Incorporating Heterogeneity into Default Rules for Retirement Plan Selection

Gopi Shah Goda
Stanford University and NBER

Colleen Flaherty Manchester
University of Minnesota

This research was supported by the Center for Retirement Research at Boston College pursuant to a grant from the U.S. Social Security Administration through the Steven H. Sandell 2009-2010 Grant Program for Junior Scholars in Retirement Research.

Retirement Plan Choice

Our Setting: Large non-profit employer transitioned from DB plan to DC plan in 2002

- One-time, irreversible plan selection decision for future plan accruals
- If no decision was made, employee defaulted into one of the plans

Retirement Plan Choice

Our Setting: Large non-profit employer transitioned from DB plan to DC plan in 2002

- One-time, irreversible plan selection decision for future plan accruals
- If no decision was made, employee defaulted into one of the plans

Default Rule: Default option differed by age of employee at date of transition (Sept. 1, 2002)

- Employees defaulted to switch to DC plan if under age 45
- Employees defaulted to remain in DB plan if age 45 or over

Overview of Paper

- What is the causal effect of a default on the choice between retirement plans?
  - Enrollment in default plan is 60 p.p. higher than alternative
- How can we arrive at a default policy that maximizes employees' expected utility?
  - We develop a framework to solve for the optimal default rule using a policy where the default plan varies by age
  - Optimal age cutoff that defines this policy is a function of pension plan, firm, and employee characteristics
- How do age-based default policies compare to alternatives?
  - Incorporating heterogeneity by age is likely to significantly improve outcomes
  - Optimal age-based default policy performs best when risk aversion is known and relatively homogenous across employees

Overview of Paper

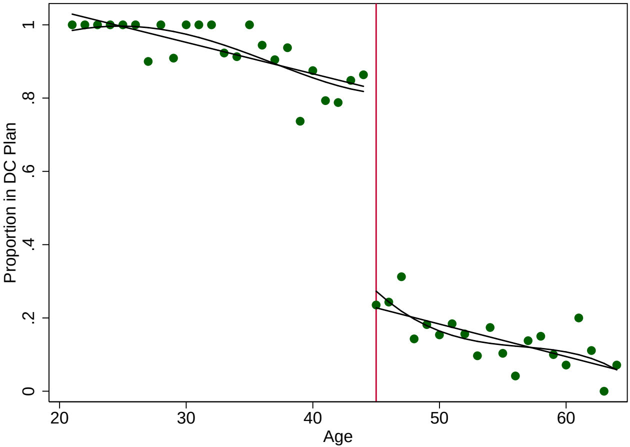
- What is the causal effect of a default on the choice between retirement plans?
  - Enrollment in default plan is 60 p.p. higher than alternative
- How can we arrive at a default policy that maximizes employees' expected utility?
  - We develop a framework to solve for the optimal default rule using a policy where the default plan varies by age
  - Optimal age cutoff that defines this policy is a function of pension plan, firm, and employee characteristics
- How do age-based default policies compare to alternatives?
  - Incorporating heterogeneity by age is likely to significantly improve outcomes
  - Optimal age-based default policy performs best when risk aversion is known and relatively homogenous across employees

Overview of Paper

- What is the causal effect of a default on the choice between retirement plans?
  - Enrollment in default plan is 60 p.p. higher than alternative
- How can we arrive at a default policy that maximizes employees' expected utility?
  - We develop a framework to solve for the optimal default rule using a policy where the default plan varies by age
  - Optimal age cutoff that defines this policy is a function of pension plan, firm, and employee characteristics
- How do age-based default policies compare to alternatives?
  - Incorporating heterogeneity by age is likely to significantly improve outcomes
  - Optimal age-based default policy performs best when risk aversion is known and relatively homogenous across employees

Regression Discontinuity: Visual Inspection

Figure 1: DC Enrollment Rate by Age



RD Estimates of Default on Plan Choice

Estimate τ using a 5-year bandwidth around age $c = 45$:

$$Y_i = \alpha + \tau d_i + \beta(A_i - c) + \gamma(A_i - c)d_i + X_i'\pi + \epsilon_i$$

