Autor and Duggan 2003; Lindner et al. 2017; Maestas et al. 2015; Rupp 2012; Rupp and Stapleton 1995). The direct approach is limited by the confounding of the effects of the business cycle with the effects of co-occurring changes in the composition of the disability-insured population at risk for SSDI awards. As the business cycle progresses, the disability-insured population changes because workers age, the percentage who are female increases, and some workers at risk for SSDI are no longer at risk because they have received awards. In general, this line of research has addressed changes in age-sex composition of those at risk for SSDI by modeling analysis of awards by sex and age, and by removing those already on SSDI from the at-risk population. The primary limitation of this approach is that the average risk of SSDI entry for those left in the at-risk population may be lower than it was before the recession, because the recession depleted the percentage who were at high risk of SSDI entry. Unlike changes in age-sex composition, other compositional changes that affect the average risk of SSDI entry are not readily observable.

B. A new approach to modelling business-cycle effects on SSDI awards

This paper uses birth-cohort analysis to better understand the effect of the business cycle on SSDI awards from the onset of the Great Recession through 2016. Our approach avoids the problem of confounding the effects of the recession with changes in the composition of the disability-insured population by analyzing the effects of the recession on initial SSDI awards made to single-year birth cohorts of workers by sex. Apart from small changes attributable to immigration, the size and sex composition of each single-year male or female birth cohort does not change over time, and their age increases by one year for each year that passes. The number at risk for SSDI entry changes because of past entry and any changes in disability-insured status, including mortality. To avoid the problem of the changing composition of those in a birth-sex cohort remaining at risk for SSDI, our analysis for each cohort focuses on the time series of awards made to those who were at risk for SSDI entry just before the recession started and compares it with series for earlier cohorts when the latter were the same age.

In brief, we create biannual series for SSDI awards by state, birth cohort, and sex between 1996 and 2016. We use observed awards, by state and sex, in the period before the Great Recession (1996 to 2006) to calculate average growth rates in awards across birth cohorts to obtain an expected age profile of awards. During the period that is the basis for the counterfactual, economic conditions varied, but not nearly as dramatically as in the post-2007 period. Our method for construction of the counterfactual cohort growth rates was designed to capture the average of business cycle and other time-varying factors affecting award growth during this period. We apply the expected age profile of awards to our sample to construct counterfactual series of awards between 2007 and 2016. The counterfactual series are an estimate of expected awards in the absence of the Great Recession and any other factors that were different in 2007 to 2016 than they were, on average, in the comparison period. The difference between observed awards and the counterfactual series of awards is the deviation from the expected age profile of awards. We model this difference by birth cohort and sex across states in each six-month period between 2007 and 2016 as a function of state variation in the characteristics of the business cycle. The result is a biannual prediction of the awards induced by the recession for each birth cohort and sex.

Our findings show the potential for birth-cohort analysis to inform our understanding of SSDI award trends and how the business cycle affects them. They also point to the potential for additional cohort analyses to inform our understanding of other important outcomes, such as labor force participation, fertility, mortality, and immigration. We explain our methodology in more detail in the next section. Because of a limitation with the award data for 2015 and 2016 described in the next section, this version of the paper reports results through 2014 only.

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III. DATA

A. Information on SSDI awards

We used the 2016 Disability Analysis File (DAF) for information on SSDI awards. The DAF is a longitudinal data file with information on all SSDI and SSI beneficiaries between the ages of 18 and full retirement age (FRA) who have received disability benefits in any month starting in 1996 through 2016. The DAF is constructed from existing SSA administrative data and updated annually.[1]

We extracted information on new SSDI awards in 1996 through 2016 for individuals born in 1938 through 1986. For each new award, we extracted the date of initial entitlement, date of award, sex, date of birth, and state of residence at the time of award. Our primary analysis sample includes beneficiaries born in 1941 through 1986; these beneficiaries were at least 20 years old and younger than 66 years old at the outset of the analysis period, January 2007. We used SSDI awards for birth cohorts 1938 through 1985 to develop the counterfactual series for the 2008–2014 period, as detailed in the methods section. We did not include awards for 2015 and 2016 because substantial numbers of applications for those whose first entitlement month was in one of those years were still pending when SSA extracted the data for the 2016 version of the DAF.

The results shown in this paper are based on awards measured at the time of initial entitlement, as opposed to the date of first benefit payment. Comparison of series based on entitlement date to series based on first payment date (not reported) showed that the increases in the actual series relative to the counterfactual series were larger using the entitlement date early in the period, and declines were substantially larger later in the period. This is consistent with expectations and findings by Maestas et al. (2015) on the effects of the recession on duration from entitlement month to month of first payment.

B. Characterizing the business cycle

We characterized the business cycle at the state level (50 states and the District of Columbia) to use state-to-state variation over the period from 2007 to 2016 to identify effects on SSDI awards. Because SSDI applicants are presumably among discouraged workers—workers who stop searching for work because of the lack of job prospects— our characterization is based on state-level employment as a fraction of the civilian non-institutional population ages 16 and older. Using the employment-population ratio enabled us to incorporate the effect of the business cycle on labor force participation as well as on employment. We used state-level employment data from the Local Area Unemployment Statistics program of the Bureau of Labor Statistics to

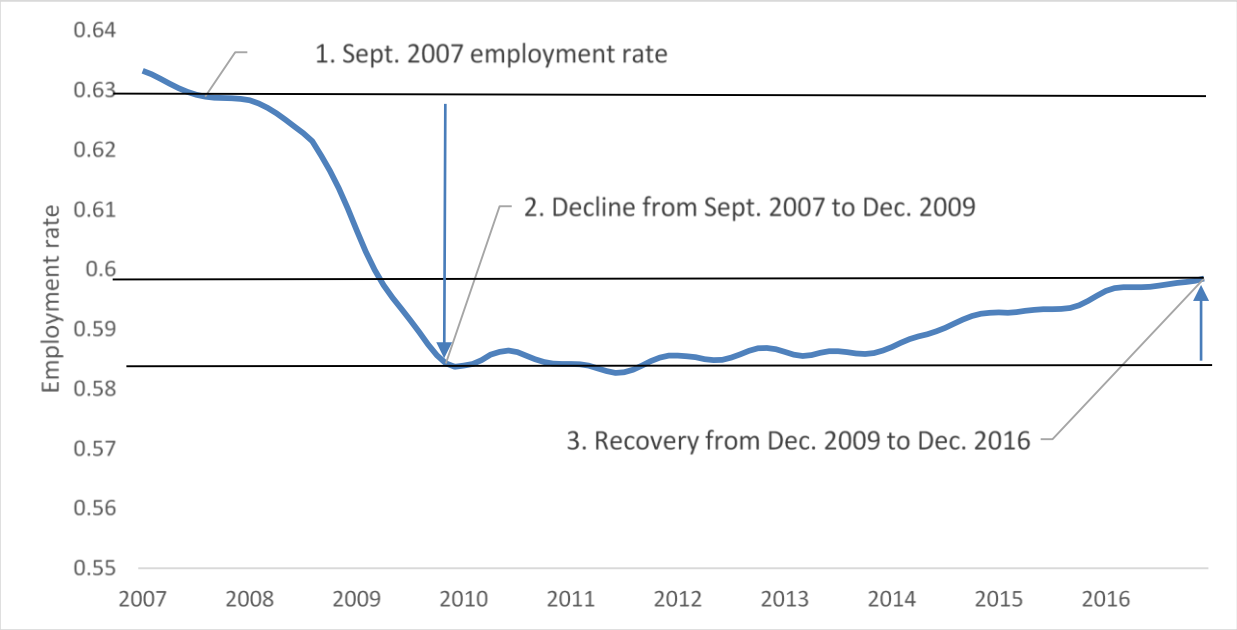
[1] The SSA data sources include the SSI - Longitudinal File, the Characteristics Extract Record 100% Field file, the Master Beneficiary Record, the Payment History Update System, the Disabled Beneficiaries and Dependents file, the Disability Control file, the Employment Network Payment Cumulative Payment Report, the Vocational Rehabilitation Reimbursement Management System, 831 & 832/833 Disability files and the Numerical Identification File. Mathematica constructed and continues to update the file under contract to SSA.

obtain monthly measures of the number of employed persons.[2] We used an estimate from the Census Bureau of the civilian non-institutional population ages 16 and older.

We created three state-level variables to characterize the evolution of the business cycle over the 10-year period. The first is the pre-recession employment rate, which we define as the employment rate in September 2007 (the stock market collapse occurred in October 2007). The second is the size of the decline in the employment rate between September 2007 and December 2009, the latter date being the final month of the initial decline of the national employment rate. The third variable is the size of the recovery in the employment rate between December 2009 and December 2016.

