Auto-enrollment, Matching and Participation in 401(k) Plans

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Motivation: 401(k) Low Take-Up Rates

- Major shift in US pension landscape (from DB to DC plans)
- Not accompanied by a rise in **take-up (participation) rates**

Table : Take-up rate by plan type and year

	Year							
	1998		2003		2006		2011	
	401k	DB	401k	DB	401k	DB	401k	DB
Take Up Rate	0.69	0.93	0.74	0.94	0.71	0.92	0.70	0.93

Source: Survey of Income and Program Participation (SIPP) 1996, 2000, 2004.

- **Matching** and **autoenrollment** are design features of **401k plans** that can be used to increase **plan participation**

A few key concepts

401k plan

- Qualified DC plan including a **Cash Or Deferred Arrangement**
  - *Thrift-savings* (66%)
  - *Traditional profit sharing* (33%)
  - *Stock bonus* or *Employee stock ownership plan (ESOP)* (1%)

Plan participation

- Requires employees' **elective deferrals**
  - **Before-tax**: deducted from current income
  - **After-tax** / **Roth**: taxed on current income

A few key concepts

Matching

- Plan sponsor (employer) not required to contribute, but can offer:
  - a **formula-based match**
  - a **discretional** (contingent or match) **profit-sharing contribution**

Match formulas

- Specified in **summary plan description** as:
  - **single-tiered**
  - **multi-tiered**
  - **discretional** (usually based on profits)
- A **single-tiered** formula (typical of **thrift-savings** plans) specifies:
  - a **match rate** (i.e., 0.50 per each $ of elective deferrals)
  - a **match threshold** (maximum elective deferrals as % of pay)

A few key concepts

Auto-enrollment

- **Default** switched
  - from **opt-in** (participation)
  - to **opt-out** (non-participation)
- Can be applied to:
  - **newly hired** eligible employees
  - **all** eligible employees
- Default **elective deferrals** and **investments**

Research questions

1. Does **auto-enrollment** affect plan participation?
2. Does **employer matching** affect participation?
3. Is there a **trade-off** between these key 401k plan design features?

Research questions

Research questions relevant for:

- **Sponsors** plan design **objectives**:
  1. developing stronger incentives for employee savings
  2. reach a employee-employer contributions mix that satisfies **non-discrimination requirements**
  3. recruitment and retention of higher quality workers
  4. satisfy employees' demand for savings
- **Policy makers:** implement policies to promote participation

Policies Summary

Tax Reform Acts of 1984 and 1986

- **Non-discrimination tests**: difference between **HCEs** and **NHCEs** contributions should not exceed 2%
  - **Average Deferral Percentage (ADP)**: on before-tax/Roth c.
  - **Average Deferral Contribution (ADC)**: on matching/after-tax c.
- Test failure is costly: requires further contributions or refunds

Job Protection Act of 1996

- **Safe harbor matching**: employers can avoid tests offering a basic **matching** or **non-matching** contribution

Policies Summary

Pension Protection Act of 2006 (PPA '06)

- protection from **fiduciary liability**
- protection from **state payroll-withholding laws**
- automatic enrollment **safe harbor**

- Prompted by the influential work of Madrian and Shea (QJE, 2001)

Main contributions

1. Providing bew evidence on:
   - effects of matching and auto-enrollment on participation
   - potential trade-off between matching and auto-enrollment
2. Focus on:
   - **internal validity**: FE and CRE estimators for **unbalanced panels**
   - **external validity**: data on population of **thrift-savings** 401k plans

Main results

1. Auto-enrollment: prominent role in increasing participation rates
2. Match rates and "reinstatements": positive and significant effects
3. Evidence of "positive" (vs. negative) selection:
   - **positive selection**: matching/autoenrollment driven by desire to attract and retain higher quality workers (savers)
   - **negative selection**: matching/autoenrollment driven by paternalistic view (help non-savers saving) or nondiscrimination requirements
4. No evidence of a matching vs. auto-enrollment trade-off

Summary of literature findings

1. In theory, the impact of a **match** on participation depends in part on the **structure of the match**
   - **Adding a matching contribution** or **increasing match generosity** should increase participation through a **substitution effect**
   - Accordingly most studies find positive and significant effects
   - However, effects found do vary widely: **methodological differences**
   - *Engelhardt and Kumar (2007)*: a 25 pp increase in the match rate increases participation by 5 pp
   - Evidence of "negative" selection in match IV studies
2. *Inertia* in 401k participation suggested by dramatic participation increase upon **switching default** (*Madrian and Shea, 2001*)
3. Auto-enrollment vs matching *trade-off*? Only descriptive and yet mixed evidence

