# Risk-Based Selection in UI: Evidence & Implications

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# Motivation

- In (almost) all countries, unemployment insurance (UI) is mandated with no choice:
  - pay payroll tax when employed
  - receive (fixed) UI benefit when unemployed
- Large literature on generosity of mandated UI:
  - theoretical: optimal generosity of UI trading off insurance vs. incentives
  - empirical: labor supply responses to generosity of UI
- Fundamental questions of UI design remain unanswered:
  - should we in fact mandate UI?
  - can we do better by allowing for choice?

# This Paper: Risk-Based Selection in UI

- Adverse selection (AS) widely recognized as hindering efficient private insurance provision
  - but no direct evidence on AS into UI
  - main challenge? no market, no choices observed
- Exploits unique setting & data in Sweden:
  - Swedish workers receive basic UI benefit, but can opt to buy generous UI coverage
  - we have data on UI choice and employment history for universe of Swedish workers
- This paper provides first evidence of risk-based selection in UI and analyzes implications for design of UI

# Evidence for Risk-based Selection

- We run standard positive correlation tests (PCT), following large insurance literature:
  - unemployment risk is about twice as high for workers with supplemental coverage
- We go beyond PCTs using exogenous variation:
  - in risks to provide direct evidence of risk-based selection
  - in prices to assess welfare-relevant selection
- Different strategies confirm the same conclusion:
  $\Rightarrow$ UI choices are (severely) adversely selected

# Implications for UI Design

- We derive simple, yet robust tests and 'sufficient statistics' formulae
- Implementation in Sweden (preliminary!):
  1. *despite* substantial selection, a universal mandate into supplemental coverage would be inefficient
  2. *due to* substantial selection, optimality of large subsidy ($\sim$ 78 percent of average costs) cannot be rejected
  3. minimum mandate can be optimal in combination with large subsidy
- Severe adverse selection justifies significant policy interventions, but not necessarily the mandated generous UI coverage seen in Europe

# Related Literature

- Large literature on PCTs in insurance markets:
  - uses (mostly proprietary) data on plan choices and costs
  - see Chiappori and Salanie 2000 and many others
- No direct evidence on adverse selection in UI:
  - Hendren (2016) is the exception
  - uses surveyed job loss probabilities to gauge workers' private information
  - can explain absence of private UI market (in addition to public policy)
- Recent literature assesses welfare and policy implications of adverse selection:
  - stylized models taking insurance plans as given (e.g., Einav et al. 2010)
  - new work considers endogeneity of plans (e.g., Veiga and Weyl 2016, Azevedo et Gottlieb 2016)

# Outline


1. Introduction
2. Institutional Background & Data
3. Positive Correlation Test
4. Beyond Correlation Test
   - Variation in Risks
   - Variation in Prices
5. Policy implications and welfare

# Swedish UI System

- Eligible, displaced worker receives one of 2 types of coverage.
- Minimum coverage:
  - mandated and funded by payroll tax ($p_0$)
  - benefit is flat and low ($b_0 \approx 20\%$ for median income earner)
- Supplemental coverage:
  - workers can voluntary opt for extra coverage
  - pay UI premia ($p_1 - p_0$) to UI funds (*Kassa*)
  - benefit is income-related and generous ($b_1 \approx 72\%$ of pre-U wage)
- Gvt defines premia and UI benefit levels
  - no price discrimination (age, gender,...)
  - no price differentiation across Kassa's
  - *Kassa* subsidized by gvt

▸ Additional institutional details

# Data

- UI fund membership info for universe of workers (2002-2009) ▸ Details
- Public Employment Service (1990-2015) + UI benefit registers ▸ Details
- LISA (tax, transfers and demographics) (1999-2015) ▸ Details
- Wealth register ▸ Details
- RAMS (matched employer-employee) (1985-2015) ▸ Details
- Layoff-notification register (2002-2012) ▸ Details