Figure 2 shows the national employment rate series. During the Great Recession and in the months following it, employment decreased nationally by more than four percentage points from 62.9 percent in September 2007 to 58.4 percent in December 2009, then remained essentially flat through 2013 before beginning a gradual rise through the end of 2016. At the end of 2016, the national employment rate remained well below the pre-recession level.

Figure 2. National employment rate, 2007 to 2016



Source: Bureau of Labor Statistics, Local Area Unemployment Statistics

States vary considerably in their employment rate decline from 2007 to 2009. Nevada experienced the largest employment rate decline (7.6 percentage points) and Vermont the smallest (1.0 percentage point). There is a similar difference in the recovery from 2009 to the end of 2016. Indiana experienced the largest increase (4.6 points), whereas Wyoming's rate decreased further (-3.2 points). Table 1 shows the distribution of the business-cycle variables across the states (and the District of Columbia).

[2] We accessed these data from https://www.bls.gov/lau/rdscnp16.htm (file name: ststdsadata.xlsx), "Employment status of the civilian noninstitutional population, seasonally adjusted."

Table 1. Summary statistics on business-cycle characteristics

Variable	Mean	Median	Standard deviation
September 2007 employment rate	0.639	0.637	0.039
Decline	0.042	0.041	0.016
Recovery	0.010	0.010	0.017

Notes: Variables are constructed at the state level using Bureau of Labor Statistics, Local Area Unemployment Statistics data. Decline is defined as the difference in the state-level employment-population ratio between September 2007 and December 2009. Recovery is defined as the difference in the state level employment-population ratio between December 2016 and December 2009.

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IV. METHODS

Our goal was to examine the extent to which business-cycle characteristics explain the deviation between observed awards and awards predicted by historical trends. To do so, we estimated a series of regression models to analyze the relationship between the actual-counterfactual difference and the business-cycle variables, including an intercept to measure the effect of factors other than the business cycle. We used the parameter estimates to predict the number of awards in each period attributable to the business cycle, which we call the business-cycle component, and the number of awards attributable to other factors. In addition, we tested for evidence that the business-cycle variables are associated with the actual-counterfactual difference in awards and whether substantial differences remain—presumably attributable to other factors. We describe our methods in more detail in the following sections.

A. Construction of counterfactual awards

The counterfactual series is an estimate of the expected trajectory of awards between 2008 and 2014 based on average age-specific award growth rates during the 1996 to 2006 period, conditional on age, sex, and state. In our analysis, described below, we used this counterfactual series as the base for measuring the difference from 2008 through 2014 between actual awards and awards based on historical trends.

For each state, sex, and age, we calculated the average growth rate for cohorts of the relevant age during the period as shown in equation 1.[3]

$$(1) rr_{ss,gg,aa} = \frac{1}{10}\sum_{yy=1997}^{2006} \frac{AA_{ss,gg,yy,bb}}{AA_{ss,gg,yy-1,bb}}$$

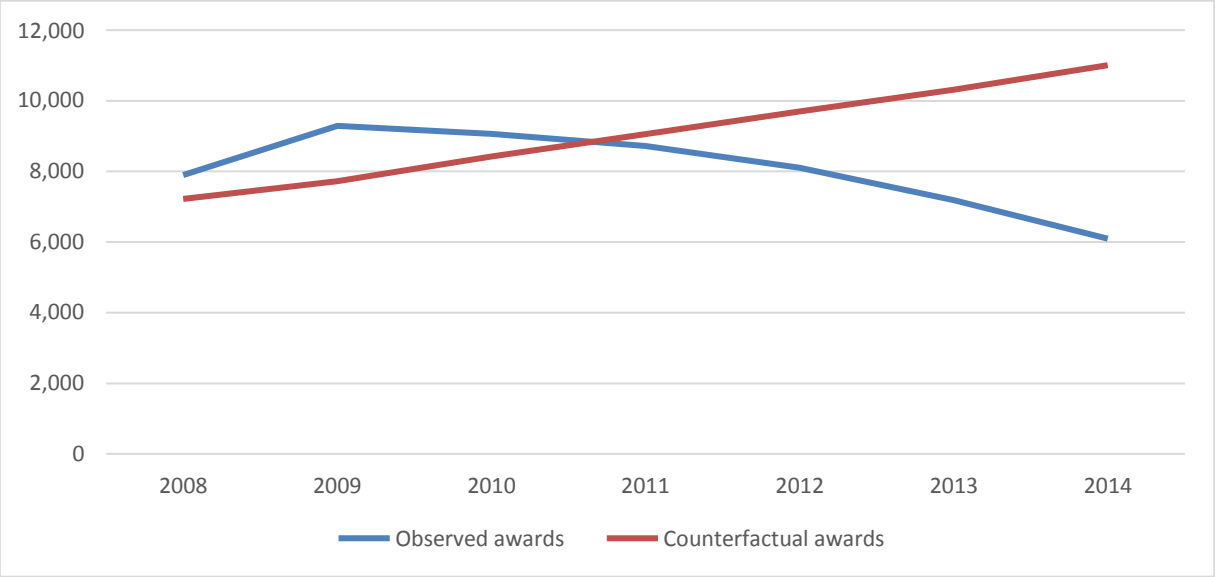
In this equation the growth rate, *r*, is conditional on state *s*, sex (denoted *g*), and age *a*. *A* is observed awards in state *s*, for sex *g*, in year *y* for birth cohort *b* which is age *a* in year *y* ($bb = yy - aa$). For example, in a given state the average counterfactual award growth rate for 55 year-old females was determined by averaging the observed growth rates in awards for the 1942 birth cohort from 1996 to 1997, the 1943 cohort from 1997 to 1998, and so forth through the 1951 birth cohort in 2006.[4] By averaging across calendar years, we smooth out the effect of time-varying factors on awards during this period, including the effect of economic conditions. The result is the expected trajectory of SSDI awards by age, conditional on state and sex given average values over the period for all factors affecting the trajectory of a cohort's awards over the period.

[3] For ease of explication, we wrote equation 1 as if growth rates were calculated for whole year ages (for example, ages 50, 51, and so on). In fact, we calculated growth rates in monthly intervals (for example, ages 50, 50 and 1 month, 50 and 2 months, and so on).

[4] We calculated monthly growth rates relative to the total number of awards in the prior 12 months. Observed awards in 1996 serve as the base for award growth in January of 1997 and so on. The oldest cohort available in the DAF was born in 1938, so the counterfactual growth rates for ages 60 through FRA are based on fewer observations in the pre-recession period. For example, in a given state, we determined the average counterfactual award growth rate for 64 year-old females by averaging the observed growth rates in awards for the 1938 birth cohort from 2001 to 2002, the 1939 cohort in from 2002 to 2003, and so forth through the 1942 birth cohort in 2006.

Figure 3 shows an example of how the counterfactual series relates to observed awards in the period from 2008 to 2014 for all males in the United States who were born in 1965. In this example, if awards had grown at rates that match historical growth rates between 1996 and 2006, then awards would have increased monotonically through the period (as shown by the counterfactual series). In fact, observed awards exceeded awards predicted from historical trends between 2008 and 2010 and then fell below historical trends starting in 2011.

Figure 3. Observed and counterfactual awards for males born in 1965



B. Derivation of the business-cycle component

The business-cycle component of awards is the portion of observed awards, net of the counterfactual, that are explained by the business-cycle variables. To construct the business-cycle component, we estimated the relationship between the actual-counterfactual differences in each state and the state business-cycle characteristics. We did this using the regression model shown in equation 2. We estimated the parameters of this model separately for each sex and birth-year cohort in each of the 14 half-year periods from 2008 to 2014.[5]

$$(2) \qquad DD_{bbggssbb} = \alpha\alpha_{bbggbb} + \beta\beta_{bbggbb}{}'XX_{ss} + \varepsilon\varepsilon_{bbggssbb}$$

The dependent variable in our model, *D*, is the difference between observed awards and the counterfactual awards by birth year, sex, and state divided by the total number of awards for the same group in 2006; that is, it is the size of the difference in period *t* relative to the actual number of awards in 2006. The covariates included in the column vector *X* are the three business-cycle variables: the September 2007 employment rate, the magnitude of the decline in employment between September 2007 and December 2009, and the magnitude of the recovery to December 2016. States are weighted in the analysis by their share (by birth year and sex) of

[5] This amounts to 1,152 separate regressions for 45 birth year cohorts (1942 through 1986) and both sexes in 14 periods, excluding periods in which cohorts had attained full retirement age. We aggregated up from the monthly level to the six-month level to reduce processing time.

