Default Options and Retirement Saving Dynamics

Taha Choukhmane

NBER (2019-2020), MIT Sloan (2020- )

September 2019
Motivation

- Key insight from behavioral economics: default options matter
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- High stakes setting: retirement savings plans

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Autoenrollment (AE) is affecting ~100 million people worldwide:
- NZ ('07), UK ('12), Turkey ('17): all private sector workers
- US: the majority of 401(k) plans already implements AE.
- 5 states are extending AE to workers without a 401(k)
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  5 states are extending AE to workers without a 401(k)
This Project

Many studies on AE short-run impact but long-run effect unknown:

Q: What is the effect of autoenrollment on **lifetime** savings and **welfare**?
This Project

Many studies on AE short-run impact but long-run effect unknown:

Q: What is the effect of autoenrollment on lifetime savings and welfare?

Challenge: no long-run data because AE is a recent policy

This paper:

1. Identify the mechanism through which AE affects behavior
2. Build and estimate a lifecycle model to study AE long-run effect
Outline

1 Three Facts about Autoenrollment

2 A Lifecycle Model with Default Effects
   - Model
   - Estimation

3 Results
   - Long-term effect
   - Optimal policies

4 Conclusion
Two Datasets

U.S. 401(k) Data:
- New proprietary dataset I obtained from a large US pension provider
- Monthly contributions, balances, and asset allocation for 4m workers btw. 2006-17

U.K. Nationally Representative Data:
- ASHE 2006-16: nationally representative 1% panel
- Follows workers across successive jobs
Three Facts about Autoenrollment

Two new facts:

**Fact I:** AE in current job ↓ saving in next job

**Fact II:** Increasing AE default ↓ participation

One known fact with a new interpretation:

**Fact III:** Median non-AE catch-up to AE over 3 yrs => small opt-out cost → large default effects... but heterogeneity matters
Fact 1: AE Reduced Saving in Next Job

Mandatory Autoenrollement for all U.K. private sector employees
Policy roll-out by employer size between 2012-2017

Identification:

\[ \beta = s_{1,j} - s_{2,j} \]

New hire 1
Treated Employer (subject to AE)
Previous employer j-1
New employer j
New Employer (AE or nonAE)

New hire 2
Untreated Employer
Year x Firm Fe
Fact 1: AE Reduced Saving in Next Job

AE reduced participation by 11% in next opt-in job!
Existing within-job estimates may overstate AE effect on lifetime savings

<table>
<thead>
<tr>
<th>Policy start date</th>
<th>Actual start date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012</td>
</tr>
</tbody>
</table>

Panel A - Participation rate

<table>
<thead>
<tr>
<th>AE to non-AE</th>
<th>-0.109**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.052)</td>
</tr>
<tr>
<td>AE to AE</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
</tr>
</tbody>
</table>

Panel B - Contribution in (% of pensionable pay)

<table>
<thead>
<tr>
<th>AE to non-AE</th>
<th>-0.472**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.185)</td>
</tr>
<tr>
<td>AE to AE</td>
<td>-0.048</td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
</tr>
</tbody>
</table>


Size$_{j-1}$ X Size$_j$ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Employer$_j$ X Year ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓

Robust standard errors clustered by current employer; *** p<0.01, ** p<0.05, * p<0.1

Sample: 22-60y & ≤1y tenure in ASHE 2006-17. Additional controls: total pay, previous total pay, tenure, previous
Fact 1: AE Reduced Saving in Next Job

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Existing within-job estimates may overstate AE effect on lifetime savings

<table>
<thead>
<tr>
<th>Policy start date</th>
<th>Actual 2012</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE to non-AE</td>
<td>-0.109**</td>
<td>0.073</td>
<td>0.022</td>
<td>-0.003</td>
<td>0.022</td>
<td>0.046</td>
<td>0.008</td>
<td>-0.056</td>
</tr>
</tbody>
</table>
<pre><code>              | (0.052)     | (0.062)| (0.041)| (0.055)| (0.054)| (0.066)| (0.055)| (0.073)|
</code></pre>
<p>| AE to AE          | 0.013       |      |      |      |      |      |      |      |
| (0.017)     |      |      |      |      |      |      |      |</p>