Literature

1. **Data:**
   - representative: surveys, administrative
   - non-representative: company data
   - cross-sectional
   - panel
2. **Unit of analysis:**
   - employee
   - plan
3. **Match rate** definition
4. **Estimation** method

Data: form 5500

Private Pension Plan (PPP) research files from form 5500

- Administrative plan-level data base
- Plans uniquely identified by **employer individual number (EIN)** and **plan number (PN)**
- Panel data for the most recent available period: 2009-2012
- **Unbalanced panel**: $T = 2$, $T = 3$, or $T = 4$

Data: form 5500

Main variables definition

- **Participation rate**: fraction of active (eligible) participants with an account balance
- **Automatic enrollment**: reported since 2009, following PPA '06
- **Match rate**: ratio of **employer** to **employee deferrals**

Data: form 5500

Match rate

- Ideally, we would like to observe the **match formula**, including:
  - **match rate**
  - **match threshold**
- Issues:
  1. Match formulas are not reported in 5500 Forms
  2. Employer contributions may include **non-matching** contributions
- However, non-matching contributions are typically variable (fixed) **profit-sharing/ESOP** contributions
- Plans do report if matching contributions are provided for ADC tests

Match rates

- In order to minimize **measurement error**:
  1. Analysis limited to **thrift and savings** plans
  2. Plans with only non-matching contributions (about 5 %) are dropped
- Employees are assumed to contribute below the **match threshold**
  - If this assumption does not hold, positive effects of match rates on participation could be partially driven by **reverse causation**, i.e., an increase in participation in time t could increase the match rate in time $t + 1$ (thus violating the FE strict exogeneity assumption)
    - Evidence that most employees fail to take full advantage of the match (*Madrian et al., 2011*)
    - Strict exogeneity of autoenrollment/matching cannot be rejected

Match rates

- Automatic enrollment (positive) effects on match rates might be driven by the fact that
  - new hires defaulted at lower deferral rates
  - participation is higher among new hires
- Again, I rely on the assumption that employees contribute **below the match threshold** (or new/old hires have same deferral rates)
- Strict exogeneity of autoenrollment cannot be rejected

Employer match dummy

- Reverse causation is not an issue when effects on participation captured by **match dummy**:
  - Suppose a firm moves from **zero** in year t to **strictly positive contributions** in year $t+1$ (or viceversa)
  - This change cannot be driven by a change in participation: It must proceed from a true change in the employer contribution policy

Empirical strategy

Participation rate equation

$$Prate_{it} = \beta_0 + \beta_1 Mrate_{it} + \beta_2 Auto_{it} + \boldsymbol{\gamma}\mathbf{x}_{it} + c_i + u_{it} \quad (1)$$

Match rate equation

$$Mrate_{it} = \delta_0 + \delta_1 Auto_{it} + \boldsymbol{\gamma}\mathbf{x}_{it} + c_i + u_{it} \quad (2)$$

where:

- $\mathbf{x}_{it}$: time-variant plan-specific characteristics
- c_i : time-invariant plan-specific unobserved heterogeneity
- u_{it} : idiosyncratic component

Empirical strategy

Estimation methods: FE with unbalanced panels

- Consistency requires **strictly exogeneity** of both **covariates** and **selection**
  - Rules out covariates/selection in any time period depending on the shocks in any time period
  - Allows arbitrary correlation between covariates/selection and c_i
- Do not account for **fractional nature** of **participation rates**
- Non-linear approach: correlated random effects (CRE) model

Participation equation: fractional response models

- *Papke and Wooldridge (2008)*: balanced panel data
- *Wooldridge (2010)*: unbalanced panel data

- Interest lies in **index form** C.E., with **additive heterogeneity**:

$$E(y_{it}|\mathbf{x}_{it}, c_i) = \Phi(\mathbf{x}_{it}\beta + c_i), \qquad i = 1, \ldots, n \qquad t = 1, \ldots, T$$

where dependent variable has **fractional nature**:

$$0 \geq y_{it} \leq 1$$

and Φ : **standard normal cdf**

Empirical strategy

- By **monotonicity** of Φ, β gives **direction** of partial effects (PE):

$$\frac{\delta E(y_t|\mathbf{x}_t, c)}{\delta x_{tj}} = \beta_j \phi(\mathbf{x}_t\beta + c)$$

- **Magnitude** obtained by **averaging PE** across the distribution of c:

$$E_c[\beta_j \phi(\mathbf{x}_t\beta + c)] = \beta_j E_c[\phi(\mathbf{x}_t\beta + c)]$$