SSDI awards in 2006, the year before our analysis period; states with a larger SSDI awardee population receive greater weight in the analysis than states with fewer SSDI awards.[6]

The business-cycle component of awards is defined as awards in a given month that can be explained by the business-cycle variables. In our notation, the estimate of the business-cycle component for a given birth year, sex, state and period is shown in equation 3:

$$(3) \qquad BCC_{bgst} = \left(\hat{\beta}_{bgt}{}'X_s\right)A_{bgs\,2006}$$

where $\hat{\beta}_{bbbbb}$ is the column vector of the estimated business-cycle coefficients, and $AA_{bbbbbb2006}$ is the total number of 2006 awards in the state for the birth cohort and sex.

The estimated intercept parameter, α_{bbbb}, captures the average effect of factors not accounted for by either the business cycle or by the effect of aging that is common to both the actual and counterfactual series. To construct an estimate of the awards attributable to other factors in levels by birth cohort, sex, and state, we scaled the estimate of the intercept by the number of awards in 2006 for the birth cohort, sex, and state.

We test two hypotheses. The first hypothesis is that there is no relationship between the business cycle and awards, H_o: $\beta\beta_{bbbbbb}{}' = 0$. The second hypothesis is that award growth not attributable to the common effect of aging across cohorts is solely due to the business cycle, H_o: $\alpha\alpha_{bbbbbb} = 0$.

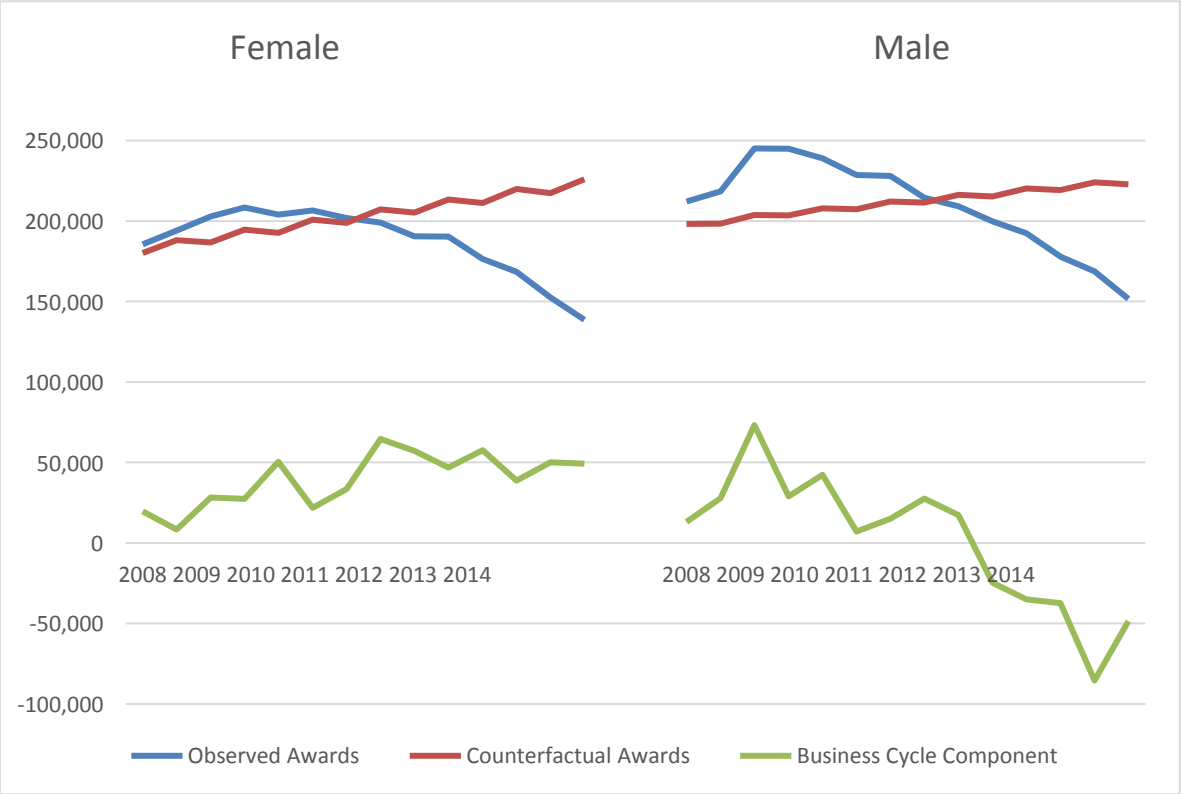
[6] One reason for weighting is to improve the fit of national projections, which give greater weight to the larger states. Another reason is that state-level awards are essentially group averages for all workers within the relevant state population, so variance in a statistic attributable to the idiosyncratic behavior of individuals is inversely proportional to the number of workers. For such data, weighting reduces the standard errors of the coefficient estimates (Prais and Atchison 1954).

V. RESULTS

A. Business-cycle effects by sex

Figure 4 shows observed awards, counterfactual awards, and the estimate of awards predicted by the business cycle with each series aggregated across birth year cohorts (1941 to 1986) separately by sex.[7] From 2008 to 2010, awards to both sexes were above the number predicted by the historical age profile of awards in the pre-recession period (shown by the counterfactual series) for both sexes, peaking in 2009. By 2012, awards for both sexes were below counterfactual awards, and they continued to fall relative to counterfactual awards through 2014.

Figure 4. Observed awards, counterfactual awards, and business-cycle component, 1941 to 1986 cohorts, by sex



Despite the similarities of the patterns in the actual and counterfactual series for females and males, there are marked differences in the estimated business-cycle components. The pattern of the business-cycle component for males is as anticipated: an increase in awards relative to the counterfactual early in the period followed by a decline later in the period. In fact, it appears that the business-cycle component explains much of the variation in awards relative to counterfactual awards for males throughout the period. For females, however, the estimated business-cycle

[7] We do not present tabular regression output given the large number of regressions. That output is available from the authors upon request.

effect does not peak until the latter half of 2012 and continues to stay at a high level through the end of 2014.

We do not fully understand the reasons for the differences in the business-cycle findings by sex. In what follows, we explore these differences further by examining findings by birth cohort groups and sex. One important feature of the counterfactuals for understanding sex differences is apparent upon closer examination of Figure 4: the female counterfactual series grows at a rate twice as large as the rate for males—25.5 percent for females from the first half of 2008 through the second half of 2014 versus 12.3 percent for males. This difference reflects factors that led to female-male differences in growth in awards from 1996 to 2006, the period on which the counterfactual series are based. One such factor is that the percentage of adult females who were disability insured (that is, met the work-history requirement for SSDI) grew substantially during this period relative to the corresponding percentage for adult males. This difference is apparent in SSA data for the number of disability-insured workers from 1996 to 2006. The number of female disability-insured workers increased by 18.1 percent over that period versus 10.7 percent for men. In contrast, female-male differences in disability insured growth rates from 2008 to 2014 were much smaller: 1.6 percent for females versus a reduction of 0.2 percent for males.[8] We also know that incidence rates—awards per disability-insured workers—were growing for females relative to males during this period, even after adjusting for age. For instance, based on Liebman (2015), the age-adjusted incidence rate for women grew by about 6 percent from 1995 to 2005, a period when the corresponding rate for men dropped by 7 percent.[9] The main point is that these female-male differences from the pre-recession period are built into the counterfactual projections.

B. Business-cycle effects and hypothesis tests by sex and birth-cohort group

Looking at the business-cycle component separately by sex and birth-cohort groups enables us to understand how the relationship between the business cycle and awards varies with age and sex during the recession. Figure 5 shows the business-cycle component separately by sex for five birth-cohort groups: 1941 to 1948, 1949 to 1959, 1960 to 1969, 1970 to 1979 and 1980 to 1986. We defined the oldest cohort group, 1941 to 1948, so that it contains the eight birth year cohorts that reach FRA during the sample period; awards for each cohort fall in the year in which they reach the FRA, and fall to zero in the following year. Ages for all cohorts in the other cohort groups are less than FRA through the end of 2014. Figure 6 summarizes the results of the hypothesis test that the coefficients for the business-cycle variables are jointly zero in each time period. Specifically, in each time period, Figure 6 shows the percentage of cohorts in the cohort group for whom the *p*-value of the joint test was less than 0.05.