Panel A - Participation rate

Panel B - Contribution in (% of pensionable pay)

| AE to non-AE      | -0.472**    | 0.023| -0.092| 0.161| -0.123| 0.021| -0.234| -0.137|
|                  | (0.185)     | (0.219)| (0.173)| (0.489)| (0.214)| (0.224)| (0.213)| (0.300)|
| AE to AE          | -0.048      |      |      |      |      |      |      |      |
                  | (0.066)     |      |      |      |      |      |      |      |


Robust standard errors clustered by current employer; *** p<0.01, ** p<0.05, * p<0.1

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Three Facts about Autoenrollment

Two new facts:

Fact I: AE in current job ↓ savings in next job
⇒ need a model to extrapolate effect after many job switches

Fact II: Increasing the AE default ↓ participation
⇒ w/ an opt-out cost

One known facts w/ a new interpretation:

Fact III: Median non-AE catch-up to AE over 3yrs ...
⇒ opt-out cost is small ...
but heterogeneity matters
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Fact II: Increasing Default ↓ Participation

Compare workers hired before/after 86 U.S. firms increased their default

Example: 3% → 6%

Participation rate
(i.e. contributions > 0%)

Controls: plan, year, and age FEs, log tenure

Sample: 86 US 401k plans. 159,216 workers w/ ≤1y of tenure post grace-period
Fact II: Increasing Default ↓ Participation

Compare workers hired before/after 86 U.S. firms increased their default

Example: 3% → 6%

Participation rate
(i.e. contributions > 0%)

AE default increased by x% of salary

Controls: plan, year, and age FEs, log tenure

Sample: 86 US 401k plans. 159,216 workers w/ ≤1y of tenure post grace-period
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Nudging workers to contribute more w/ higher default ....

... led more to drop-out and contribute at the lowest rates!

Opt-out cost: fits this evidence
- Ex. worker prefered contribution rate 1%
- 3% default: stay at 3% (not worth bearing opt-out cost)
- 6% default: drop to 1% (far enough from prefered rate)

Other theories (loss aversion, anchoring): opposite prediction
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Fact III: Median non-AE Catch-up to AE

Workers hired in the 12 months before/after AE at 3% in 34 firms

Median worker

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<tr>
<th>Contrib. Stock (Cumul. employee contrib. % of salary)</th>
<th>Tenure (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>3%</td>
<td>12</td>
</tr>
<tr>
<td>6%</td>
<td>24</td>
</tr>
<tr>
<td>9%</td>
<td></td>
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- Tax benefit
- Generous employer match

Gains from switching:

Large opt-out cost:
- DellaVigna ('06,'18): min. $1,200
- Bernheim et al ('15): avg. $2,200
Fact III: Median non-AE Catch-up to AE

Workers hired in the 12 months before/after AE at 3% in 34 firms

![Median worker](chart)

- Opt-in
- 3% AE

Gains from switching:
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Workers hired in the 12 months before/after AE at 3% in 34 firms

![Graph showing contribution stock over tenure for median worker and opt-in versus static setting with 3% AE]

**Static setting**

**Gains from switching:**
- Tax benefit
- Generous employer match

⇒ **Large opt-out cost:**

DellaVigna ('06, '18): min. $1,200
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Workers hired in the 12 months before/after AE at 3% in 34 firms

Dynamic setting

Gains from switching:
- Tax benefit
- Generous employer match

⇒ Smaller opt-out cost:
   In a lifecycle model I estimate an opt-out cost of $250
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... but heterogeneity matters
In the short run: large treatment effects only at the bottom …

... will these savings increase persist in the long run?
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3 Results
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   - Optimal policies

4 Conclusion
The Model

I build and estimate a detailed lifecycle model with default effects.

- Features rich economic environment (8 state variables) ... 

1. **Assets**: realistic retirement account, liquid saving, and unsecured debt
2. **Labor market**: income and employment risk varies with age and tenure (SIPP data)
3. **Government**: progressive tax and benefit system (Social Security & UI)
4. **Demography**: mortality risk, and changing household composition over lifecycle
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- ... parsimonious specification of preferences (3 parameters):
  - **Time preferences:** standard (E.I.S. & exponential discount factor)
  - **Opt-out cost:** utility cost every time agent deviates from the default
Data and Estimation

Estimation Sample:
- 34 plans w/ a 50% match up to 6% and no autoescalation
- Workers hired in the 12 months before/after AE at 3%

Simulated Method of Moments results:

<table>
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<tr>
<th>Estimates (quarterly freq.)</th>
<th>EIS</th>
<th>disct. fact.</th>
<th>opt-out cost</th>
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<tr>
<td>( \sigma )</td>
<td>0.455</td>
<td>0.987</td>
<td>$254</td>
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<td>(0.013)</td>
<td></td>
<td>(0.001)</td>
<td>(11)</td>
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\[ \chi^2 \text{ stat. (41 df): 586} \]

Robustness:  Weighting Matrix  Opt-in only  AE only

Extensions:  Present Bias  Proportional Cost  Sensitivity:  Andrews, Gentzkow, Shapiro '17
Estimation Moments
Distribution of Contribution Rates

Employees in their 1st year of tenure

Opt-in (0% default)

Auto-enrollment (3% default)
Distribution of Contribution Rates

Employees in their 1st year of tenure

Opt-in (0% default)

Auto-enrollment (3% default)

Data Model
Evolution over Tenure

Participation - Opt-in

Participation - 3%

Share at the 3% default

Data
Evolution over Tenure

Participation - Opt-in

Participation - 3%

Share at the 3% default

Data

Model
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External validity

Why should we believe the model long-run predictions?

**Advantage of structural estimation:**
extrapolate to another policy, population, institutional setting, time-frame
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**Out-of-Sample validation I:** results
Model estimated using the introduction of AE at 3% ...
... predicts response to increasing the default
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Out-of-Sample validation I: results
Model estimated using the introduction of AE at 3% ...
... predicts response to increasing the default

Out-of-Sample validation II: results
Preference estimates from U.S. 401(k) plans ...
... predict the response to a national policy in the U.K.
AE ↑ Lifetime Savings at the Bottom

Typical AE policy at 3% adopted by all employers

![Graph showing the changes in lifetime savings relative to opt-in across different deciles of lifetime earnings.](image-url)
AE ↑ Lifetime Savings at the Bottom

Typical AE policy at 3% adopted by all employers

For most people: ↑ saving early-on ↓ saving later in life

BUT large effects at the bottom of the lifetime earnings distrib.
Optimal Policy

Planner selects default to maximize social welfare: (selected default adopted by all employers over a lifetime)

- can be more patient than individuals (paternalistic)
- can put more weight on low-income (inequality-averse) Saez '02
- treat only a fraction of opt-out cost as welfare relevant Goldin, Reck '18
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Subject to employers’ budget constraint:

Total profits + Wages + Matching costs = Constant
**Utilitarian Policymaker**

**Utilitarian** policymaker prefers the *opt-in regime* ...

Match and tax incentives ⇒ save more than implied by preference

AE shift cons. even more toward retirement ⇒ ↓ welfare

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<th>Wages adjustment</th>
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<td>Opt-in</td>
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<td>Opt-in</td>
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Proportional Cost  High Present Bias  Low Present Bias
Utilitarian Policymaker

Utilitarian lifetime utility decreases for most …

… but increases at the bottom (ex. 6% AE)
Inequality-Averse/Paternalistic Policymaker

**Inequality-averse** or **paternalistic** policymaker sets default near **match threshold**

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<td>AE 6%</td>
<td>AE 5%</td>
<td>AE 5%</td>
</tr>
<tr>
<td>Paternalistic</td>
<td>AE 6%</td>
<td>AE 6%</td>
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- **Proportional Cost**
- **High Present Bias**
- **Low Present Bias**
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Summary of my Findings

People catch up over time ...
- workers undo much of AE positive effect by saving less later on
- AE in current job causes workers to save less at their next opt-in job

... therefore, a $250 opt-out cost can explain default effect
- Not so costly to remain at default because can compensate late

AE increases lifetime welfare/savings only at the bottom
- optimal default is either 0% or employer match threshold
  (depends on social planner's preferences)
What have we learned

Life Cycle Hypothesis (LCH):

- AE effect seen as a major challenge to the LCH
- I show that w/ small friction LCH performs remarkably well
What have we learned II

Nudges:
- in a dynamic setting savings nudges are less effective ...
- ... but can still have important distributional effects
Supplementary Material I
Default Propensity by Age