1 Introduction

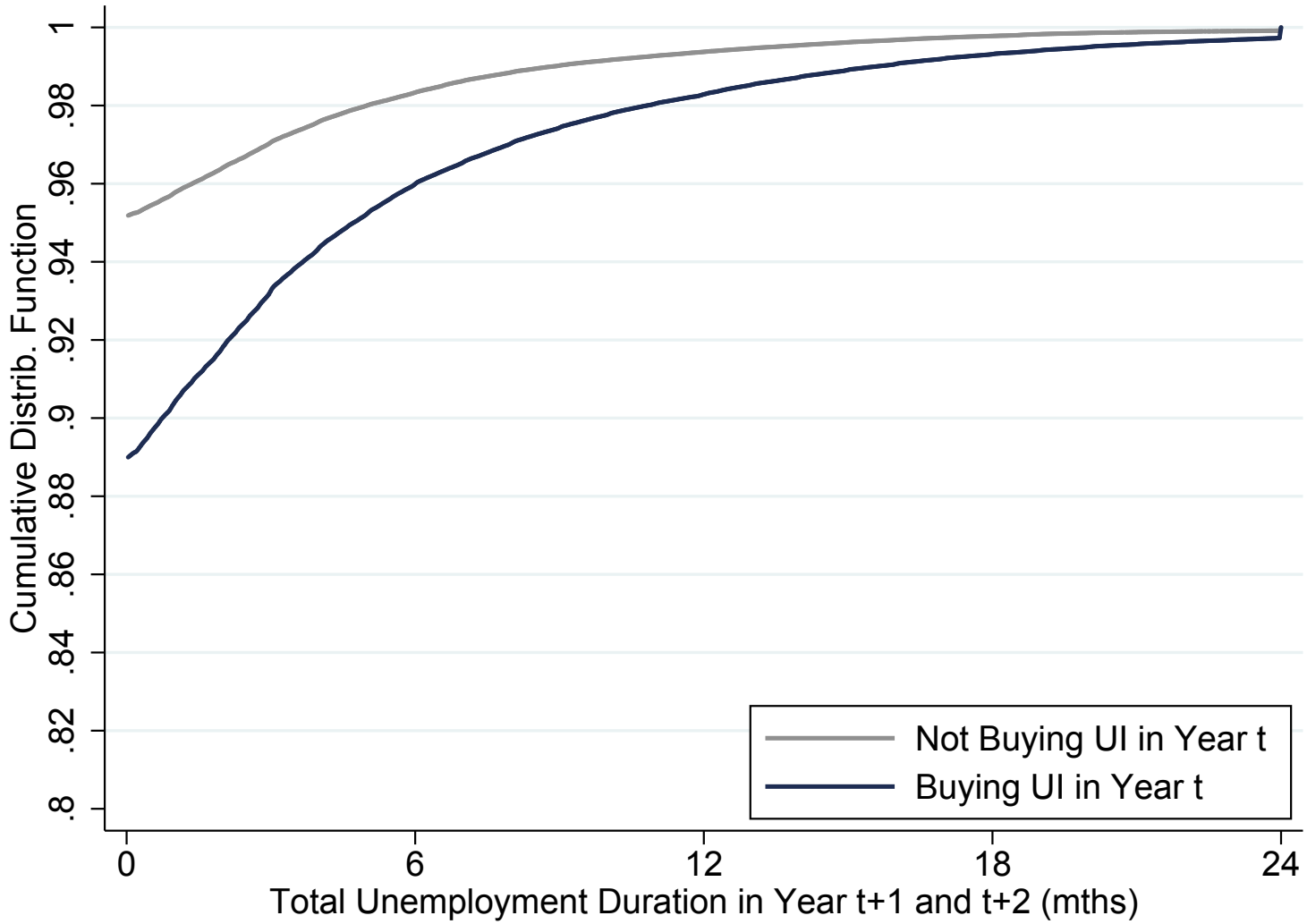
2 Institutional Background & Data

3 Positive Correlation Test

4 Beyond Correlation Test
- Variation in Risks
- Variation in Prices

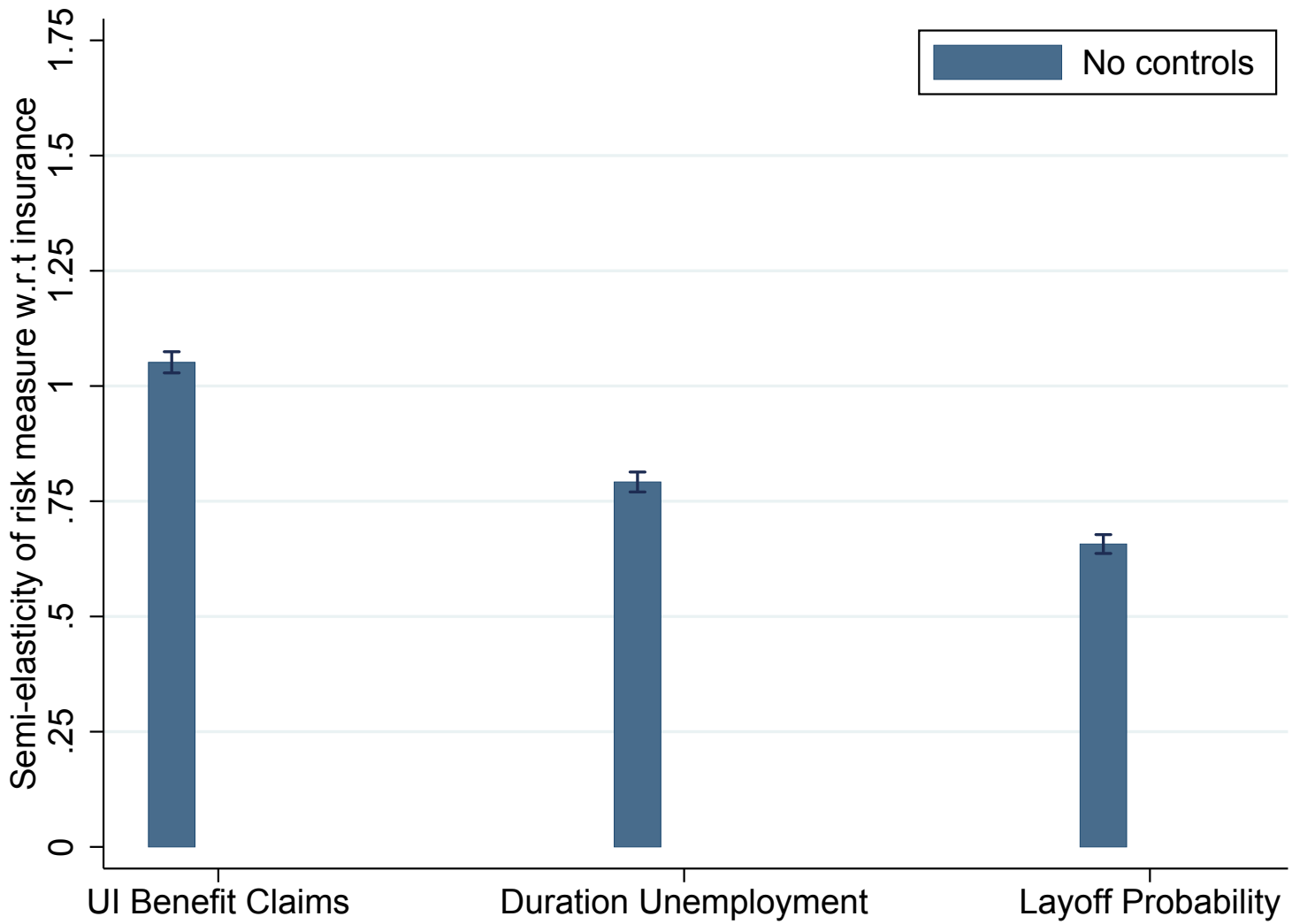
5 Policy implications and welfare

# Future Unemployment Duration By Insurance Status



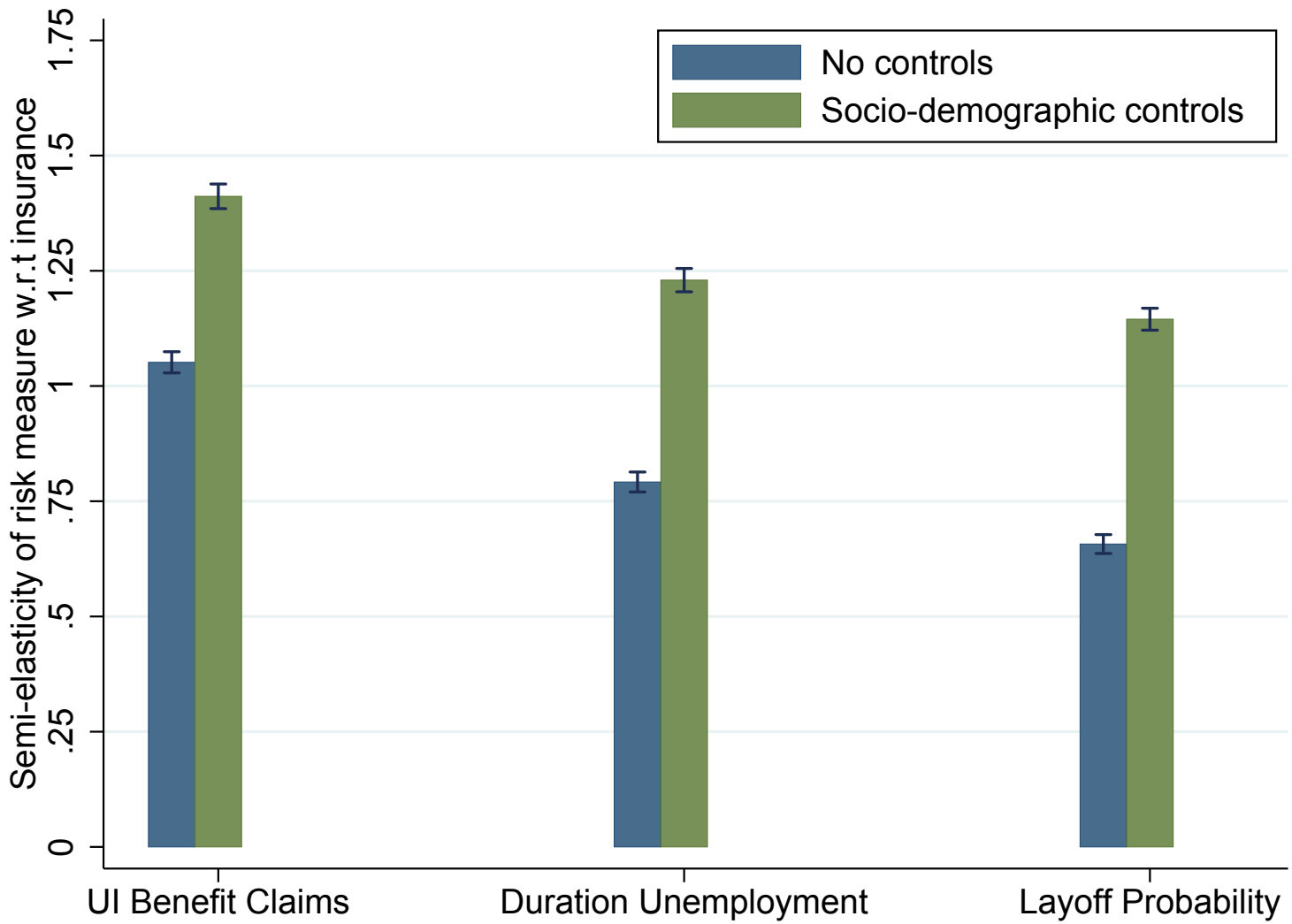

▸ Details ▸ Summary Stats