[8] These statistics are based on the SSA table at https://www.ssa.gov/oact/STATS/table4c2DI.html, accessed on May 17, 2019. According to the table, there were 58,831,000 disability-insured females in 1996 and 69,462,000 in 2006. The corresponding numbers of for males are 70,282,000 and 77,791,000. The female-male differences in the growth of disability-insured workers reflect differences in the age distributions of the disability-insured female and male workers as well as female-male differences in changes in the percentage who are disability insured.

[9] The following estimates are from Figure 4 in Liebman (2015). The age-adjusted incidence rates for females in 1995 and 2005 were, respectively, 4.9 and 5.2 percent. The corresponding values for males were 5.9 and 5.5 percent.

Figure 5. Business-cycle component by sex and cohort group

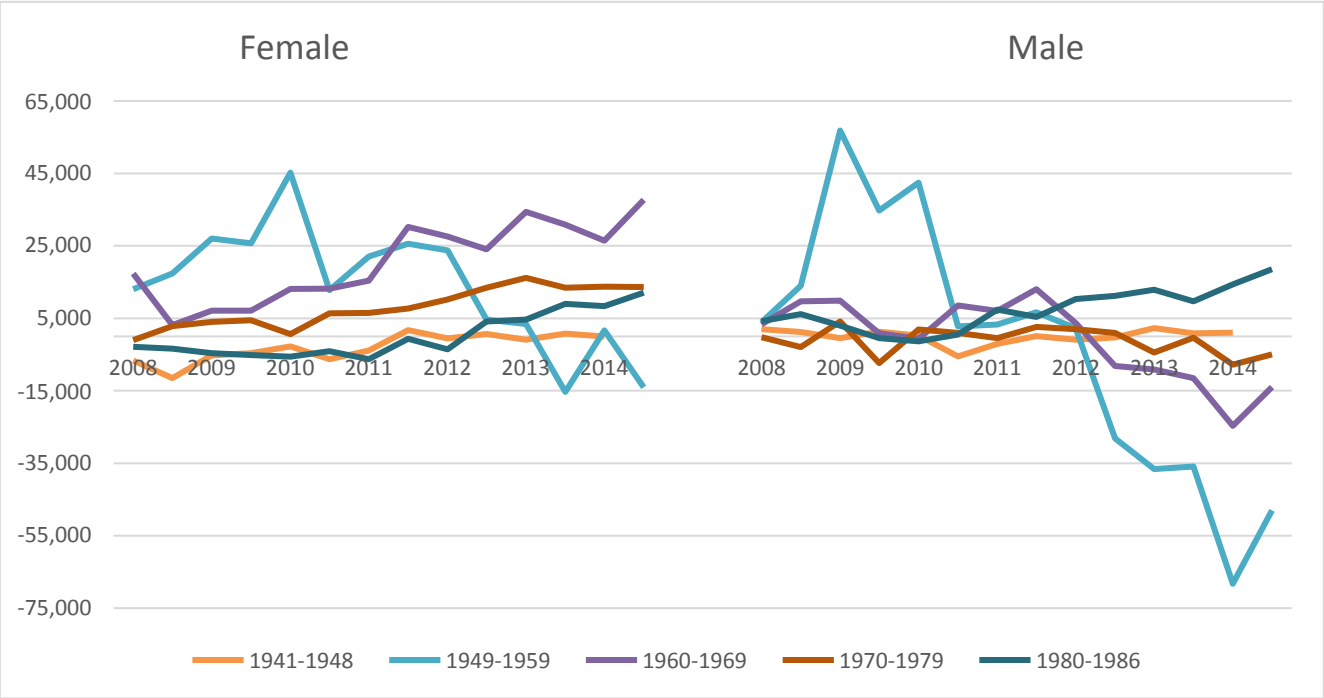
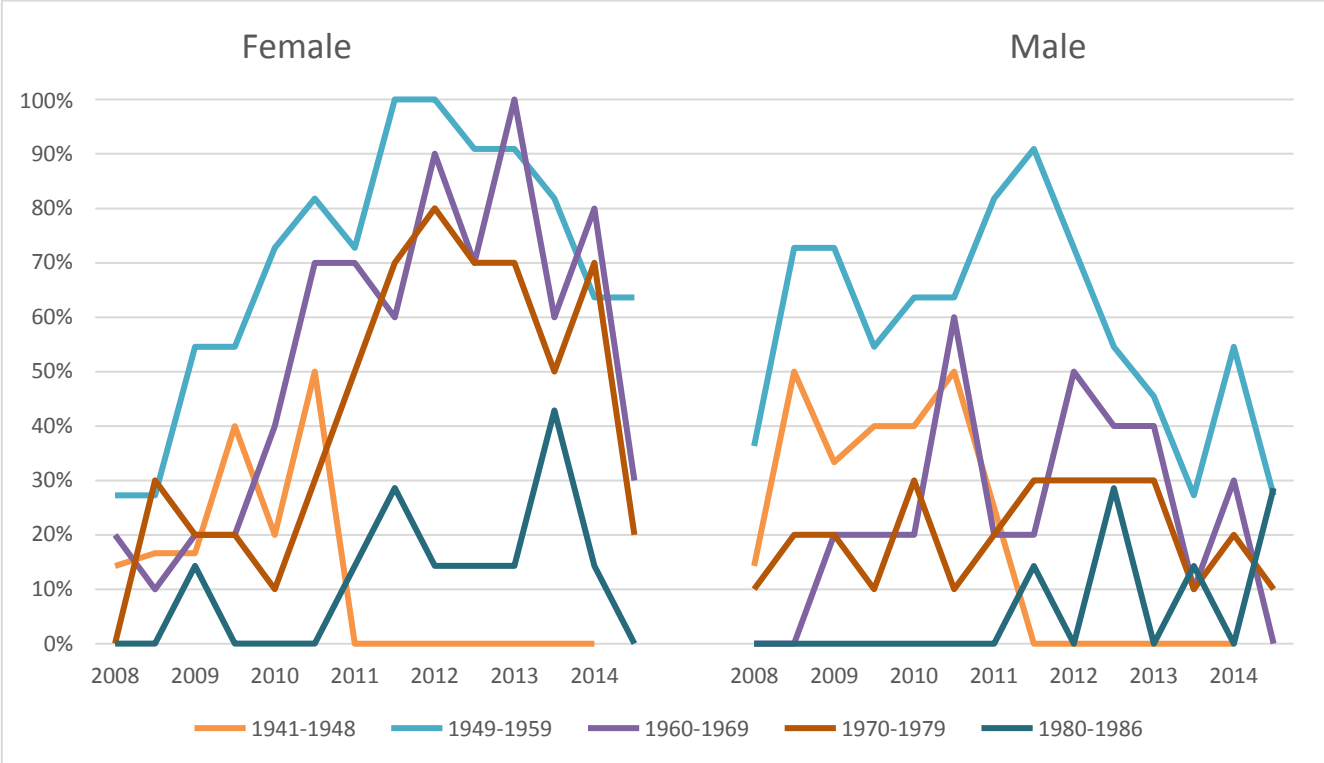


Figure 6. Percentage of cohorts with statistically significant business-cycle variables (at 5 percent significance)



For both sexes, the second oldest cohort group, born between 1949 and 1959, who attained ages 48 to 58 in 2008, the year of the largest decline in the employment rate, stands out as having the largest magnitude of positive awards attributed to the business cycle in the early years and the largest magnitude of negative awards in the later years (Figure 5). The size of the effects is more pronounced for males than for females, especially in the later years. Furthermore, as shown in Figure 6, the relationship between the business-cycle variables and awards is statistically significant more frequently for this cohort group than for the other groups. These results indicate an acceleration of awards to people in this age group from the later period to the earlier period. Between 2008 and the first half of 2012, the business-cycle variables predict an additional 212,097 awards relative to the counterfactual for females and 166,874 for males, whereas in the latter half of the period, the business-cycle variables predict a decrease in awards equal to 19,787 and 216,889 for females and males respectively. The net effect is an additional 192,310 awards for females and a decrease of 50,015 awards for males.

Males born between 1960 and 1969 (that is, those age 38 to 47 in 2008) show a similar pattern of shifting awards from later to earlier periods but to a lesser magnitude than for males in the 1949 to 1959 cohorts (Figure 5). The increase in awards through the first half of 2012, 55,148 awards, is offset by 67,550 fewer awards in the later period. In contrast, the business-cycle component for females born in 1960 to 1969 is positive and generally increasing throughout the period. Over the full period, there are a net additional 287,589 awards predicted relative to the counterfactual for females, the largest of any gender/cohort group. For this group of female cohorts, the relationship between the business-cycle variables and awards is statistically significant only slightly less frequently than for the 1949 to 1959 female cohort group.