Default contribution (i.e. 3%) conditional on participation

(source: Madrian, Shea '01)
## Robustness

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline model</th>
<th>(2) Full var-cov weighting matrix</th>
<th>(3) Opt-in workers only</th>
<th>(4) Autoenrolled workers only</th>
</tr>
</thead>
<tbody>
<tr>
<td>$k$</td>
<td>$254$ (11)</td>
<td>$268$ (17)</td>
<td>$340$ (29)</td>
<td>$258$ (11)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.987 (0.000)</td>
<td>0.987 (0.001)</td>
<td>0.988 (0.001)</td>
<td>0.987 (0.001)</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>0.455 (0.013)</td>
<td>0.444 (0.015)</td>
<td>0.454 (0.027)</td>
<td>0.426 (0.012)</td>
</tr>
<tr>
<td>$\chi^2$ stat.</td>
<td>586 (41)</td>
<td>583 (41)</td>
<td>414 (13)</td>
<td>131 (25)</td>
</tr>
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Discount factor ($\delta$)  
Elasticity of inter. subst. ($\sigma$)  
Opt-out cost ($k$)
## Roll-out of Autoenrollment in the UK

<table>
<thead>
<tr>
<th>Employer size</th>
<th>Policy staging date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>120,000+</td>
<td>October, 2012</td>
<td>2,000+</td>
<td>August, 2013</td>
<td>61+</td>
<td>August, 2014</td>
</tr>
<tr>
<td>50,000+</td>
<td>November, 2012</td>
<td>1,250+</td>
<td>September, 2013</td>
<td>60+</td>
<td>October, 2014</td>
</tr>
<tr>
<td>30,000+</td>
<td>January, 2013</td>
<td>800+</td>
<td>October, 2013</td>
<td>59+</td>
<td>November, 2014</td>
</tr>
<tr>
<td>20,000+</td>
<td>February, 2013</td>
<td>500+</td>
<td>November, 2013</td>
<td>58+</td>
<td>January, 2015</td>
</tr>
<tr>
<td>6,000+</td>
<td>April, 2013</td>
<td>250+</td>
<td>February, 2014</td>
<td>50+</td>
<td>April, 2015</td>
</tr>
<tr>
<td>4,100+</td>
<td>May, 2013</td>
<td>160+</td>
<td>April, 2014</td>
<td>40+</td>
<td>August, 2015</td>
</tr>
<tr>
<td>4,000+</td>
<td>June, 2013</td>
<td>90+</td>
<td>May, 2014</td>
<td>30+</td>
<td>October, 2015</td>
</tr>
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Roll-out of Autoenrollment in the UK

Eligible private sector employees 2009 to 2015

- 30,000+
- 6,000 to 29,999
- 350 to 5,999
- 160 to 349
- 58 to 159
- 50 to 57
- 5 to 49
- 1 to 4

Source: Figure 2 of Cribb and Emmerson (2016).
Default Mechanism

Other Mechanisms:

1. **Convex Adjustment**
   - **One-sided:** Temptation (Gul, Pesendorfer, '01) Loss aversion (Prelec, Loewenstein et al, '92)
   \[
   U(c|\gamma_{\text{def}}) = \begin{cases} 
   u_\gamma(c_t) & \text{if } \tau_{\gamma} \leq \gamma_{\text{def}} \\
   u_\gamma(c_t) - \alpha \left[ u_\gamma(\gamma_{\text{def}}) - u_\gamma(c) \right] & \text{if } \tau_{\gamma} > \gamma_{\text{def}}
   \end{cases}
   \]

   - **Two-sided:** anchoring (Bernheim et al, '15)

   * counterfactual prediction: \( \uparrow \) default \( \Rightarrow \) \( \uparrow \) participation

2. **Endorsement effects/ Default as advice:**
   - Large effects despite public randomization into AE (Blumenstock et al, '17)

3. **Unawareness:** employees may not be aware of AE
   - Text reminders have no effect on default effect (Blumenstock et al, '17)
   - No effect from a financial education intervention (Choi et al, '11)
Opt-out Cost

Opt-out cost model:

\[ V^S(d) = u \left( (1 - s)w - \mathbb{1}_{s \neq d} \cdot k \right) + \delta V(sw) \]

Assume \( u' > 0, \ u'' < 0 \) and \( V' > 0, \ V'' < 0 \)

**Proposition.** With an opt-out cost, increasing the default contribution rate from \( d \) to \( \bar{d} \) (weakly) increases contributions strictly below \( d \):
Loss Aversion

