The Effect of Pension Income on Elderly Earnings
Evidence from U.S. Social Security

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Notes

- Does not necessarily reflect the views of the U.S. Treasury or the Social Security Administration
Outline

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Policy Environment

Data

Graphical and Statistical Evidence

Income vs. Substitution Effects

Relationship to Krueger and Pischke

Conclusion
Effect of incentives on work decisions is a central question in public economics and labor economics.

Effect of pensions on work decisions of elderly is a key context for studying this question.

We study U.S. Social Security (Old Age and Survivors Insurance, OASI).

- Single largest U.S. federal program: $776.4 billion in 2016
- ~20 percent of U.S. federal government spending
Introduction

Background

- OASI could be major determinant of elderly work decisions in U.S.
  - Suggestive correlations over time (e.g. Coile and Gruber 2007, Blau and Goodstein 2010)
    - Elderly employment rate fell from 26.6 percent in 1950 to 11.2 percent in 1985 (larger for men than women, similar in many other OECD countries)
    - Over that period real median OASI benefit rose from $4,846.68 to $12,097.16
    - Replacement rate also rose from 18.9 percent to 41.5 percent for average earner (Klingman, Burkhalter, and Chaplain 2014)
  - Correlations over time potentially confounded by other factors changing over time
    - Employment rate influenced by many factors other than OASI
    - Turn to microdata to estimate effects of OASI on work decisions
Examine OASI "Notch" created by 1977 Social Security Act amendments

- "Notch" cut average lifetime discounted individual benefits by ~$6,100 (~$500 per year, ~5 percent of average benefits) for individuals born in 1917 relative to those born in 1916 (including secondary/dual claimants)
- Also greatly reduced net incentive to earn more for those in 1917 cohort
- Often seen as one of cleanest settings for studying effects of pensions/OASI (Krueger and Pischke 1992; Engelhardt, Gruber, and Perry 2005; Snyder and Evans 2006)

Note: "notch" does not refer to budget set
Introduction

Key empirical strategy

- Each birth cohort year may face its own OASI benefit schedule
- Those born on or after Jan. 2, 1917 faced sharply different OASI benefit structure than those born before this date
  - Allows comparison of otherwise similar individuals who have sharply different OASI benefits because they are born one day earlier or later
  - To our knowledge, represents largest discontinuous change in OASI benefits of its kind
- Use SSA data on full U.S. population by exact date of birth
  - 24,619,604 observations on 724,106 individuals in relevant DOB range
- Regression Discontinuity Design examines whether this causes discontinuity in earnings, probability of positive earnings
  - No discontinuity in outcomes in placebo samples
  - Robustness to controls, bandwidth, specification of running variable, using other samples to address potential threats to validity
Variation created by the Notch more generally useful in understanding determinants of earnings decisions of elderly, effects of pensions, and effects of OASI

- Setting with large, clean variation for studying such issues and accurate, large administrative dataset

- 1977 amendments important to understand in their own right
  - One of major historical changes in OASI policy
  - Potential to cause substantial changes in work behavior that could help explain time series patterns
Follows large existing body of work on effects of OASI, other pensions, and other retirement income on elderly work in the U.S.

- See the literature review in Blundell, French, and Tetlow (2016)

- Gruber and Wise (1999, 2004) conclude using evidence from the U.S. and around the world that (old age) Social Security often reduces incentive to work and therefore reduces work substantially
Introduction

Contribution

- Our most salient new finding: clear, very large income effects on earnings in a modern elderly pension program
  - Others have found evidence for income effects in OASI under parametric restrictions (e.g. Coile and Gruber 2007), but usually of modest size
  - Costa (1995, 2010) finds very large income effects of Union Army pensions
  - Fetter and Lockwood (2016) find large income effects of Old Age Assistance near beginning of 20th century
  - Brown, Coile, and Weisbenner (2010) find large inheritance wealth effects on retirement

- Under further assumptions, find that substitution elasticities are at most small in our context
  - Contrasts with emphasis of Gruber and Wise (1999, 2004) on substitution effects
Introduction