The business-cycle component for the other cohort groups does not show evidence of shifting awards from later to earlier time periods (Figure 5). The oldest cohort group was born between 1941 and 1948 and were ages 58 to FRA during the sample period (the sample is shrinking over time within this group as cohorts reach their FRA). The estimated effect of the business cycle for both sexes in this cohort group is negative in the early years before converging to zero in later years. The estimated net effect of the business cycle on awards over the full period is a decrease of 39,673 for females and 520 for males in this cohort group.

The cohort group born in 1970 through 1979 attained ages 28 to 37 in 2008. The profiles of the business-cycle component for males and females born in these years differ (Figure 5). For females, awards attributed to the business cycle generally increase throughout the period with a net increase of 112,374 over the full period. For males, the business cycle fluctuates around zero for a net decrease of 16,440 over the full period. As shown in Figure 6, the business-cycle variables are more frequently statistically significant for females compared with males in this cohort group, particularly in the later years.

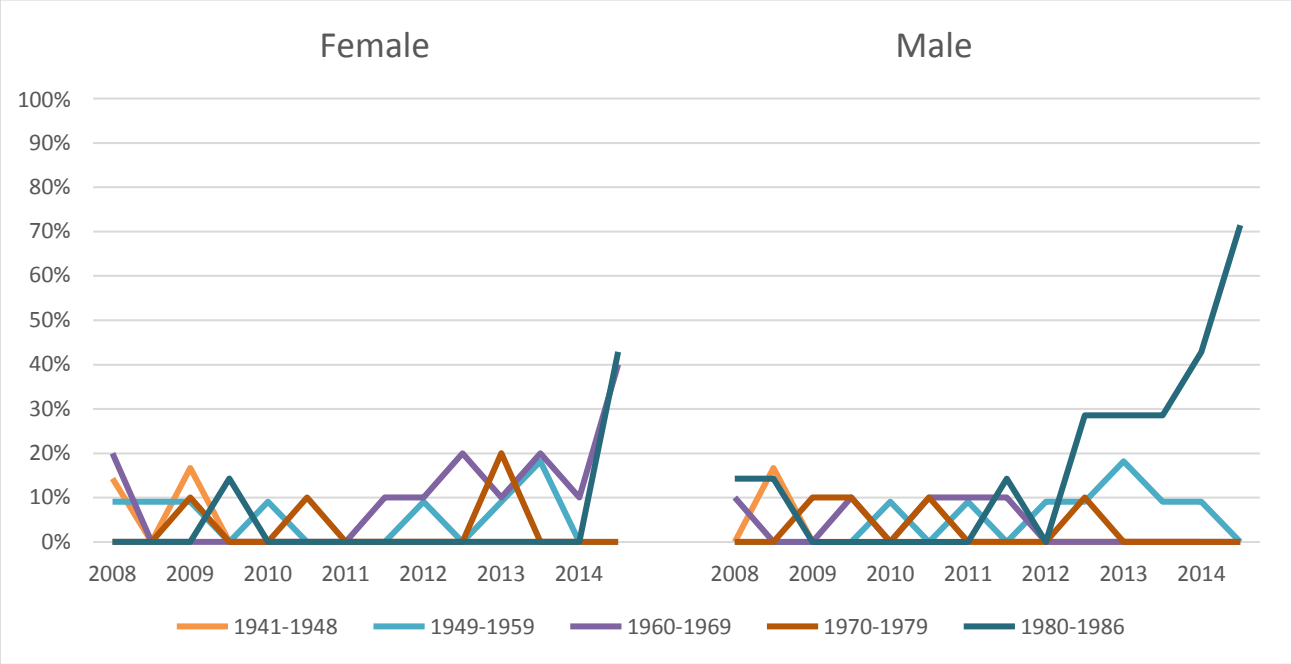
The youngest cohort groups' business-cycle components are centered around zero in the first half of the sample period and become positive in the latter half (Figure 5). These cohorts were born in 1980 to 1986 and attained ages 21 to 27 in 2008. The net awards attributed to the business cycle for females in these cohorts is a decrease of 1,405, whereas for males it is an increase of 101,427. The business-cycle variables are rarely statistically significant for the youngest cohort group in the early years and somewhat more frequently significant in the later years.

C. Test for the effects of other factors

The second hypothesis that we tested was whether the intercept of the regression model is statistically significantly different from zero. In other words, after controlling for the business-cycle variables and the common effects of aging for the actual and counterfactual series, are other factors associated with the deviation of observed awards from the counterfactual? Figure 7 shows the percentage of cohorts in each cohort group for which the *p*-value of the H_o: $\alpha\alpha_{bbbbbb} = 0$ test was less than 0.05.

Across all 14 time periods for each birth cohort and gender, the null was rejected in 5.8 percent of the tests, just slightly above the incidence of Type 1 error under the null hypothesis. The only marked deviations are for the males and females in the youngest birth-cohort group and females in the middle (1960 to 1969) cohort group; the percentage of rejections increases for each of these three cohort groups in 2014. The increase in the percentage of rejections for two of these groups appears to begin in 2012. The value of the estimated coefficients for each of these cohort groups is generally negative during these time periods, indicating that some factor is decreasing awards relative to the counterfactual.

Figure 7. Percentage of cohorts with statistically significant intercept (at 5 percent significance)

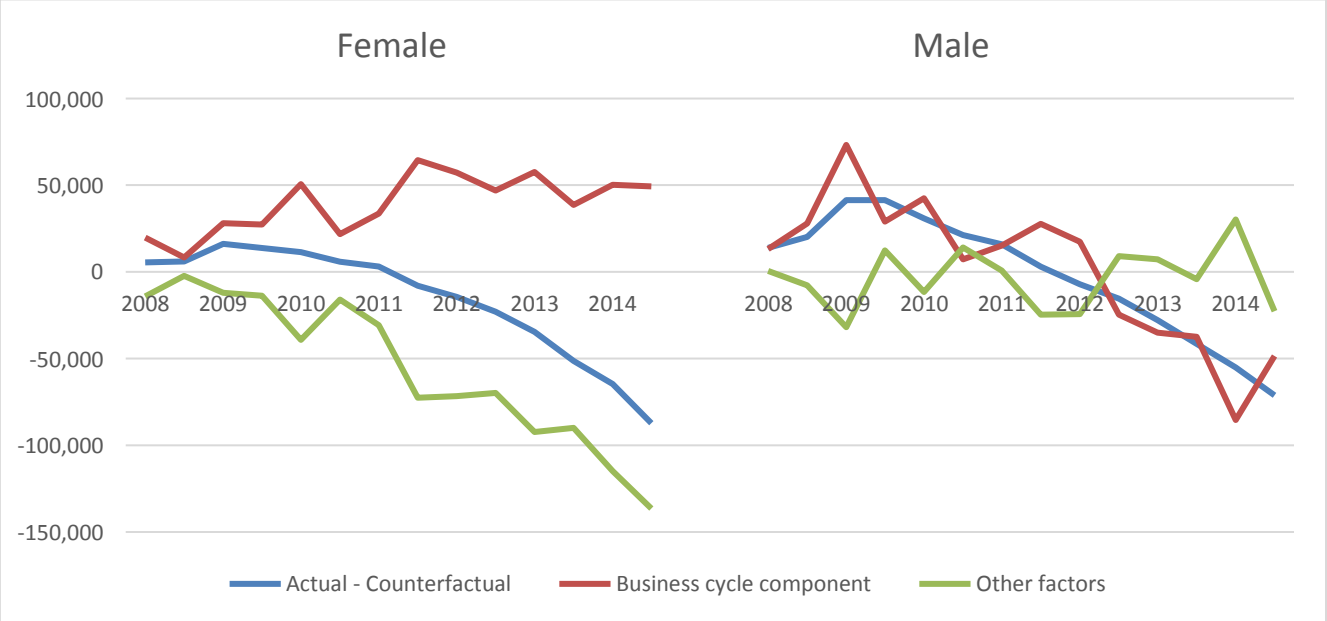


D. Differences in findings by sex

Based on the estimates, the relative contributions of (1) the business cycle and (2) all other factors are quite different for females and males (Figure 8). Consider the series for males first. The estimated business-cycle component appears to account well for the actual-counterfactual difference throughout the period. The residual estimate for the influence of other factors is

relatively small in every year and its sign switches back and forth. For females, however, the business cycle contributes positively to awards throughout the period, and especially from the second half of 2011 on. The observed decline in the difference between the actual and counterfactual after 2011 is attributed to other factors. Also, as shown in the appendix, the findings across all male cohorts mask differences across cohort birth-year groups in how well the business-cycle measure account for the observed pattern of awards. We consider the implications of these findings in the discussion section.