# Positive Correlation Test: $\mathbb{E}_I[y_i] \geq \mathbb{E}_U[y_i]$



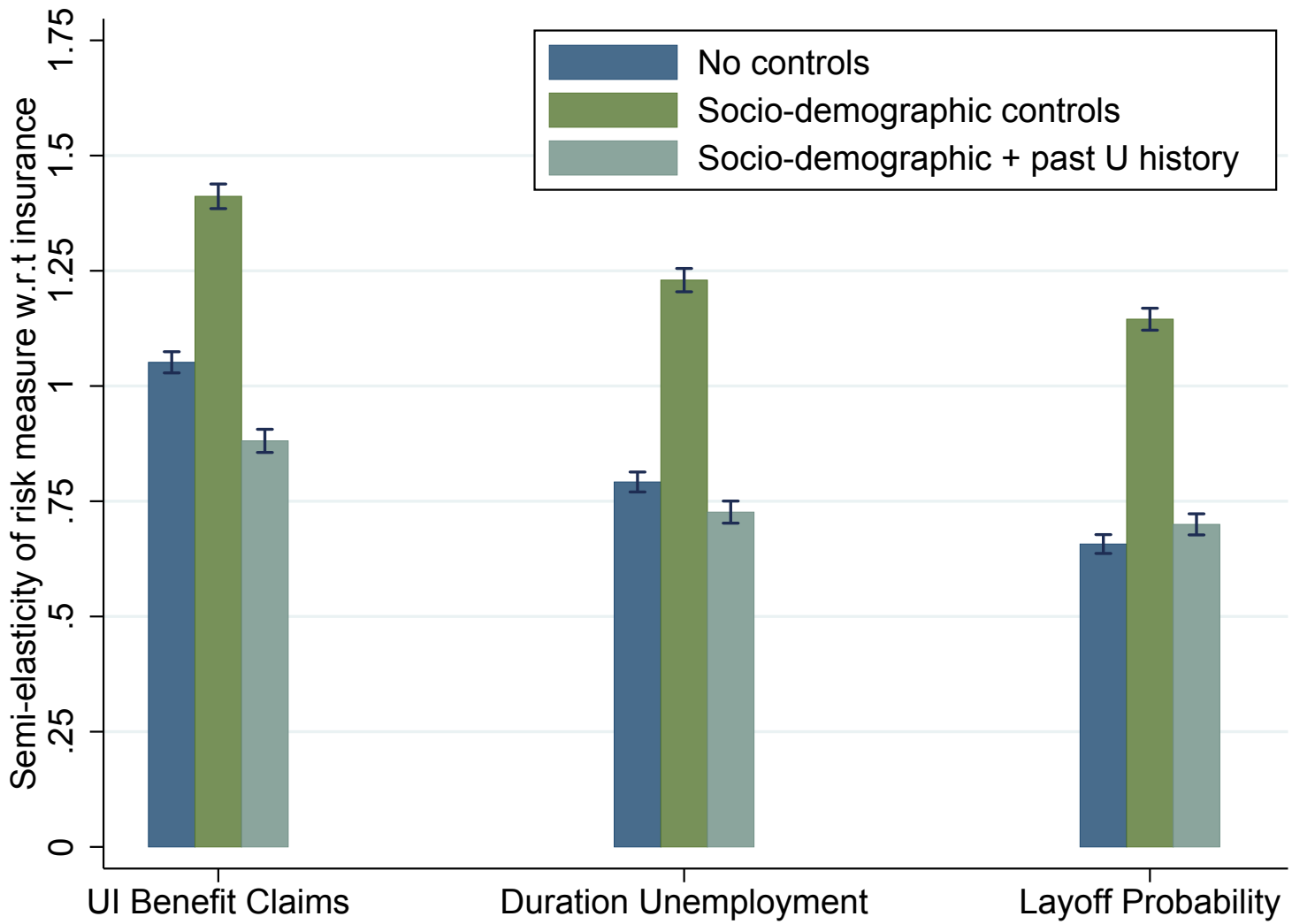

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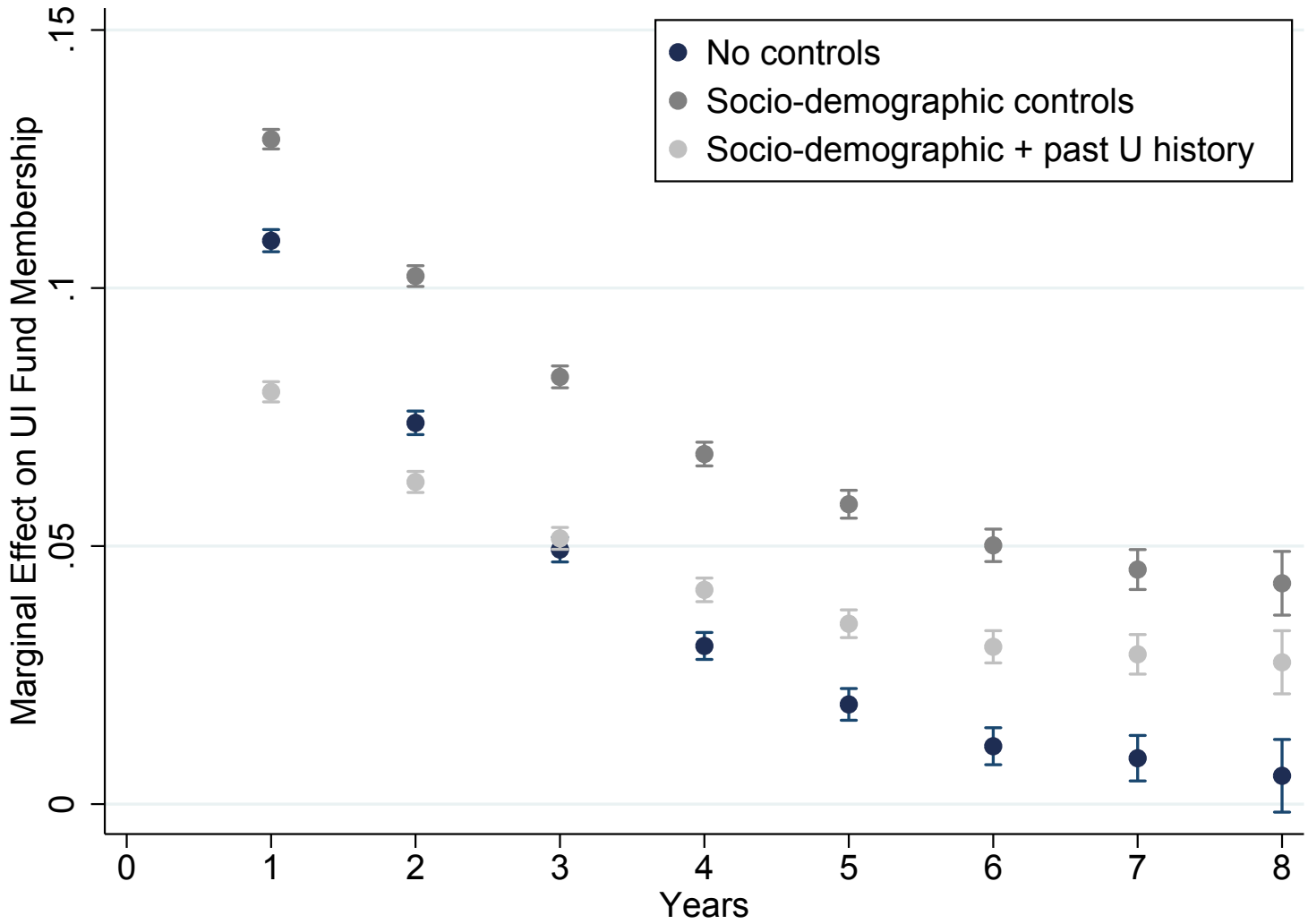

▸ Details

# Positive Correlation Test: $\mathbb{E}_I[y_i] \geq \mathbb{E}_U[y_i]$




▸ Details

# PCT: Correlation with Unemployment in Future Years



# Regression-based PCT: Discussion

- Identical results when doing traditional "bivariate probit" analysis *a la* Chiappori & Salanie