Contribution

- Krueger and Pischke (1992, “KP”) started economics literature on Notch
  - Use CPS data and variation across birth years in OASI benefits and LFP
  - Correlating OASI benefits and LFP across birth years, find no evidence that Notch change in OASI benefits affected elderly male labor force participation
  - Do not explicitly examine earnings impacts
- We use different data and identification strategy
  - Use data on full U.S. population, both men and women
  - RDD strategy using data at date of birth level
  - Come to seemingly divergent conclusions for men
    - We find moderate participation response that corresponds to very large earnings crowdout
  - Show that using similar sample and specification in our data, we estimate similar results to KP
  - Our view: KP was executed as well as allowed by the data available, underpowered
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Social Security Notch: Policy Environment and Brief History

- OASI Early Retirement Age 62, Normal Retirement Age 65 for 1916 and 1917 cohorts
- OASI benefit based on Primary Insurance Amount (PIA)
- Prior to 1977 Social Security Amendments, PIA was increasing and generally progressive function of Average Monthly Wage (AMW)
- AMW calculated as mean nominal lifetime monthly earnings in highest-earning years
  - No indexation of earnings for inflation
Social Security Notch: Key Policy Changes

- 1972 Social Security Amendments indexed PIA to Consumer Price Index (CPI) ("double indexation"), adjusted in each year
- PIA increased with inflation due to two factors:
  - 1) PIA indexed to CPI; clearly increased from inflation
  - 2) PIA depended on AMW; increased when inflation increased earnings
- Amid high inflation of 1970s, double indexation led to sharp increases in OASI benefits over time
- 1977 Social Security Amendments addressed this fast benefit growth
  - Bipartisan act signed into law December 20, 1977
  - DOB discontinuity could not have been anticipated until earlier in 1977
    - Mostly exclude 1977 from analysis because expectations unclear
- 1922 and later cohorts: PIA depends on Average Indexed Monthly Earnings (AIME)
  - AIME in turn depends on wages indexed for wage growth
Social Security Notch: Key Policy Changes

- Under 1977 Amendments, 1917-1921 cohorts faced “transitional guarantee,” which gave beneficiaries the greater of:
  - 1) Benefits based on AIME formula
  - 2) Benefits based on AMW, but modified:
    - (i) earnings in calendar years after age 61 not used to calculate AMW
    - (ii) after 1978, no CPI adjustment of benefits until calendar year of turning age 62

- Majority of 1917 cohort was covered under #2
  - Because of (i), income effect: mean yearly benefit amounts cut over $500 from 1916 cohort to 1917 cohort
  - Also because of (i), substitution effect: substantially smaller average incentive to earn more after age 61 in 1917 cohort than 1916 cohort
    - Earnings after 61 irrelevant to PIA under modified AMW calculation
    - Average 21 percent decrease in net returns to pre-tax, pre-transfer earnings in 1979 and after, in 1917 cohort relative to 1916 cohort
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- Income vs. Substitution Effects
- Relationship to Krueger and Pischke
- Conclusion
Data

- Social Security administrative data on universe of U.S. earnings records in 1916 and 1917 cohorts
- Complete yearly W-2 FICA earnings history beginning in 1951
  - Earnings observed in each calendar year
  - Exclude self-employment earnings (subject to manipulation)
  - Similar results when use un-capped earnings that starts in 1978
- Key variables: earnings, date of birth (DOB), OASI benefits, month when claiming began, gender
  - OASI benefits calculated using many OASI rules
  - Important to use DOB-level data because more aggregate data (e.g. quarterly) could be confounded by unrelated seasonal variation in outcomes (Buckles and Hungerman 2013)
Data

Key outcomes: earnings, participation

- Main focus on earnings
  - Can be relevant to effects on government budget (which we estimate), welfare (Chetty 2009)
  - “Participation”: probability of positive earnings
    - Different than labor force participation in CPS

- Standard in recent public finance literature, e.g. Saez (2010), to study determination of earnings rather than hours worked
  - Earnings, not hours worked, observed in these and other administrative data
  - Makes sense if human capital/MPL smooth through boundary
Data

- After death, earnings and participation set to zero
- All dollar amounts in 2012 terms
- Where relevant, discount earnings and benefits at 3 percent real rate
  - Estimates in same range between 1 and 5 percent
  - Discounted version relevant for effects on government budget
- Measure pre-tax benefits and earnings
  - SS benefits generally not taxed here (and can’t measure tax rate)
  - Pre-tax benefits answer policy-relevant question
- Dropped: never have positive earnings, claim OASI, or die pre-1977
- Pass McCrary test
  - Jan. 1 DOBs can be misreported in the data, Jan. 2 birthdays have different incentives to claim (Kopczuk and Song 2008)
  - Results robust to removing Jan. 1 and surrounding few days
  - Look at placebo years and samples
Data and Interpretation