Figure 8. Decomposition of actual-counterfactual difference, by sex



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VI. DISCUSSION

Our goal for the cohort analysis is to better understand the extent to which accelerated entry into SSDI, attributable to the 2007–2009 recession, explains the rapid growth in awards during and immediately following the recession as well as the more recent decline in awards. We are especially interested in assessing whether the decline in the later years can be partly attributed to recession-induced acceleration of SSDI entry by workers who would have entered SSDI during the later period had the economy been stable. Negative estimates of business-cycle effects in the latter part of the period indicate the extent to which positive estimates early in the period represent accelerated entry. Estimates of recession-induced awards to a cohort in the early part of the period that exceed recession-induced reductions later in the period are presumably awards to workers who would not have otherwise entered SSDI before their FRA. We would expect the latter to be especially important for the oldest cohorts, who were already close to their FRA when the recession started.

The findings for all male cohorts combined suggest that the high growth in awards through 2010 and the large decline in awards from 2010 to the end of 2014 are fully accounted for by the Great Recession. As the male panel of Figure 8 shows, in the cohort model, the business cycle can essentially explain the entire pattern of awards relative to counterfactual awards from 2008 to 2014.

But this interpretation must be tempered by two other findings. First, the findings for females are quite different, showing that business-cycle impacts peaked later and continued to be positive through the end of 2014, implying that the decline in awards to females after 2009 is attributable to an unspecified set of other factors that more than offsets the positive business-cycle impacts. Second, the findings across all male cohorts mask differences across cohort birth-year groups in how well the business-cycle measure accounts for the observed pattern of awards.

The most apparent candidates for the other factors that reduced awards to females relative to the counterfactual are the factors that caused the counterfactual series for females to grow faster than the counterfactual series for males (see Figure 4). These factors caused sex differences in award growth during the period from 1996 to 2006. As pointed out earlier, the female counterfactual series increases by 25.5 percent from 2008 to 2014 versus 12.3 percent for males—13.2 percentage points higher.

As discussed, the proximate reason for female-male differences in the counterfactual projections is that they are based on a period during which awards to females were growing substantially relative to awards to males. As the years passed, younger female cohorts with relatively high labor force participation rates replaced older cohorts. The counterfactual projections assume that the female series would have continued to grow relative to the male series in the absence of the Great Recession. There are reasons to think, however, that relative growth in awards to females would have ended, or have at least declined, in the absence of the recession. One reason is that growth in the percentage of women who were disability insured appeared to have leveled off before the recession started, shortly after the female labor force participation rate had leveled off (Ben-Shalom et al. 2019). It is also possible that the age-adjusted SSDI incidence rate for disability-insured women, which grew substantially relative to the incidence rate for men in the decade before the Great Recession, would have leveled off in

the absence of the recession (see Liebman 2015, Figure 4). The female incidence rate had almost reached the level of the male rate by that point. It should be recognized, however, that the male rate is not a ceiling for the female rate.

Female-male differences in the counterfactual projections help account for the sex differences in the findings, but they may not fully explain them. Inspection of Figure 4 makes apparent that more moderate growth of the female counterfactual series, on a par with growth for males, implies that the actual series for females would have exceeded the revised counterfactual series by a larger amount and for more years in the early part of the period and would have dropped below the counterfactual series later and not by as much. Thus, had we developed a counterfactual series for females that grew at a rate more in line with the rate for males, at the aggregate level, the results for females would have been more on a par with those for males. That would not necessarily mean, however, that the estimated business-cycle effect for females would be negative in the latter half of the period as it is for males.

The findings across all male cohorts also mask differences across cohort birth-year groups in how well the business-cycle measure accounts for the observed pattern of male awards relative to counterfactual awards. As shown in the appendix, the business-cycle component appears to account well for the pattern of awards made to those born in the 1960s and 1970s; they were between 27 and 46 years old at the end of 2006. Business-cycle impacts for these groups are small relative to the total number of awards to males, however, because most awards are made to males older than age 50. Estimated business-cycle effects are largest for those in cohorts born between 1948 and 1959, who were ages 47 to 58 at the end of 2006. The estimated business-cycle effect for this group appears to be too extreme. More specifically, the business-cycle estimates are larger than the positive differences between actual and counterfactual awards in 2009 and 2010 and more negative than the negative difference in 2013 and 2014.

The business-cycle effects for the oldest and youngest male cohort groups are the least consistent with the aggregate findings. The oldest group, born between 1941 and 1948, were ages 58 to 65 by the end of 2006 and all had attained their FRA by the end of the period. This is an important group for the analysis; the number of SSDI awards to this group in 2007 was essentially the same as the number of awards to those in the second oldest group, born between 1949 and 1959. Actual minus counterfactual awards to this group did increase sharply in 2008 and 2009 before declining to zero by the end of the period, when all had reach their FRA. Surprisingly, the business-cycle variables do not account for this growth. As a result, the ability of the business-cycle model to account for growth in awards early in the period appears to be attributable to a fortuitous combination of over-predicting growth for those in the second oldest group and not predicting the growth for those in the oldest group. Awards to males in the youngest cohort group, born 1980 to 1986 and age 20 to 26 at the end of 2006, are low and relatively unimportant to the aggregate findings. The actual minus counterfactual series for this group follows the familiar pattern of being positive early in the period then becoming negative later in the period, but the estimated business-cycle effects do not fit that pattern well. As with the female business-cycle estimates, the estimates for the youngest male cohort imply that the recession continued to have a positive impact on awards through the end of 2014.

It may be that the estimates of positive business-cycle effects in the later years of the period for females, aggregated across all cohort groups, and for the youngest male cohort group are

artifacts of the methodology. But there is a mechanism through which the Great Recession's impacts on SSDI awards for some groups can be delayed for many years. People that experienced protracted difficulty firmly reestablishing themselves in the workforce during what remained a relatively weak economy throughout the entire period were also aging, and therefore increasingly likely to have a medical condition that would qualify them for SSDI—especially as they reached age thresholds in SSDI's medical-vocational criteria. They would have needed to earn enough to maintain disability-insured status—annual earnings of at least the amount needed to earn two quarters of coverage is sufficient for that purpose ($2,720 annually in 2019). Such people seem likely to find that SSDI benefits are attractive relative to their potential earnings, and as they age, they are more likely to qualify. These people seem likely to be more prevalent in groups that were relatively young at beginning of the recession. It is also possible that they are relatively prevalent among women of other ages, if they are more likely than men to reenter the labor force following an extended absence (for example, as children become more independent or following divorce).

Despite their anomalies, the findings demonstrate the potential of the cohort approach to improve our understanding of the effects of the business cycle on SSDI awards. Although the estimates of the business-cycle effects may not be as accurate as we would like, they clearly demonstrate that much of the pattern of the growth in male awards through 2010 and the subsequent unanticipated decline through 2014 may well be because of the Great Recession. Two factors likely contributed to the decline: (1) declines in the number of newly unemployed workers with medical conditions that might make them eligible for SSDI, and (2) accelerated awards, during the recession, to substantial numbers of workers who would have otherwise entered in the later period.

To further assess the value of the cohort approach, it is helpful to compare them with the findings from the most extensive and recent use of the more conventional pooled time-series approach. Maestas et al. (2018) used monthly state-level application data, not differentiated by age or sex, for 2006 to 2012. They regressed each application outcome (allowed or denied) on a distributed lag of unemployed workers per capita in the state, as well as state and month fixed effects. For applications, the authors found significantly positive coefficients on the contemporaneous value of the unemployment variable plus smaller, and also statistically significant, coefficients on the one-month lag as well as relatively small and negative coefficients on the third, fourth, and fifth lags (Maestas et al. 2018, Table 3). For awards, they found a large positive coefficient on the contemporaneous unemployment variable, a marginally significant positive coefficient on the one-month lag, and a marginally significant negative coefficient on the two-month lag. Based on these regressions, Maestas and colleagues concluded that the effect of the recession on awards through 2012, net of those induced to enter a few months early, is about 400,000, or about 8.9 percent of all entrants from 2008 to 2012. That amount is on the order, though somewhat less than the sum, across all female and males, of our estimates of the effect of the recession on awards from 2008 to 2012: 586,567 (358,248 for females and 228,319 for males).