Loss aversion model:

\[
U(s, d) = \begin{cases} 
\mu_a(c_t(s)) + \eta (\mu_a(c_t(s)) - \mu_a(c_t(d))) & \text{if } s < d \\
\mu_a(c_t(s)) + \eta \lambda (\mu_a(c_t(s)) - \mu_a(c_t(d))) & \text{if } s \geq d
\end{cases}
\]

where \( c(s) \) is the optimized consumption policy:

\[
c_t(s) = \arg \max (1 + \eta) \mu_a(c_t) + \beta (1 - m_a) \mathbb{E}_t (V_{t+1}(s))
\]

Proposition. Under loss-averse preferences, increasing the default contribution rate from \( d \) to \( \bar{d} \) (weakly) decreases contributions strictly below \( d \):

\[
Pr(s^* < d \mid d = d) \leq Pr(s^* < d \mid d = \bar{d})
\]
Psychological Anchoring

Anchoring model: Following Bernheim et al (2015), I assume that the anchoring parameter $\chi$ shifts the participants' preferences toward the value that would rationalize the default as an optimal choice:

$$V_t^S(d) = \begin{cases} u_a(c_t(s)) + (\beta + \chi)(1 - m_a)E_t(V_{t+1}(d)) & \text{if } s < d \\ u_a(c_t(s)) + \beta(1 - m_a)E_t(V_{t+1}(d)) & \text{if } s = d \\ u_a(c_t(s)) + (\beta - \chi)(1 - m_a)E_t(V_{t+1}(d)) & \text{if } s > d \end{cases}$$

Proposition. When the default serves as a psychological anchor, increasing the default contribution rate from $d$ to $\bar{d}$ (weakly) decreases contributions strictly below $d$:

$$Pr(s^* < d \mid d = d) \leq Pr(s^* < d \mid d = \bar{d})$$
The Role of Present Bias

**Specification I**

![Diagram showing the role of present bias]

- **Present**: Adjustment cost ↘ Consumption
- **Near future** (next pay period): Consumption ↗ Consumption
- **Far future** (retirement): Consumption

- $k$ magnified by $\beta$
- $\tau$ only reflects long-term preference $\delta$

- Present bias ↑ inertia ...
- ... but does not affect contribution conditional on acting

Present bias $\Leftrightarrow$ higher adj. cost
The Role of Present Bias

**Specification I**

- **Present**
  - Adjustment cost
  - $k$ magnified by $\beta$

- **Near future** (next pay period)
  - ↓ Consumption

- **Far future** (retirement)
  - ↑ Consumption
  - $\tau$ only reflects long-term preference $\delta$

- Present bias ↑ inertia ...
- ... but does not affect contribution conditional on acting

Present bias $\Leftrightarrow$ higher adj. cost
The Role of Present Bias

**Specification II**

<table>
<thead>
<tr>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment cost</td>
<td>↗ Consumption</td>
</tr>
<tr>
<td>↘ Consumption</td>
<td>↗ Consumption</td>
</tr>
</tbody>
</table>

\[ \tau \text{ reflects present biased preference } \beta \delta \]

**Estimation:**

- I fix the short-term discount factor at \((\beta)\) and re-estimate the model:
  \[ \{ \beta = 0.5; \delta = 0.999; \sigma = 0.625; k = \$430 \} \text{ and } \{ \beta = 0.8; \delta = 0.989; \sigma = 0.454; k = \$269 \} \]

With a higher long-term discount factor the model no longer fits the age-heterogeneity.
The Role of Present Bias

Model Fit: 

With a higher long-term discount factor the model no longer fits the age-heterogeneity.

![Default effect by age and income](attachment:default-effect.png)
Long-Term Effect - Present bias $\beta = 0.5$

$$\{\beta = 0.5; \delta = 0.999; \sigma = 0.625; k = $430\}$$

AE policy at 3% adopted by all employers:

<table>
<thead>
<tr>
<th>Deciles of lifetime earnings</th>
<th>% change relative to opt-in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>30%</td>
</tr>
<tr>
<td>2nd</td>
<td>25%</td>
</tr>
<tr>
<td>3rd</td>
<td>15%</td>
</tr>
<tr>
<td>4th</td>
<td>10%</td>
</tr>
<tr>
<td>5th</td>
<td>5%</td>
</tr>
<tr>
<td>6th</td>
<td>3%</td>
</tr>
<tr>
<td>7th</td>
<td>2%</td>
</tr>
<tr>
<td>8th</td>
<td>1%</td>
</tr>
<tr>
<td>9th</td>
<td>0%</td>
</tr>
<tr>
<td>10th</td>
<td>0%</td>
</tr>
</tbody>
</table>
Long-Term Effect - Present bias $\beta = 0.8$

$$\{\beta = 0.8; \delta = 0.989; \sigma = 0.454; k = \$269\}$$

AE policy at 3% adopted by all employers:
Optimal policies - Present bias $\beta = 0.5$

\[\{\beta = 0.5; \delta = 0.999; \sigma = 0.625; k =$430\}\]

<table>
<thead>
<tr>
<th></th>
<th>Employers profits</th>
<th>Matching rate</th>
<th>Wages adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utilitarian</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi = 1$</td>
<td>AE 9%</td>
<td>AE 9%</td>
<td>AE 9%</td>
</tr>
<tr>
<td>$\pi = 0$</td>
<td>AE 10%</td>
<td>AE 10%</td>
<td>AE 10%</td>
</tr>
<tr>
<td><strong>Inequality averse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi = 1$</td>
<td>AE 10%</td>
<td>AE 10%</td>
<td>AE 10%</td>
</tr>
<tr>
<td>$\pi = 0$</td>
<td>AE 11%</td>
<td>AE 10%</td>
<td>AE 11%</td>
</tr>
</tbody>
</table>
Optimal policies - Present bias $\beta = 0.8$

$$\{\beta = 0.8; \delta = 0.989; \sigma = 0.454; k = \$269\}$$

<table>
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<th></th>
<th>Employers profits</th>
<th>Matching rate</th>
<th>Wages adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utilitarian</strong></td>
<td>$\pi = 1$ Opt-in</td>
<td>Opt-in</td>
<td>Opt-in</td>
</tr>
<tr>
<td></td>
<td>$\pi = 0$ AE 15%</td>
<td>Opt-in</td>
<td>Opt-in</td>
</tr>
<tr>
<td><strong>Inequality averse</strong></td>
<td>$\pi = 1$ AE 6%</td>
<td>AE 5%</td>
<td>AE 5%</td>
</tr>
<tr>
<td></td>
<td>$\pi = 0$ AE 6%</td>
<td>AE 5%</td>
<td>AE 6%</td>
</tr>
</tbody>
</table>
I introduce an opt-out cost $\tilde{k}$ that is proportional to earnings:

$$u_a \left( c_t - \mathbb{1}_{s_t \neq d_t} \tilde{k} w_t \right)$$

**Estimate:**
I estimate $\tilde{k}$ to be equal to 3.16% of quarterly income (i.e. $292 for average earner) - $\{\beta = 0.985; \sigma = 0.334; k = 3.2\%\}$
Long-Term Effect - Proportional Cost

\{ \beta = 0.985; \sigma = 0.334; k = 3.2\% \}

AE policy at 3% adopted by all employers:
Long-Term Effect - Proportional Cost

\[ \{ \beta = 0.985; \sigma = 0.334; k = 3.2\% \} \]

**AE policy at 6% adopted by all employers:**

<table>
<thead>
<tr>
<th>Deciles of lifetime earnings</th>
<th>% change relative to opt-in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>5%</td>
</tr>
<tr>
<td>2nd</td>
<td>4%</td>
</tr>
<tr>
<td>3rd</td>
<td>3%</td>
</tr>
<tr>
<td>4th</td>
<td>2%</td>
</tr>
<tr>
<td>5th</td>
<td>1%</td>
</tr>
<tr>
<td>6th</td>
<td>1%</td>
</tr>
<tr>
<td>7th</td>
<td>1%</td>
</tr>
<tr>
<td>8th</td>
<td>1%</td>
</tr>
<tr>
<td>9th</td>
<td>1%</td>
</tr>
<tr>
<td>10th</td>
<td>1%</td>
</tr>
</tbody>
</table>
Optimal policies - Present bias $\beta = 0.5$

$$\{\beta = 0.985; \sigma = 0.334; k = 3.2\%\}$$

<table>
<thead>
<tr>
<th>Employers profits</th>
<th>Matching rate</th>
<th>Wages adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utilitarian</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi = 1$</td>
<td>AE 6%</td>
<td>AE 4%</td>
</tr>
<tr>
<td>$\pi = 0$</td>
<td>Opt-in</td>
<td>Opt-in</td>
</tr>
<tr>
<td><strong>Paternalistic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi = 1$</td>
<td>AE 6%</td>
<td>AE 5%</td>
</tr>
<tr>
<td>$\pi = 0$</td>
<td>AE 6%</td>
<td>AE 5%</td>
</tr>
</tbody>
</table>
Wealth to earnings ratio over the lifecycle