- Calonico, Cattaneo, and Titiunik (2014) bandwidth for discounted earnings: 56 days of birth
  - Similar results with cross-validation (68)
- Figures show seven 10-DOB bins around 1916/17 cohort boundary
  - Visual patterns robust to other bin sizes
- Pool men and women for main analysis
  - Also separately investigate men and women
  - Women typically claim as secondary or dual in 1916-1917 cohorts
    - Secondary/dual wives’ total benefits determined by husband’s DOB
    - For substantial majority of women, no discontinuity in woman’s benefit when moving from woman’s DOB in 1916 to woman’s DOB in 1917
- Cannot investigate GE effects with our RDD
- Estimate responses net of frictions
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Graphical and Statistical Evidence

Mean Cumulative Discounted OASI Benefits 1978 to 2012 (Ages 61 to 95), by 10-day DOB Bin

![Graph showing mean cumulative discounted OASI benefits for different date of birth bins.]
Graphical and Statistical Evidence

Mean Number of Individuals per DOB, by DOB Bin
Graphical and Statistical Evidence

Other Predetermined Characteristics

- Insignificant jump in number of observations at cohort boundary
  - Regress # obs on 1917 cohort dummy, linear DOB trend, and interaction of trend with 1917 dummy ($p=0.40$)

- Other predetermined characteristics also show insignificant jump:
  - Fraction white
  - Fraction male
Mean Discounted Earnings 1978 to 2012 (Ages 61 to 95),
by DOB Bin
Initial Regression Specification

\[ E_{jPDV} = \beta_1 D_j + \beta_2 DOB_j + \beta_3 (D \times DOB)_j + \epsilon_j \]

- \( j \) indexes DOB; \( E_j \) mean PDV earnings 1978 to 2012; \( D_j \) dummy for being born on or after Jan. 2, 1917; \( DOB_j \) linear trend in DOB; \( (D \times DOB)_j \) interaction between \( D \) and \( DOB \)
  - Regression weighted by number of observations on each DOB
  - Documents magnitude and statistical significance of jump in earnings
    - Not intended to estimate a parameter relevant to individuals’ decisions
  - Use means at DOB level to estimate “conservative” standard errors
    - Paper analyzes data at DOB vs. individual level
    - Use robust standard errors
  - Many other factors could have affected earnings
    - RDD assumes they affect earnings smoothly through cohort boundary
  - Following figure shows \( \beta_1 \) and confidence interval, for each bandwidth from 20 days of birth to 100, measured in days
Robust to controls for demographics and/or quadratic polynomial

Effect at CCT bandwidth (56): $3,766.01 (858.30)***
Extensive Margin: Mean by DOB Bin, Percent of Years with Positive Earnings from 1978 to 2012

- Paper discusses individual-level model: would allow duration model but weights data differently; “unretirement” (Maestas 2010)
- Intensive margin positive and insignificant, but selection problem
No significant discontinuity in 1978
No significant discontinuity in 1978
Robustness (see paper)

- Coefficient maximized at actual cohort boundary rather than placebo boundaries
- Effects do not show up at other cohort boundaries
- Effects do not show up prior to OASI-eligible ages
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Next, we analyze income and substitution effects.

Results so far show income effect “outweighs” substitution effect.

- Substitution effect pushes toward decrease in earnings, whereas income effect pushes toward increase in earnings at cohort boundary.

To go further, need a framework.

- To start, specify simple lifecycle framework.
  - Use as illustrative benchmark.
  - Consider alternative frameworks later.