The most striking difference in the two methodologies concerns the dynamics. Whereas the cohort approach explains much of the decline in awards to males after 2012 by the absence of awards to males who were induced to enter SSDI before 2012, the pooled time-series approach does not. More generally, the cohort methodology allows for dynamic effects on the scale of

many years—some laid-off workers first becoming entitled to awards only a few years after they lose their jobs and others obtaining SSDI awards many years earlier than they would have had the recession not occurred. In contrast, the pooled time-series approach allows for dynamic effects on the order of months.

VII. CONCLUSION

Much remains to be done to solidify our understanding of the dynamic effects of the Great Recession on SSDI awards. Our initial cohort analysis just scratches the surface of what promises to be a rich line of research. We have plans to address what we now see as limitations of our approach to constructing the counterfactual series, which seem especially important for women. In the future, we expect to produce estimates of business-cycle effects for cohorts that are not dependent on the counterfactual series. We also will explore options for improving the business-cycle specification. We note, for instance, that the state employment rate data are for both sexes combined, although national data show that employment rates for men were much more sensitive to the Great Recession than those for women. We will also consider options for smoothing the business-cycle effects across half-year periods; under the current methodology, effects for each half-year period are estimated independently of all other half-year periods. A similar statement applies to impacts across birth cohorts that are adjacent to each other.

SSDI award rates may have been influenced by changes in several other important factors over this period. Notable other factors include consolidation of SSA field offices (Deshpandi and Li 2017), changes in SSA quality assurance processes at the appeals level (Ray and Lubbers 2015; Maestas et al. 2015, 2018), implementation of the Affordable Care Act (ACA) (Anand et al. 2017), the opioid epidemic (Currie et al. 2018; Savych et al. 2018), expansion of telework opportunities and increased availability of work accommodations. To the extent that effects of changes in such factors are correlated across states with our business cycle measures, they may be confounding our estimated business cycle effects. State-level variation in the adoption of the ACA's Medicaid expansion and in field office consolidation might be especially important in this regard. Future work could potentially incorporate state-level measures of some of these factors.

Finally, it would be worthwhile to develop models that predict the path of awards several years into the future based on past data. The models we have estimated are not directly useful for that purpose because they use measures of the path of the economy over the full 10-year period to account for the path of awards over the same period; they assume the path of the economy in the last few years of the period provides information about the path of awards earlier in the period. This is sensible for our goal of understanding how much of the path of awards over the full period can be attributed to the Great Recession and recovery but not immediately helpful to actuaries and others interested in predicting future awards based on what we have observed in the past. Our findings for males suggest that, following a multi-year period of substantial, recession-induced awards, we should expect declines in awards for multiple years because of the recession-induced acceleration of awards to many workers who would otherwise have applied during those later years.

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APPENDIX A

DECOMPOSITION OF ACTUAL-COUNTERFACTUAL DIFFERENCE BY COHORT GROUP

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Figure A1. Decomposition of actual-counterfactual difference, 1941 to 1948 cohorts, by sex

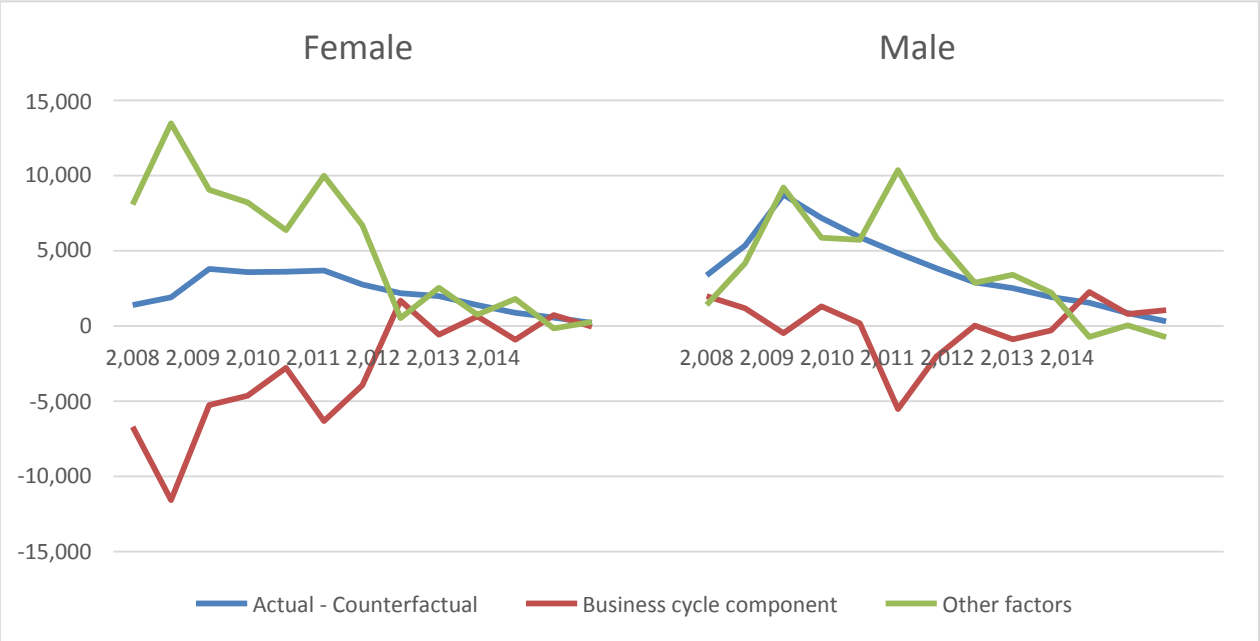


Figure A2. Decomposition of actual-counterfactual difference, 1949 to 1959 cohorts, by sex

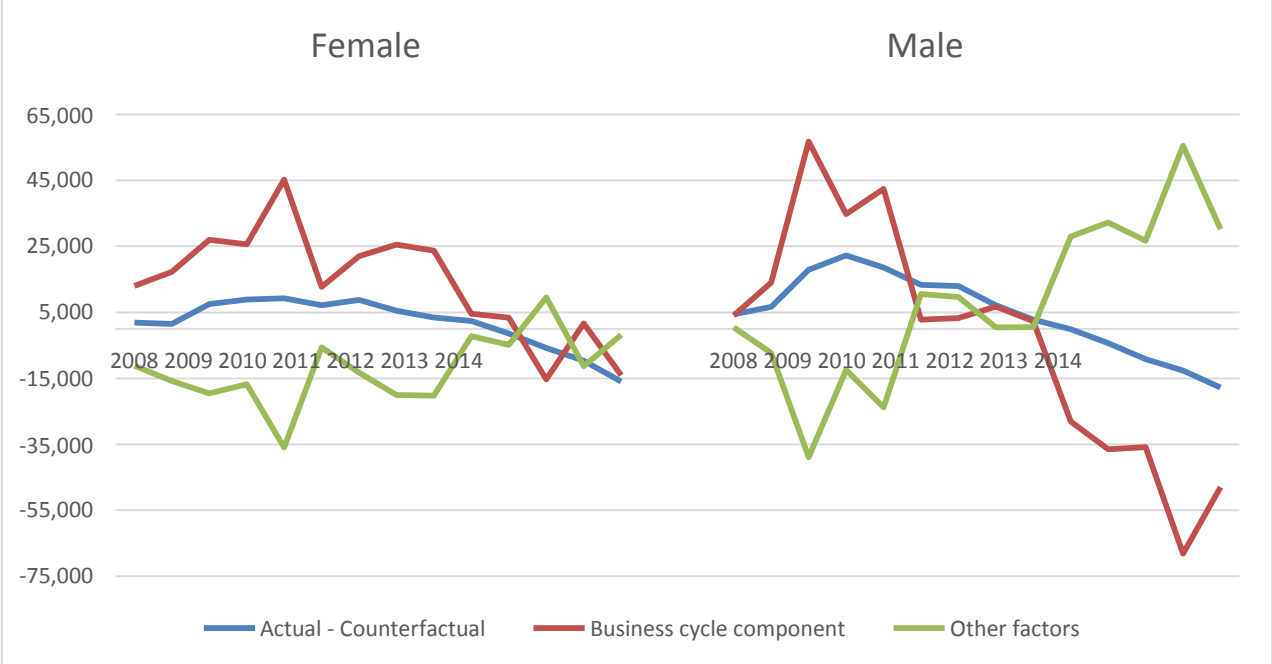


Figure A3. Decomposition of actual-counterfactual difference, 1960 to 1969 cohorts, by sex