Table 4: Regression Discontinuity Estimates of DC Plan Enrollment

	(1)	(2)	(3)	(4)	(5)
Under 45	0.605***	0.581***	0.601***	0.758***	0.784***
	(0.042)	(0.082)	(0.083)	(0.116)	(0.110)
(Age - 45)		-0.023	-0.017	0.523*	0.644**
		(0.027)	(0.027)	(0.271)	(0.273)
(Age - 45)×Under 45		0.035	0.038	-0.578	-0.727*
		(0.043)	(0.045)	(0.421)	(0.426)
Higher Order Terms	No	No	No	2, 3	2, 3
Controls	No	No	Yes	No	Yes
R^2	0.28	0.281	0.308	0.291	0.32
N	353	353	353	353	353

Notes: Probit model, marginal effects reported. Robust standard errors in parentheses. Controls include hours, wage, work location, and gender and race dummies.
* p<0.10, ** p<0.05, *** p<0.01.

Solving for the Optimal Default Policy

We solve for the optimal age-based default policy as follows:

1. Construct measures of the value each employee would receive from each plan, taking into account risk and the level of risk aversion
2. Aggregate these values under the assumption that employees choose the default plan across all possible age-based default policies
3. Choose the age cutoff to maximize this *aggregate default wealth.*

We then construct two measures to evaluate the optimal age-based default policy relative to alternative default policies:

1. The number of employees who are defaulted into a suboptimal plan
2. The average loss in value for these employees, relative to their optimal plan

Finally, we numerically simulate these results for the firm in our setting.

Assumptions for Simulation: Uncertainty

Separation Risk (r)

- Assume a constant hazard rate of exiting the firm each year with $\bar{r} = \rho = 65$
- Average rate taken from the data

Investment Risk

- Monte Carlo simulation: 1,000 draws of 45-year sequences of returns
- Lognormal distribution of returns with correlation between asset classes based on historical data Monte Carlo Assumptions
- Asset allocation based on target-date fund Asset Allocation

Operational assumptions

- Investment and separation risk are independent
- Distributions do not vary by plan type

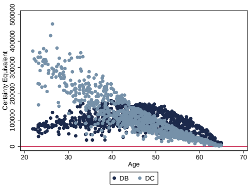
Assumptions: Employer/Employee Characteristics

Utility: Use CRRA utility function with relative risk aversion parameter α between 0 and 10.

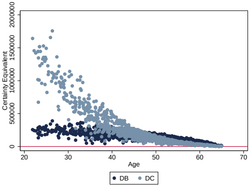
	Assumption
Plan Characteristics:	
DB Multiplier (b)	2.0%
DC Contribution Rate (c)	8.5%
Other Parameters:	
Real Wage Growth Rate (g)	2.0%
Real Discount Rate (d)	1.0%
Separation Hazard ($\Rightarrow p_r^a$)	5.0%
Inflation Rate (i)	2.5%

Certainty Equivalent for Pension Plans

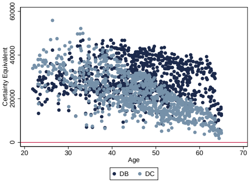
Figure 5: Certainty Equivalent by Age for Different Levels of Risk Aversion



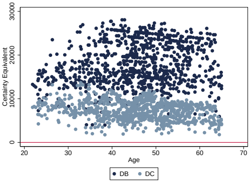
(a) α=0



(b) α=2



(c) α=5



(d) α=10

Optimal Age-Based Default Policy

Table 6: Age Cutoff under Optimal Age-Based Default Rule

	(1) $\alpha = 0$	(2) $\alpha = 2$	(3) $\alpha = 5$	(4) $\alpha = 10$
Optimal age cutoff	44	47	36	20

- For $\alpha < 4$, optimal cutoff between 42 and 47, a range which includes firm's chosen cutoff age of 45.
- Universal DB default optimal only for fairly high levels of risk aversion.
- Interaction between separation risk and investment risk produces non-monotonicity in optimal cutoff as risk aversion increases.