Income vs. Substitution Effects

Lifecycle Framework

\[
\max U_{ijt} = U_{ij}(U^t_{ijt}(C_{ijt}, E_{ijt}, X_{ijt}, Z_{ijt}), \ldots U^T_{ijt}(C_{ijT}, E_{ijT}, X_{ijT}, Z_{ijT}))
\]

s.t. \( A_{ijt+1} = (1 + r_{t+1})(A_{ijt} + B_{ijt} + E_{ijt}(1 + \mu_{ijt} - \tau_{ijt}) - C_{ijt} + R_{ijt}) \)

- Earnings function of MU of wealth \( \lambda_{ijt} \), implicit net-of-tax rate \( 1 + \mu_{ijt} - \tau_{ijt} \), other observed, unobserved factors \( X_{ijt}, Z_{ijt} \):

\[
E_{ijt} = L(\lambda_{ijt}, 1 + \mu_{ijt} - \tau_{ijt}, X_{ijt}, Z_{ijt})
\]

\[
\lambda_{ijt} = f(B_{ijPDV} + Y_{ijPDV}, X_{ijt}, Z_{ijt})
\]

- Parallel framework under uncertainty (assuming no borrowing constraints), but expectations matter instead

- Most parameterizations: cut in \( B_{ijt} \) nearer retirement causes larger yearly earnings response (e.g. Imbens, Rubin, and Sacerdote 2001; Mastrobuoni 2008)

  - Intuition: early-informed worker more fully smooths consumption and labor supply response over lifetime

  - Most relevant to effects of cuts near retirement
Initial Regressions: Lower Bound on Income Effect

- Assume in range of variables we investigate, mean earnings (unconditional on $Z_{ijt}$) expressed as:

$$\mathbb{E}(E_{ijt}) = \alpha(B_{ijPDV} + Y_{ijPDV}) + g(1 + \mu_{ijt} - \tau_{ijt}) + h(X_{ijt})$$

- Assuming $Y_{ijPDV}$, $\tau_{ijt}$, $X_{ijt}$ have continuous effects at boundary, can estimate 2SLS regression to estimate lower bound:

$$B_{jPDV} = \gamma_1 D_j + \gamma_2 DOB_j + \gamma_3 (D \times DOB)_j + \varepsilon_j$$

$$E_{jPDV} = \alpha_1 B_{jPDV} + \alpha_2 DOB_j + \alpha_3 (D \times DOB)_j + \eta_j$$

- Estimates LATE for those at cohort boundary

- Since theory tells us substitution effect weakly positive ($g'(\cdot) \geq 0$), (absolute value) $\alpha_1$ will be lower bound on (absolute value) income effect
  - $\alpha_1$ estimates income effect, assuming substitution effect is zero
  - Slutsky matrix negative semidefinite $\Rightarrow \alpha_1$ lower bound on income effect

- Central finding of the paper: lower bound very large $\Rightarrow$ income effects very large
### 2SLS Regression Estimates

<table>
<thead>
<tr>
<th></th>
<th>(1) Discounted Earnings, 1978-2012</th>
<th>(2) Percent of Years with Earnings &gt; 0, 1978-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_1$</td>
<td>-0.61 (0.17)***</td>
<td>-0.65 (0.17)***</td>
</tr>
</tbody>
</table>

- Participation coefficient scaled: yearly percentage point effect on employment of $10,000 increase in lifetime discounted OASI benefits
  - Similar results with log odds specification
- Similar results with demographic controls (and/or quadratic, simulated benefits; see paper)
  - Earnings: 0.63 (0.17)***; participation 0.67 (0.18)***
- With higher (lower) discount rate, crowdout estimate larger (smaller)
  - Ranges from 0.54 (0.15)*** with 1 percent discount rate to 0.69 (0.19)*** with 5 percent discount rate (see paper)
- Larger estimates for women rel. men, lower-income rel. higher
Intertemporal Substitution Elasticity

- Further assumptions yield intertemporal substitution elasticity
- Linearize earnings equation within range of variables we investigate:

\[ E(E_{ijt}) = \beta \lambda_{ijt} + \delta(1 + \mu_{ijt} - \tau_{ijt}) + \theta X_{ijt} \]

- Three periods of interest:
  - Calendar years before 1977 reform is anticipated
  - Calendar year 1978
    - Occurs after the 1977 reform is (anticipated and) passed but before individuals in 1917 cohort reach age 62 in 1979
    - Earnings should adjust immediately in 1978, because of immediate change in \( \lambda \)
  - Calendar year 1979 and after, when substitution effect should also operate for those born in 1917