Ratio of net wealth to earnings by age:

- **Data**: Survey of Consumer Finances 2016
- **Sample**: households where head or spouse has any type of account-based pension plan on current job
- **Total wealth**: all assets net of all outstanding debt
AE Adoption by all Employers

AE policy at 3% adopted by all employers:

Panel A: % change relative to opt-in

- Bottom
- 2nd
- 3rd
- 4th
- 5th
- 6th
- 7th
- 8th
- 9th
- Top

Deciles of lifetime earnings

Panel B: dollars change relative to opt-in

- Bottom
- 2nd
- 3rd
- 4th
- 5th
- 6th
- 7th
- 8th
- 9th
- Top

Deciles of lifetime earnings

- profit adjustment
- wage adjustment
- match adjustment
AE Adoption by all Employers

AE policy at 6% adopted by all employers:

Panel A: % change relative to opt-in
Panel B: dollars change relative to opt-in

Deciles of lifetime earnings

- profit adjustment
- wage adjustment
- match adjustment
AE Adoption by all Employers

AE policy at 10% adopted by all employers:

Panel A: % change relative to opt-in
Panel B: dollars change relative to opt-in

Deciles of lifetime earnings

-5%
0%
5%
10%
15%
20%

profit adjustment
wage adjustment
match adjustment
Utilitarian Policymaker

Panel A: profit adjustment
Panel B: match adjustment
Panel C: wage adjustment

Change in social welfare in consumption-equivalent

default contribution rate $d^SP$

-0.6% -0.5% -0.4% -0.3% -0.2% -0.1% 0.0%
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

welfare-relevant opt-out cost ($\pi=1$) - welfare-irrelevant cost ($\pi=0$)
Inequality-Averse Policymaker

Panel A: profit adjustment
Panel B: match adjustment
Panel C: wage adjustment

Change in social welfare in consumption-equivalent welfare-relevant opt-out cost ($\pi=1$) welfare-irrelevant cost ($\pi=0$)
Panel A: profit adjustment

Panel B: match adjustment

Panel C: wage adjustment

Change in social welfare in consumption-equivalent welfare-relevant opt-out cost ($\pi=1$) welfare-irrelevant cost ($\pi=0$)

- default contribution rate $d_{SP}$

welfare-relevant opt-out cost (π=1)  welfare-irrelevant cost (π=0)
Out-of-Sample Validation I

Compare workers hired before/after AE default increased

Contributions at 0%, 1% or 2%

Controls: plan, year, and age FE, log tenure
Sample: 50 US 401k plans, 97,714 workers w/ \( \leq 1 \) y of tenure post grace-period

All cases: 85% success rate at the 10% level
Out-of-Sample Validation I

Compare workers hired before/after AE default increased

Contributions at 0%, 1% or 2%

Controls: plan, year, and age FE's, log tenure

Sample: 50 US 401k plans, 714 workers w/ ≤1y of tenure post grace-period

All cases: 85% success rate at the 10% level
## Out-of-Sample Validation I

### Data Model

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Model prediction</th>
<th>Nbr. of plans</th>
<th>Nbr. of worker</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial default</td>
<td>86 plans</td>
<td>31,364</td>
<td>0.483</td>
<td></td>
</tr>
<tr>
<td>Default increased by 1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default 2% → 3%</td>
<td>0.017 (0.014)</td>
<td>0.007</td>
<td>11</td>
<td>31,364</td>
</tr>
<tr>
<td>Default 3% → 4%</td>
<td>0.016 (0.013)</td>
<td>0.005</td>
<td>10</td>
<td>13,116</td>
</tr>
<tr>
<td>Default 4% → 5%</td>
<td>-0.003 (0.020)</td>
<td>0.013</td>
<td>3</td>
<td>1,821</td>
</tr>
<tr>
<td>Default 5% → 6%</td>
<td>-0.016 (0.009)</td>
<td>0.034</td>
<td>5</td>
<td>3,970</td>
</tr>
</tbody>
</table>