Sensitivity to Assumptions

Table 7: Comparative Statics for Optimal Age-Based Default Rule

Assumptions	$\alpha = 0$	$\alpha = 2$	$\alpha = 5$	$\alpha = 10$
Baseline	44	47	36	20
5% DC Contribution Rate	36	40	20	20
10% DC Contribution Rate	47	49	42	20
1% DB Multiplier	56	57	56	30
3% DB Multiplier	38	42	20	20
100% Stocks	48	48	20	20
100% Bonds	32	39	33	20
100% Cash	20	26	23	20
0% Separation Hazard	40	36	23	20
10% Separation Hazard	46	48	36	20
No Investment Risk	40	47	50	50
Double Investment Risk	50	46	20	20

Additional Sensitivity Results

Evaluation of Optimal Age-Based Default

Table 8: Measures to Evaluate Optimal Age-Based Default

α	Policy	Age Cutoff	N_π	$loss_\pi$
	Universal DB Default	20	344	38.0%
$\alpha = 0$	Universal DC Default	65	581	34.7%
	Optimal Age-Based Default	44	9	4.0%
	Universal DB Default	20	462	41.8%
$\alpha = 2$	Universal DC Default	65	463	34.0%
	Optimal Age-Based Default	47	6	3.6%
	Universal DB Default	20	143	15.4%
$\alpha = 5$	Universal DC Default	65	782	33.8%
	Optimal Age-Based Default	36	9	1.0%
	Universal DB Default	20	–	–
$\alpha = 10$	Universal DC Default	65	925	59.5%
	Optimal Age-Based Default	20	–	–

Evaluation of Optimal Age-Based Default (cont.)

- Relative to default policies that do not incorporate heterogeneity, the optimal age-based default policy:
  - Categorizes significantly fewer employees into a suboptimal plan ($<$1% vs. 15-85%)
  - Substantially reduces the loss in certainty equivalent for employees who are defaulted into a suboptimal plan ($<$4% vs. 15-60%)
- Conditioning default on additional characteristics would not significantly change outcomes.

Evaluation of Optimal Age-Based Default (cont.)

- Relative to default policies that do not incorporate heterogeneity, the optimal age-based default policy:
  - Categorizes significantly fewer employees into a suboptimal plan (<1% vs. 15-85%)
  - Substantially reduces the loss in certainty equivalent for employees who are defaulted into a suboptimal plan (<4% vs. 15-60%)
- Conditioning default on additional characteristics would not significantly change outcomes.
- Caveat: Previous results assume risk aversion is known and same for all employees
  - If α misestimated by 1, 13-16% defaulted into suboptimal plan with average loss of 10-13%
  - If α is random, 12% defaulted into suboptimal plan with average loss of 14%; less if heterogeneity in α is due to age

Conclusions

Effect of default rule on plan enrollment:

- Increases probability of enrollment in default plan by 60 percentage points

Numerical simulation of the optimal age-based default policy:

- Incorporating heterogeneity by age is likely to significantly improve outcomes
- Uniform DB default optimal only for higher values of risk aversion
- Optimal age-based default policy performs best if distribution of risk aversion is known

Implications for retirement plan choice:

- Ongoing plan transitions from DB plans to DC plans
  - Among plan closures, 83 percent implement alternative plans, typically DC plans (GAO 2008)
- Some employers offer all new hires a choice between DB and DC plans (e.g., public universities)