- Can assume that exogenous factors approximately constant on average in adjacent calendar years, discount factor \( \kappa = 1/(1 + r_{t+1}) \), implying: \( \lambda_{j1978} \approx \lambda_{j1979} \); \( X_{j1978} \approx X_{j1979} \); \( \tau_{j1978} \approx \tau_{j1979} \)
  - Adjacent years hold other exogenous factors constant most credibly
Intertemporal Substitution Effect

\[
\begin{align*}
\mathbb{E}(E_{ij1978}) &= \beta \lambda_{ij1978} + \delta (1 + \mu_{ij1978} - \tau_{ij1978}) + \theta X_{ij1978} \\
\mathbb{E}(E_{ij1979}) &= \beta \lambda_{ij1979} + \delta (1 + \mu_{ij1979} - \tau_{ij1979}) + \theta X_{ij1979}
\end{align*}
\]

- Subtracting:
  \[
  \mathbb{E}(E_{j1979} - E_{j1978}) = \delta (\mu_{j1979} - \mu_{j1978})
  \]

- Use to estimate constant-MU-wealth intertemporal elasticity (i.e. holding \( \lambda \) constant): discontinuity in \( \Delta E_j \equiv E_{j1979} - E_{j1978} \) at cohort boundary proportional to discontinuity in \( \Delta \mu_j \equiv \mu_{j1979} - \mu_{j1978} \)

- Note: Stock and Wise (1990) find important to model option value of future work and later accruals of Social Security wealth
  - Makes it more striking to find small substitution incentive
    - Value of option to continue working also falls at discontinuity, so our estimates should over-estimate substitution incentive
  - Finding of no discontinuity in \( \Delta E_j \) at the cohort boundary is robust
  - Need to know future earnings probabilities to estimate S&W model
Substitution Incentive by Calendar Year and Birth Cohort for Those on AMW

<table>
<thead>
<tr>
<th></th>
<th>1916 cohort</th>
<th>1917 cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>$\mu_{j1978}$</td>
<td>$\mu_{j1978}$</td>
</tr>
<tr>
<td>1979</td>
<td>$\mu_{j1979}$</td>
<td>0</td>
</tr>
</tbody>
</table>

- Table considers *identical* individual (with identical earnings history) who is born in 1916 vs. 1917
- OASI benefits discontinuous across 1916/1917 cohort boundary in both 1978 and 1979
- Note: variation is differences-in-discontinuities
  - Not differences-in-differences
Thus, for each DOB $j$ near the 1916/1917 cohort boundary, we calculate $\Delta E_j$.

The following graph shows $\Delta E_j$ by DOB bin.

With non-zero substitution effect, would expect a downward jump in $\Delta E_j$ at the cohort boundary.

- With even modest substitution elasticity, should be very large (because of 21% change in substitution incentive).
- Example: with substitution elasticity of 0.25, should expect downward discontinuity in $\Delta E_j$ of $905$. 
Income vs. Substitution Effects

1979 Mean Earnings Minus 1978 Mean Earnings

- Insignificant discontinuity ($p=0.20$)
Intertemporal Substitution Elasticity

- Use Notch cohort dummy to instrument for $\Delta \mu_j$ in 2SLS regression:

$$\Delta \mu_j = \phi D_j + \phi_1 DOB_j + \phi_2 (D \times DOB)_j + \zeta_j$$

$$\Delta E_j = \delta \Delta \mu_i + \delta_1 DOB_j + \delta_2 (D \times DOB)_j + \eta_j$$

- Calculate $\mu$ for each individual in each year by calculating the marginal increase in lifetime discounted OASI benefits when earnings increase by $1$
## Implied Intertemporal Substitution Elasticities

<table>
<thead>
<tr>
<th></th>
<th>Earnings</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\hat{\varepsilon}$</td>
<td>-0.017</td>
<td>0.0033</td>
</tr>
<tr>
<td>(0.014)</td>
<td>(0.023)</td>
<td></td>
</tr>
</tbody>
</table>

- In baseline, 95 percent confidence interval on $\hat{\varepsilon} \left( = \hat{\delta} \frac{1 + \bar{\mu} - \bar{\tau}}{\bar{E}} \right)$ rules out earnings (participation) elasticity of 0.010 (0.048) or higher
  - Point estimate of $\hat{\varepsilon}$ negative for earnings $\rightarrow$ preferred estimate of income effect on earnings same as lower bound
  - Implied upper bound for earnings barely above lower bound (64 cents)
- Participation elasticity calculated with respect to net return to earning actual (or simulated) earnings rather than 0 in 1979 (and 1978)
- No significant effects (or differences) in high vs. low earnings groups
Lifecycle Framework with Myopia or Liquidity Constraints