Average Partial Effect (APE) with respect to x_{tj}, evaluated at $\mathbf{x}_t$

Identification assumptions: CRE model

1. **Strict exogeneity** of $\mathbf{x}_{it}$ conditional on c_i and **ignorable selection**:

$$E(y_{it}|\mathbf{x}_i, c_i, \mathbf{s}_i) = E(y_{it}|\mathbf{x}_{it}, c_i),$$

   where $\mathbf{s}_i = (s_{i1}, s_{i2}, \ldots, s_{iT})$ vector of selection indicators

2. **Unbalanced panel nature** accounted for by specifying a **model** for

$$D(c_i|\mathbf{w}_i)$$

   for suitably chosen functions $\mathbf{w}_i$ of $\{(s_{it}, s_{it}\mathbf{x}_{it}) : t = 1, \ldots, T)\}$ acting as **sufficient statistics** for selection
   Tipically: **number of time periods** (T_i) and **time averages** $(\bar{x}_i)$

CRE model specification (*Wooldridge, 2010*)

1. A specification **linear** in $\bar{x}_i$, with **intercept** different for each T_i:

$$E(c_i|\mathbf{w}_i) = \sum_{r=1}^{T} \psi_r 1[T_i = r] + \bar{\mathbf{x}}_i \xi$$

2. The **conditional variance** of c_i is also allowed to vary with T_i :

$$Var(c_i|\mathbf{w}_i) = \exp\left(\tau + \sum_{r=1}^{T-1} 1[T_i = r]\omega_r\right)$$

where:

- $\exp(\tau)$: variance for the base group ($T_i = T$)
- ω_r : deviations from the base group

CRE model specification (*Wooldridge, 2010*)

3. Dropping observations with $T_i = 1$ and assuming

$$D(c_i|\mathbf{w}_i) \sim Normal,$$

after reparametrization:

$$E(y_{it}|\mathbf{x}_{it}, \mathbf{w}_i) = \Phi \left[\frac{\mathbf{x}_{it}\boldsymbol{\beta} + \sum_{r=2}^{T} \psi_r 1[T_i = r] + \bar{\mathbf{x}}_i \xi}{\exp\left(\sum_{r=2}^{T-1} 1[T_i = r]\omega_r\right)^{\frac{1}{2}}} \right]$$

APEs in CRE

- Corresponding **average structural function (AFS)** estimated as:

$$\widehat{ASF}(\mathbf{x}_t) = N^{-1} \sum_{i=1}^{N} \Phi \left[\frac{\mathbf{x}_t \hat{\boldsymbol{\beta}} + \sum_{r=2}^{T} \hat{\psi}_r 1[T_i = r] + \bar{\mathbf{x}}_i \hat{\xi}}{\exp\left(\sum_{r=2}^{T-1} 1[T_i = r] \hat{\omega}_r \right)^{\frac{1}{2}}} \right]$$

- For continuous $\mathbf{x}_t$:

$$\widehat{APE}(\mathbf{x}_t) = \hat{\beta}_j \left\{ N^{-1} \sum_{i=1}^{N} \phi \left[\frac{\mathbf{x}_t \hat{\boldsymbol{\beta}} + \sum_{r=2}^{T} \hat{\psi}_r 1[T_i = r] + \bar{\mathbf{x}}_i \hat{\xi}}{\exp\left(\sum_{r=2}^{T-1} 1[T_i = r] \hat{\omega}_r \right)^{\frac{1}{2}}} \right] \right\}$$

CRE model estimation (*Wooldridge, 2010*)

- Estimating equation derived as a **response probability**
- Directly estimable by **heteroscedastic probit software**, assuming

$$D(c_i|\mathbf{w}_i) \sim Normal$$

CRE model estimation (*Wooldridge, 2010*)

- I use Stata `fhetprobit` (now also `fracreg` command available)
  1. To allow for unobserved heterogeneity in CRE form: outcome equation includes **time averages** of all time-varying covariates
  2. Moreover, both **outcome** and **variance** equations allowed to depend on **number of observations within each subperiod**: T_i
     - Observations with $T_1 = 1$ are dropped
     - $T_i = 4$: reference period
     - Regressors in **outcome equation**:

$$1, \mathbf{x}_{it}, 1[T_i = 2], 1[T_i = 3], \bar{\mathbf{x}}_i$$

     - Regressors in **conditional variance equation**:

$$1[T_i = 2], 1[T_i = 3]$$

     - **APEs** and **delta-method S.E.** obtained through `margins`

Descriptive statistics

Table : Descriptive statistics, by enrollment protocol

	Opt-in	**Auto**	**Total**
Participation rate	0.61	0.82	0.65
Active participants	707.9	1166.7	789.8
Automatic enrollment	0	1	0.18
Employer match	0.77	0.83	0.79
Match rate	0.33	0.37	0.34
Match rate: 0.01-0.50	0.53	0.56	0.53
Match rate: 0.51-1.00	0.21	0.22	0.21
Match rate: 1.01-1.50	0.032	0.044	0.034
Match rate: $>$ 1.50	0.011	0.010	0.011
Sole plan	0.86	0.77	0.84
Erisa 404 (c) plan	0.89	0.95	0.90
Erisa 401 (m) plan	0.94	0.97	0.95
Corrective distributions made	0.31	0.38	0.32
Loans available	0.72	0.85	0.75
Partially self-directed account	0.012	0.015	0.013
Totally self-directed account	0.97	0.98	0.97
Self-directed brokerage option	0.052	0.11	0.062
Default investment account	0.62	0.95	0.68
Employer contrib. in employer securities	0.003	0.008	0.004
Observations	104,332	22,671	127,003

Descriptive statistics

Table : Descriptive statistics: plans that switched to automatic enrollment

	Before	**After**
Participation rate	0.72	0.80
Active participants	969	961
Employer match	0.82	0.81
Match rate	0.34	0.36
Match rate: 0.01-0.50	0.60	0.55
Match rate: 0.51-1.00	0.18	0.20
Match rate: 1.01-1.50	0.037	0.046
Match rate: >1.50	0.0088	0.0093
Erisa 404 (c) plan	0.93	0.95
Erisa 401 (m) plan	0.96	0.96
Corrective distributions made	0.38	0.38
Loans available	0.82	0.81
No self-directed account	0.013	0.009
Partially self-directed account	0.015	0.01
Totally self-directed account	0.97	0.98
Self-directed brokerage option	0.076	0.086
Default investment account	0.67	0.95
Employer contrib. in employer securities	0.006	0.006
Observations	5,816	11,447

Table : Participation equation results

	(1)			(2)			(3)			(4)		
	POLS	**FE**	**FHP**	**POLS**	**FE**	**FHP**	**POLS**	**FE**	**FHP**	**POLS**	**FE**	**FHP**
Automatic enrollment	0.183**	0.065**	0.073**	0.183**	0.065**	0.074**	0.183**	0.065**	0.074**	0.186**	0.074**	0.065**
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Match rate	0.248**	0.056**	0.064**							0.269**	0.061**	0.062**
	(0.003)	(0.003)	(0.004)							(0.004)	(0.003)	(0.004)
Match rate: 0.01-0.50				0.119**	0.024**	0.022**						
				(0.003)	(0.002)	(0.002)						
Match rate: 0.51-1.00				0.198**	0.043**	0.042**						
				(0.004)	(0.002)	(0.005)						
Match rate: 1.01-1.50				0.337**	0.055**	0.062**						
				(0.005)	(0.004)	(0.004)						
Match rate: $>$ 1.50				0.348**	0.065**	0.079**						
				(0.007)	(0.006)	(0.009)						
Employer match							0.151**	0.025**	0.026**			
							(0.003)	(0.002)	(0.002)			
Automatic enrollment $\times$ Match rate										-0.115**	-0.028**	0.012
										(0.006)	(0.005)	(0.008)
Observations	127,003											

Results

Table : Match rate equation results

	POLS	**FE**
Autoenrollment	0.020^{**}	0.012^{**}
	(0.004)	(0.002)
Observations	127,003	

Table : Tests of strict exogeneity

	Participation rate		**Match rate**
	Spec. 1	**Spec. 2**	
Automatic enrollment	0.064**	0.064**	0.013**
	(0.003)	(0.003)	(0.003)
Match rate	0.045**		
	(0.004)		
Employer match		0.022**	
		(0.002)	
Autoenrollment lead	0.001	0.000	-0.003
	(0.003)	(0.003)	(0.004)
Match rate lead	0.000		
	(0.004)		
Employer match lead		0.003	
		(0.002)	
F test (p-value)	0.98	0.94	0.52
Observations		90,319	

Results

Participation equation results

- Switching to auto-enrollment prominent in boosting participation rates (7.4 percentage points)
- A match rate increase of 50 pp increases participation by 3.2 pp
- Nonlinear effect: from 1 pp at lower ranges to 4 pp at higher ranges
- Effect not statistically different in opt-in and opt-out plans
- Match reinstatements increase participation by only 2.5 pp
- Cannot reject strict exogeneity for both equations
- POLS estimates biased upward: i. e., "positive selection"
- FE estimates biased downward compared to FHP

Match equation results

- No evidence of trade-off between auto-enrollment and matching

Conclusions

- Switching to auto-enrollment increase participation rates by 7.4 pp
- Match rate effects: positive and nonlinear; similar for auto-plans
- No evidence of trade-off between auto-enrollment and matching

Thank You!