- Higher $\hat{\beta}$ when introducing socio-demographic controls suggest that these covariates create advantageous selection
  - E.g.: age negatively correlated with $\pi$ but positively correlated with UI coverage
- PCT using layoff probability not confounded by MH during unemployment, but still potentially by "MH on the job"
- Dynamics: even after controlling for past U history, significant correlation between insurance choice and unemployment risk in $t + 8$

# Positive Correlation Test: Decomposition

- Consider linear model of wtp for supplemental coverage $v$ $(= v_1 - v_0)$:

$$v = b\pi + cX + \mu$$

- **Issue**: PCT with ex-post realization of risk type $\pi$

$$b_{OLS,bivar.} = \text{risk-based selection} + \text{MH} - \text{attenuation bias} + \text{selection on risk-related heterogeneity}$$

- Go beyond PCT using two strategies:
  1. Risk variation
  2. Price variation

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$$b_{IV\text{-Risk}} = \textbf{risk-based selection} + \sout{\text{MH}} - \sout{\text{attenuation bias}} + \sout{\text{selection on risk-related heterogeneity}}$$

- Go beyond PCT using two strategies:
  1. **Risk variation**
     - Use *instruments* for individuals' risks: firm shocks, tenure
     - Direct test for asymmetric information
  2. Price variation