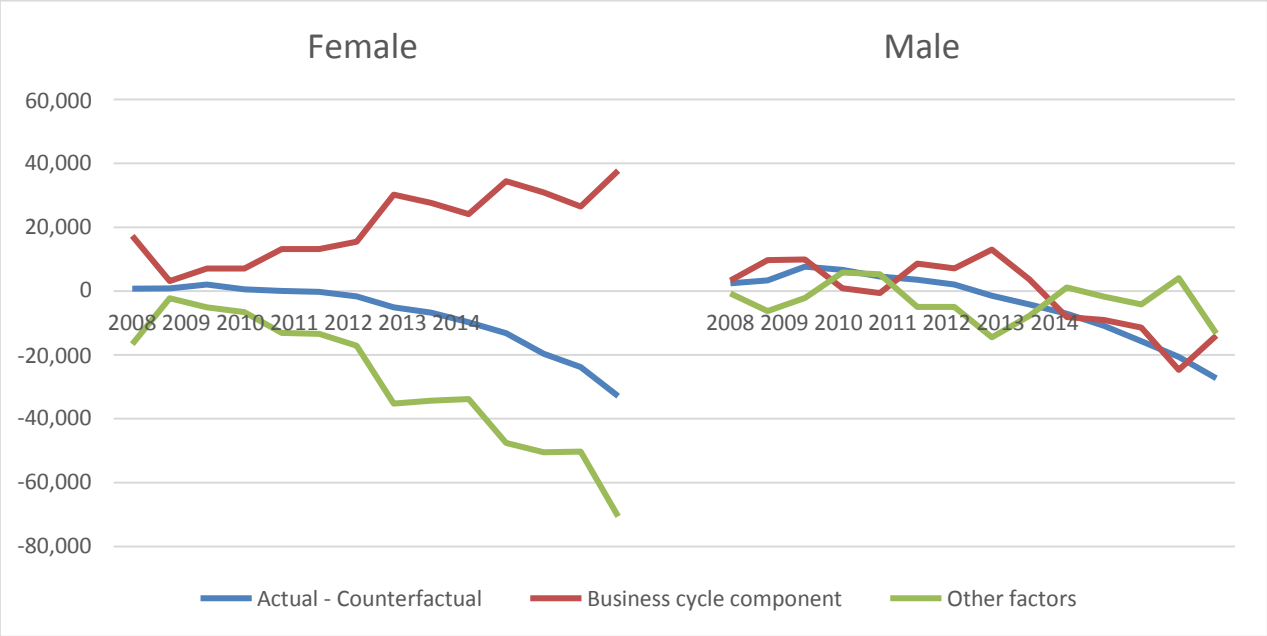


Figure A4. Decomposition of actual-counterfactual difference, 1970 to 1979 cohorts, by sex

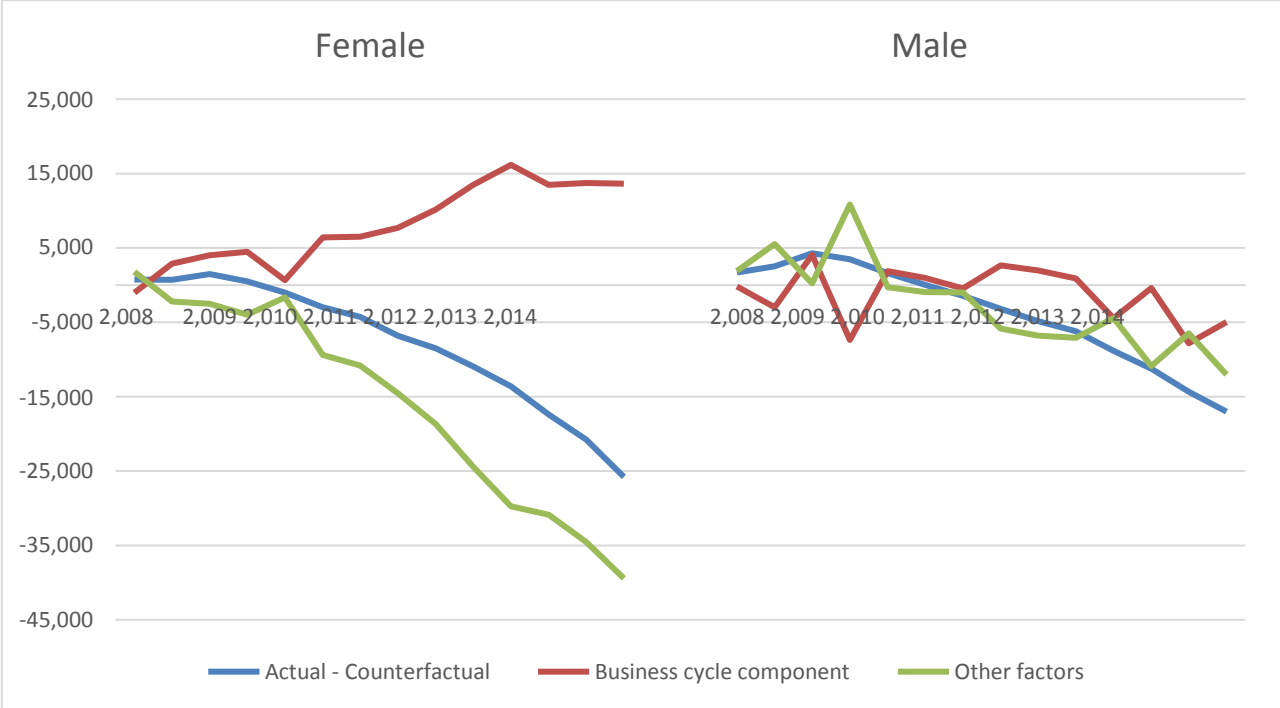
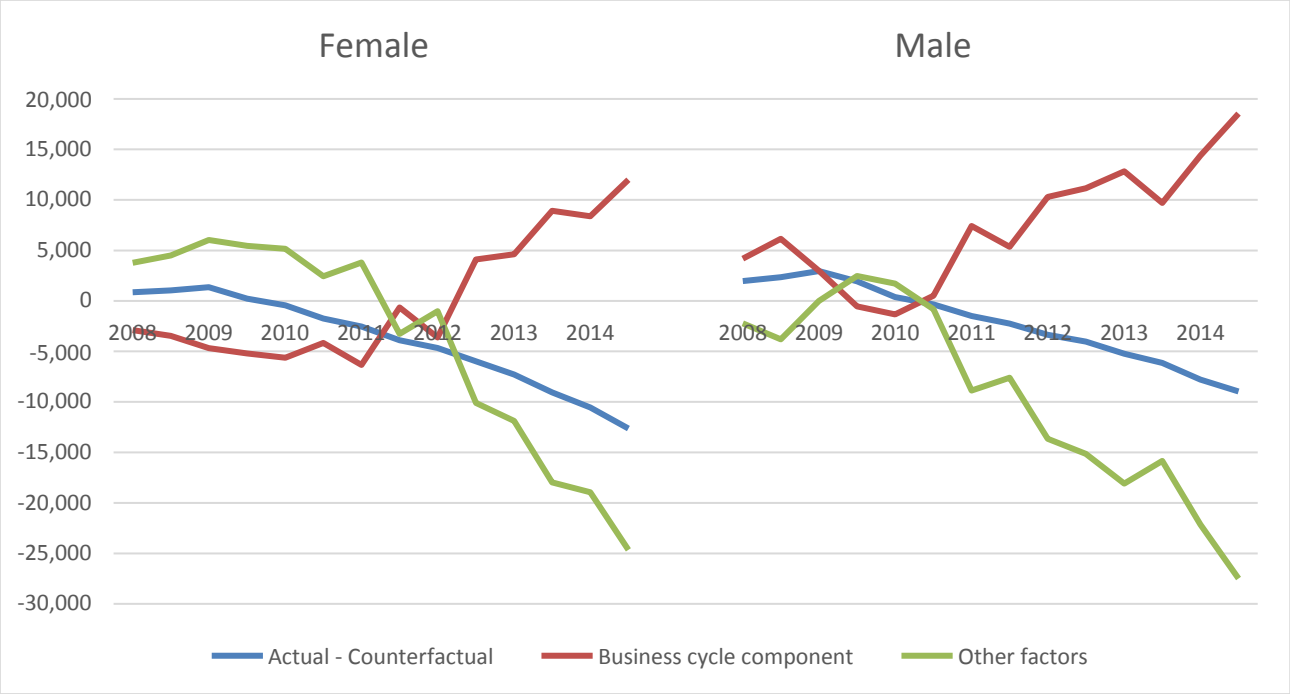


Figure A5. Decomposition of actual-counterfactual difference, 1980 to 1986

cohorts, by sex



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