- Time pattern of effects consistent with myopia or liquidity constraints: earnings in given year depends on benefits paid in that year
- Estimates insignificant when there is little-to-no discontinuity in benefits received (1978-1980, 1978)
  - Many individuals not claiming in these years
  - Benefits discontinuity emerged slowly as more years of earnings in 1979 and after accumulated
- Estimates become significant when discontinuity in benefits received increases (1981 and after)
- In our context, retirement-age individuals often have substantial assets and typically may not want to borrow since incomes falling
  - Could be surprising to find large liquidity effects
- Results consistent with myopia/learning about cuts in benefits only through experience (Diamond and Köszegi 2003, Kaplow 2015)
- Myopia (or lack of understanding) hypothesis is also consistent with the lack of a measured substitution effect
Discontinuity in benefits received in 1978-80 negligible: only $38
With myopia or liquidity constraints, earnings at time $t$ can depend on OASI transfers $B_t$ and substitution incentives at $t$: 

$$
\mathbb{E}(E_{ijt}) = \alpha (B_{ijt} + Y_{ijt}) + \beta (1 + \mu_{ijt} - \tau_{ijt}) + \gamma X_{ijt}
$$

Assuming $\tau_t$ and non-OASI unearned income $Y_t$ continuous through boundary, run this regression separately in each $t$:

$$
B_{jt} = \xi_1 D_j + \xi_2 DOB_j + \xi_3 (D \ast DOB)_j + \rho_{jt}
$$

$$
E_{jt} = \vartheta_1 B_{jt} + \vartheta_2 DOB_j + \vartheta_3 (D \ast DOB)_j + \eta_{jt}
$$

Alternatively, can pool across years:

$$
B_{jt} = (D_j \ast I_t) \omega_1 + (DOB_j \ast I_t) \omega_2 + (D_j \ast DOB_j \ast I_t) \omega_3 + I_t \omega + \nu_{jt}
$$

$$
E_{jt} = \chi_1 B_{jt} + (DOB_j \ast I_t) \chi_2 + (D_j \ast DOB_j \ast I_t) \chi_3 + I_t \chi + \nu_{jt}
$$

Interpret $\hat{\vartheta}_1$, $\hat{\chi}_1$ as lower bounds on (static) income effect
Effect of Yearly Benefits on Yearly Earnings: 2SLS Results

- Coefficient pooling all years (and controlling for year dummies): -0.46 (0.12)***
Coefficient: p.p. effect of $1,000 in annual benefits
Pooling all years (controlling for year dummies): -1.31 (0.33)***
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Consistency of Men’s Results with Krueger and Pischke

Findings

- When identifying using cross-cohort variation, both KP and we find no significant effect on men’s participation
- Our RDD estimates insignificantly different from KP’s estimate
  - Our RDD results for men 60-68 show elasticity of odds of participation with respect to OASI wealth of -0.66 (standard error 0.21, \( p < 0.01 \))
    - Note: LFP (KP) not directly comparable to probability of positive earnings (this paper)
- Cross-cohort empirical design underpowered to separate true effect from unrelated cross-cohort variation (Handwerker 2011)
- In our data, moderate effect on participation corresponds to large earnings crowdout
- Our view: KP was executed as well as allowed by the data available
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Conclusion

- Cut in OASI benefits for the 1917 cohort led to large increase in earnings
  - Both men and women
- Income effect very large
  - Lower bound point estimate: $1 increase in (discounted lifetime) benefits leads to 61-cent decrease in discounted earnings in lifecycle model, and 46-cent decrease in static model
    - Central finding of paper
    - Lower bound under broad range of lifecycle or static models
- Under further assumptions, maximum substitution elasticity 0.010
- Results consistent with static framework in which individuals respond to contemporaneous benefits
Implications for OASI Benefit Changes

- Assuming 25% federal MTR (and no taxation of benefits), $1 decrease in SS benefits would save government $1.12 on net in static model
  - Calculated MTR for ages 65+ using Taxsim from 1979 to 1994
  - OASDI Trust Fund alone would save $1.06
  - Relevant given Trustees projected exhaustion of OASDI Trust fund in 2034
  - $1.15 in lifecycle model

- PDV of OASDI Trust Fund 75-year unfunded obligation is $12.5 trillion → benefit cuts to eliminate 75-year deficit $713 billion smaller in PDV than if no behavioral effects