Employee Sample

Table 2: Summary Statistics

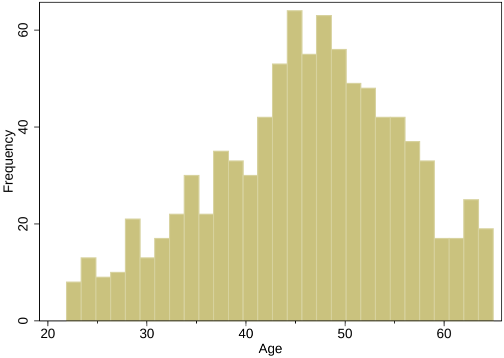
Variable	Mean	Std. Dev.	Min	Max
Enrolled in DC Plan	0.478	0.500	0	1
Made Passive Choice	0.543	0.498	0	1
Age	46.07	9.72	21.88	64.96
Female	0.188	0.391	0	1
White	0.425	0.495	0	1
Black	0.114	0.317	0	1
Hispanic	0.303	0.460	0	1
Other	0.159	0.366	0	1
Hours	39.35	3.27	20.00	55.00
Hourly Wage	23.98	6.63	10.24	36.81
Tenure	12.08	9.12	0.75	43.41
Primary Work Location	0.699	0.459	0	1

back

Regression Discontinuity: Validation of Assumptions

- Verify no irregularities in distribution of forcing variable at age 45

Figure 2: Distribution of Employee Age

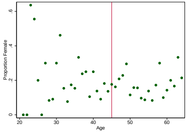


back

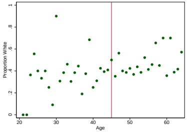
Regression Discontinuity: Validation of Assumptions

- Confirm smooth distribution of other covariates at age 45

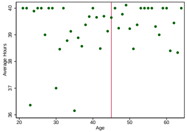
Figure 3: Average Value of Covariates by Single Year of Age



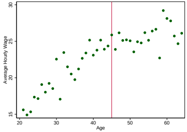
(a) Female



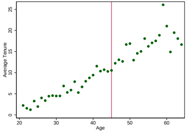
(b) White



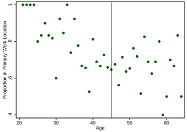
(c) Hours per Week



(d) Hourly Wage



(e) Tenure



(f) Work Location

back

Calculating DB Retirement Wealth

Annual retirement benefit in DB plan depends on the firm's DB formula defined by $b_j(w_j)$ for all service years j between 0 and $r - a$,

$$w^{DB}(a) = \int_0^{r-a} b_j(w_j) A_\rho dj$$

where

- r is the age of exit from the firm
- a is the worker's current age
- w_j is the annual wage in year j
- A_ρ is the actuarial present value of a stream of $1 annual payments commencing at age ρ and paid until death.

back

Calculating DC Retirement Wealth

The wealth evaluated at retirement age ρ in the DC plan as a function of age a is:

$$w^{DC}(a) = \int_0^{r-a} c_j w_j e^{\int_j^{\rho-a} \delta(k) dk} dj$$

- c_j represents employer contributions into the employee's account in year j
- $\delta(k)$ represents sequence of returns in all subsequent years for $k \in [j, \rho - a]$
- r is the age of exit from the firm
- a is the worker's current age
- w_j is the annual wage in year j

back

Sources of Variability and Risk

Separation risk (uncertainty in r):

- Stems from voluntary and involuntary separations
- Affects risk in both DB and DC plan

Investment risk (uncertainty in $\delta(\cdot)$):

- Stems from uncertainty in investment experience
- Affects risk in DC plan only

Assumption: r and $\delta(\cdot)$ drawn from $h^p(r, \delta | a < r \leq \bar{r})$ for plan $p \in \{DB, DC\}$. back

Expected Utility and Certainty Equivalent

For a discount rate d the expected utility is given by:

$$EU(w^{DB}(a)) = \int_a^{\bar{r}} \frac{U(w^{DB}(a))}{(1+d)^{\rho-a}} h^{DB}(r,\delta|a<r\leq\bar{r})dr$$

$$EU(w^{DC}(a)) = \int_{-\infty}^{\infty}\int_a^{\bar{r}} \frac{U(w^{DC}(a))}{(1+d)^{\rho-a}} h^{DC}(r,\delta|a<r\leq\bar{r})drd\delta.$$

Define the certainty equivalent wealth for plan $p \in \{DB, DC\}$ as:

$$CE^p(a) = U^{-1}(EU(w^p(a)))$$

- Individual indifferent between receiving the amount $CE^p(a)$ for certain and the gamble characterized by the uncertain income stream from plan p
- Plan $\tilde{p}$ is preferable to plan $\hat{p}$ if and only if $CE^{\tilde{p}}(a) > CE^{\hat{p}}(a)$

back

Measures to Evaluate Age-Based Default Policies (cont.)