* p<0.10, ** p<0.05, *** p<0.01

### Individual’s characteristics

- ✓ Plan FE
## Out-of-Sample Validation I

<table>
<thead>
<tr>
<th>Contrib &lt; initial default</th>
<th>Sample size</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
<td><strong>Model prediction</strong></td>
<td><strong>Nbr. of plans</strong></td>
</tr>
<tr>
<td>86 plans</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Default increased by 2%

- **Default 1% → 3%**
  
  Default increased by 2%

<table>
<thead>
<tr>
<th>Contrib&lt;initial default</th>
<th>Sample size</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.023 (0.025)</td>
<td>0.020</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Default 2% → 4%**
  
  Default increased by 2%

<table>
<thead>
<tr>
<th>Contrib&lt;initial default</th>
<th>Sample size</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.005 (0.011)</td>
<td>0.012</td>
<td>4</td>
</tr>
</tbody>
</table>

- **Default 3% → 5%**
  
  Default increased by 2%

<table>
<thead>
<tr>
<th>Contrib&lt;initial default</th>
<th>Sample size</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.022*** (0.005)</td>
<td>0.018</td>
<td>14</td>
</tr>
</tbody>
</table>

- **Default 4% → 6%**
  
  Default increased by 2%

<table>
<thead>
<tr>
<th>Contrib&lt;initial default</th>
<th>Sample size</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.031*** (0.007)</td>
<td>0.047</td>
<td>9</td>
</tr>
</tbody>
</table>

- **Default 6% → 8%**
  
  Default increased by 2%

<table>
<thead>
<tr>
<th>Contrib&lt;initial default</th>
<th>Sample size</th>
<th>P-value difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.067*** (0.021)</td>
<td>0.148</td>
<td>1</td>
</tr>
</tbody>
</table>

* p<0.10, ** p<0.05, *** p<0.01

Individual's characteristics ✓

Plan FE ✓
## Out-of-Sample Validation I

<table>
<thead>
<tr>
<th>Contrib&lt;initial default</th>
<th>Sample size</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Model prediction</td>
<td>Nbr. of plans</td>
</tr>
<tr>
<td>86 plans</td>
<td>26</td>
<td>27,190</td>
</tr>
<tr>
<td>Default increased by 3 or 4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default 3% → 6%</td>
<td>0.045***</td>
<td>0.052</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td>Default 3% → 7%</td>
<td>0.060</td>
<td>0.132</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td></td>
</tr>
</tbody>
</table>

Individual’s characteristics ✓
Plan FE ✓

* p<0.10, ** p<0.05, *** p<0.01
Preference estimates from U.S. 401(k) plans ... 

... predict the response to a national policy in the U.K.
Preference estimates from U.S. 401(k) plans ...

... predict the response to a national policy in the U.K.

**US pref. estimates...**
Opt-out cost at £160 (avg. exch. rate over 06-17)
Time pref. \( \delta = 0.987 \) and \( \sigma = 0.455 \)

**... w/ UK calibration:**
Estimate the UK Income process using AShE
Estimate heterogeneity in employers contribution formulas (5 types)
Calibrate the UK tax and public pensions system
Mandatory Autoenrollement for all U.K. private employees

Policy roll-out by employer size between 2012-2017

Within-job effect:
Mandatory Autoenrollement for all U.K. private employees

Policy roll-out by employer size between 2012-2017

Within-job effect:
Mandatory Autoenrollement for all U.K. private employees
Policy roll-out by employer size between 2012-2017

Participation after a job-switch:

AE to non-AE

Data

-10.9% (**)

AE to AE

Data

1.3% (n.s)
Mandatory Autoenrollement for all U.K. private employees
Policy roll-out by employer size between 2012-2017

Participation after a job-switch:

AE to non-AE

Data: -10.9% (**)
Model: -9.5%

AE to AE

Data: 1.3% (n.s)
Model: -3.2%
After job-switch (from AE to AE):
Peer Effects?

No difference in saving behavior btw. those hired in the 12 months prior to AE and those hired earlier.
Peer Effects?

No difference in saving behavior btw. those hired in the 12 months prior to AE and those hired earlier