- One-year unanticipated increase in NRA causes increase in lifetime discounted earnings of $2,678 for beneficiary with average benefit
Conclusion

Historical perspective: OASI benefits and elderly employment rate
Conclusion

**Potential Implications for Time Series**

- **Illustrative calculation:** how much of decline we can account for
- Our point estimates suggest rise in mean OASI benefits from 1950 to 1985 could lead 65+ e-pop to decrease 8.9 pp
  - Mean annual OASI benefit rose by $7,250.49 from 1950 to 1985
- Accounts for 57.6 percent of actual decline
  - 65+ employment-to-population ratio decreased by 15.4 percentage points from 1950 to 1985
- Note stabilization in elderly (65+) employment-to-population ratio occurs in the mid-1980s
  - Does not match perfectly with year of 1977 amendments
  - But 1917 cohort reaches age 65 (thus included in 65+ data) in 1982
  - Timing of stabilization matches very well with years when RDD strategy shows big effect on participation
- In moving from micro estimates to implications for macro time series, calculations subject to important caveats: GE effects, spousal interactions, estimates local, *etc.*
  - Calculations illustrative of order of magnitude of potential implications
Conclusion

Generalizability

- Notch episode of great interest on its own
- Results do not imply that substitution effects also small in all other contexts
  - Substitution incentives complex to understand in this context
  - Could be larger in other contexts, *e.g.* when easier to understand
- Results do not imply income effects very large in all earnings or labor supply contexts
  - Elderly often on margin of retirement
  - Bigger effects in lifecycle model of policy change near retirement
  - Though if static model is correct, distinction is immaterial
- Results do demonstrate that opaque substitution incentives may have little effect, while income effects of pensions may be large
Other Results

- 1917/1918, 1918/1919, 1919/1920, 1920/1921: underpowered (including pooled)
- Similar results with discounted 1979-2012 earnings
- No conclusive evidence on age of claiming OASI
  - See Kopczuk and Song (2008)
- Similar results when exclude birthdays from December 30 to January 4 (or similar dates)
- Early indications suggest any mortality effect at most modest
Other Policies

- 1978 Age Discrimination in Employment Act (ADEA) amendment: discrimination (including mandatory retirement) prohibited up to age 65 (pre-1978), up to 70 (1978 and after)
  - No discontinuous effect around the 1916/1917 cohort boundary
  - 1916 and 1917 cohorts ages 65 to 70 in 1982 to 1987, all affected

- Mandatory schooling policies could imply that first quarter births discontinuously have lower schooling on average than fourth quarter births (Angrist and Krueger 1991)
  - Should push toward lower earnings in 1917 cohort, working against our later finding of large income effects
  - Would strengthen our conclusion that the lower bound on income effects is large
  - Three placebo tests to rule out discontinuity in other contexts
Issues our Strategy Does Not Attempt to Address

- Available data underpowered to estimate effect on consumption or savings
  - In theoretical framework we specify (lifecycle model or adding myopia), do not need consumption or asset data to estimate substitution effect or income effect
- We investigate how one spouse’s benefit affects *that* spouse’s earnings
  - Cannot assess how one spouse’s benefit affects other spouse’s earnings
  - Only observe linked spouses when one spouse claims on other spouse’s record
  - Claiming on spouse’s record endogenous
    - Higher husband benefit increases probability that wife claims on husband’s record, and vice versa
Intertemporal Substitution Elasticity

- Two presumptions appear consistent with data
  - First, strategy assumes individuals could react within a year
    - With very large change in substitution incentives, if there is response at all, might expect a measurable portion of it to appear in first year
    - Consistent with fast reaction in Gelber, Jones, and Sacks (2013)
  - Second, unanticipated inflation affected size of income effect
    - Could affect change in earnings from 1978 to 1979
    - If this is major driver of results, would expect to see discontinuity arise in $E_{j1979} - E_{j1978}$ at 1917/1918 cohort boundary
      - At 1917/1918 boundary, no change in substitution incentives from 1978 to 1979
      - No evidence of discontinuity in $E_{j1979} - E_{j1978}$ at 1917/1918 boundary
Spousal Benefits and Interpretation of Crowdout Estimates