Let π denote one of three potential policies: {universal DB default policy, universal DC default policy, optimal age-based default policy}.

Define N_π to be the number of employees defaulted into a suboptimal plan under policy π, and $loss_\pi$ to be the average relative loss in certainty equivalent for these employees.

The values N_π and $loss_\pi$ are constructed as follows:

$$N_\pi \equiv \int_{\underline{a}}^{\overline{a}} \mathbf{1}_{[\overline{CE} > CE_\pi]} da \qquad loss_\pi \equiv \frac{\int_{\underline{a}}^{\overline{a}} \frac{\overline{CE} - CE_\pi}{\overline{CE}} da}{N_\pi}$$

where $\overline{CE} = \max(CE^{DB}, CE^{DC})$ and CE_π represents the certainty equivalent of the plan specified as the default under policy π.

back

Default Rules that Account for Firm Costs

Alternative #1: Firm solves two-stage problem

$$a^{**} = \arg\max_{\tilde{a}} \int_{\underline{a}}^{\tilde{a}} \left(CE^{DC}(a) - CE^{DB}(a) \right) da$$

subject to pre-specified budget constraint for deferred compensation (B):

$$\int_{\underline{a}}^{a^{**}} FC^{DC}(a)da + \int_{a^{**}}^{\overline{a}} FC^{DB}(a)da \leq B,$$

which is equivalent to the initial problem if constraint does not bind.

Alternative #2: Social Planner's Problem

$$a^{***} = \arg\max_{\tilde{a}} \int_{\underline{a}}^{\tilde{a}} \left[\left(CE^{DC}(a) - FC^{DC}(a) \right) - \left(CE^{DB}(a) - FC^{DB}(a) \right) \right] da$$

The first order condition equates marginal benefits accrued to employees to marginal costs incurred by firm. back

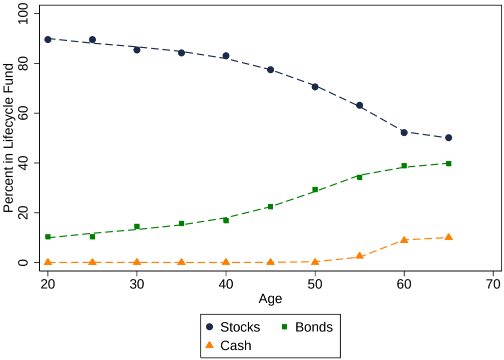
Assumptions: Monte Carlo

	Assumption	
Real Asset Returns:	μ	σ
Stocks (Large Firms)	6.4%	18.8%
Bonds	2.7%	9.2%
Money Market	0.7%	3.9%
Asset Covariances:		
Stocks-Bonds	0.4065%	
Bonds-Money Market	0.2033%	
Money Market-Stocks	0.0763%	
Asset Allocation:		
Fidelity Target-Date Funds (*default allocation*)		

Source: Ibbotson (2008) back

Asset Allocation

Figure 4: Asset Allocation by Age



Note: Based on asset allocation of Fidelity Freedom Funds. Lines represent fit using fractional multinomial logit model with fourth-order age terms.

back

Sensitivity to Assumptions (cont.)

Assumptions	$\alpha = 0$	$\alpha = 2$	$\alpha = 5$	$\alpha = 10$
Baseline	44	47	36	20
0% Real Wage Growth	45	47	36	20
4% Real Wage Growth	43	47	36	20
0% Real Discount Rate	44	47	36	20
2% Real Discount Rate	44	47	36	20
1.5% Inflation	42	45	20	20
3.5% Inflation	46	49	42	20

back