- Secondary or dual-entitled: benefits determined by spouse’s record
- Affects interpretation of first stage and crowdout estimate
- Measure of OASI benefits calculated only for individual
- For husbands whose wives are secondary or dual-entitled, discontinuity in couple’s total benefits is 50 percent larger
- Our first stage corresponds to extreme case: husbands’ earnings not influenced by wives’ benefits, and vice versa
- Alternatively: “unitary” model, so total family income matters
  - Discontinuity in benefits in the first stage 30.2% larger for men (50% percent x 60.5% of men whose wife dual or secondary)
  - 2SLS estimates for full population 15% smaller (15=30.2%*53% of sample male) if spousal benefits taken into account
    - 30 percent smaller for men alone
    - Negligibly smaller for women alone
- Crowdout estimate we quote: shorthand for discussion above
Effect of Actual vs. Simulated Benefits

- Actual benefits could be endogenous
  - But very little endogeneity in 1917 cohort since earnings did not affect AMW
    - Possible channels: claiming, mortality, Earnings Test
- Also estimated effect of “simulated” benefit change
  - Simulated post-1977 earnings for both 1916 and 1917 cohort, using relationship in 1916 cohort between pre-1977 and post-1977 earnings
  - Used simulated earnings to calculate simulated benefit
- Effect of actual benefit vs. effect of simulated benefit
  - Different objects
  - Both of interest
- Effect of simulated benefit very similar to effect of actual benefit
  - *e.g.* earnings coefficient -0.58 and SE 0.15
Rationale for Empirical Strategy

- Alternative empirical strategies:
  - (1) Estimating at individual level, and/or...
  - (2) Estimating income and substitution effects in same regression
  - (3) Estimating using data from all ages

- Compare earnings discontinuity with discontinuity in incentives

- Re #1/2: could generate results with not-necessarily-useful weighting if response heterogeneous across groups and correlated with size of income or substitution incentive
  - Standard issue in DD: weighted average of responses across groups
    - Example: those with largest cut in OASI payments tend to have high earnings near retirement age, who could be more (less) responsive
    - Example: those with largest substitution incentives tend to have low lifetime income (pre-1977), who could be more or less responsive
  - Regressions at DOB-mean level weight individuals to estimate average effect on earnings for those at cohort boundary
    - Relevant e.g. to government revenue implications for those at boundary

- Re #3: *Same group across adjacent years* most comparable
Using Individual-Level Data

- Use discontinuity in benefit formula to drive regression estimates
- Step 1: Run regressions in the 1916 cohort to obtain fitted values $\hat{E}_{it}$ in both 1916 and 1917:

$$E_{jt} = \psi_0 + \psi_1 E_{ij1975} + \psi_2 E_{ij1975}^2 + \psi_3 E_{ij1976} + \psi_4 E_{ij1976}^2 + \epsilon_{ijt}$$

- Step 2: Calculate simulated benefits $B_{ijt}^{sim,T}$ by applying cohort $T$ benefit rules to $\hat{E}_{ijt}$ (adding random noise to $\hat{E}_{ijt}$)

- Step 3: For 1917 cohort, change in yearly benefit amount due to policy variation is: $\Delta B_{ijt}^{sim} = B_{ijt}^{sim,1917} - B_{ijt}^{sim,1916}$
  - $\Delta B_{ijt}^{act}$ is the difference under the actual earnings history

- Step 4: 2SLS, cluster by DOB

$$\Delta B_{ijPDV}^{act} = \alpha_0 + \alpha_1 \Delta B_{ijPDV}^{sim} + \alpha_2 DOB_j + \alpha_3 (D \times DOB)_j + \Gamma_t \alpha_4 + \epsilon_{ij}$$

$$E_{ijPDV} = \beta_0 + \beta_1 \Delta B_{ijPDV}^{act} + \beta_2 DOB_j + \beta_3 (D \times DOB)_j + \Gamma_t \beta_4 + \eta_{ij}$$
## Earnings Estimates using Individual-Level Data

<table>
<thead>
<tr>
<th>Earnings</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$</td>
<td>-0.63</td>
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<tr>
<td></td>
<td>(0.015)***</td>
</tr>
<tr>
<td></td>
<td>-2.67</td>
</tr>
<tr>
<td></td>
<td>(0.046)***</td>
</tr>
</tbody>
</table>

▶ Adding substitution effects reduces income effects insignificantly
  ▶ Substitution effects insignificant
Mean Age at Death
5-day bins
Mean Age of Initial OASI Claim