# Positive Correlation Test: Decomposition

- Consider linear model of wtp for supplemental coverage $v$ $(= v_1 - v_0)$:

$$v = b\pi + cX + \mu$$

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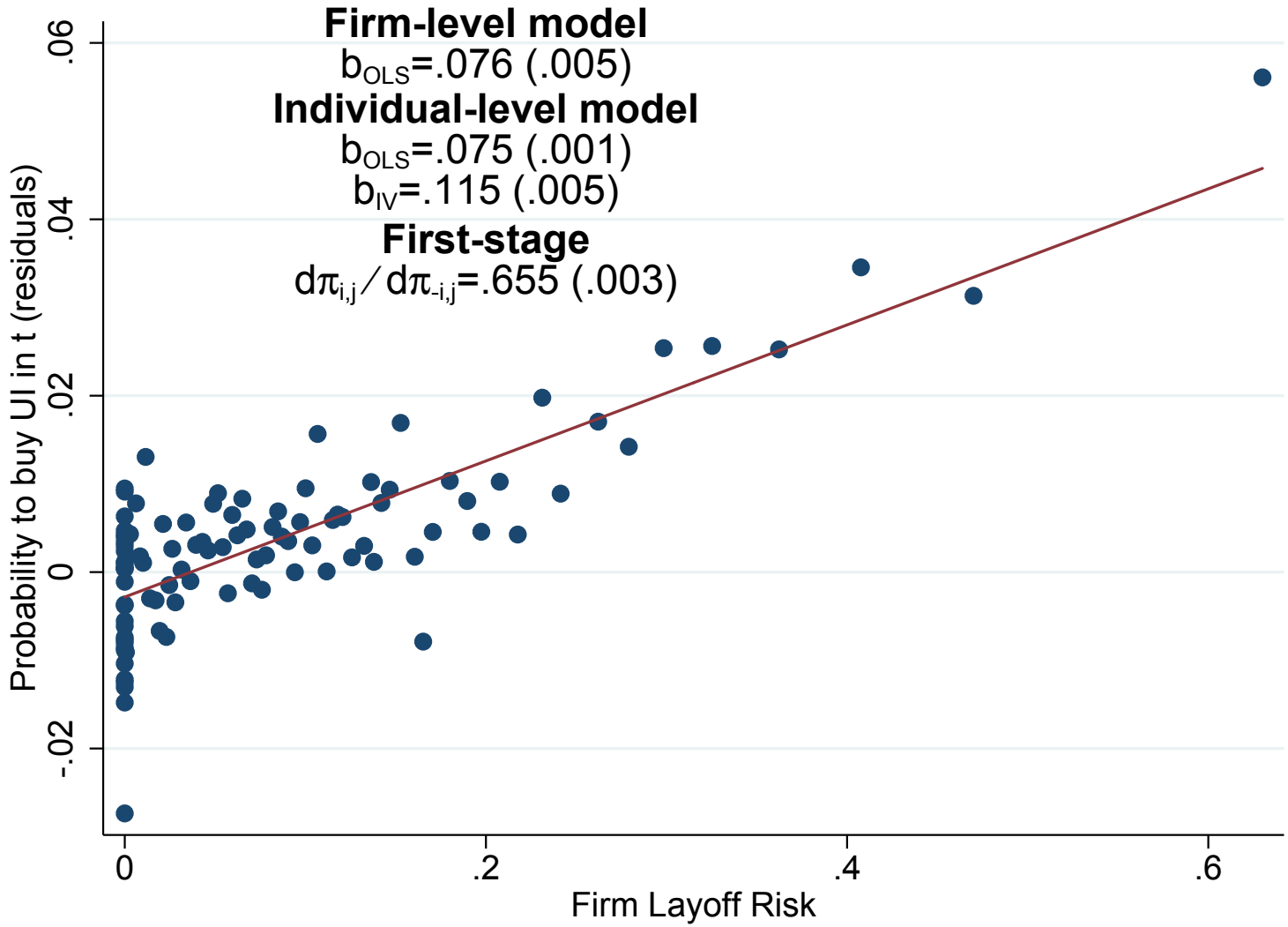
- Go beyond PCT using two strategies:
  1. Risk variation
  2. **Price variation**
     - Reveals welfare-relevant selection, given unpriced heterogeneity

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# Risk Variation: Empirical Agenda

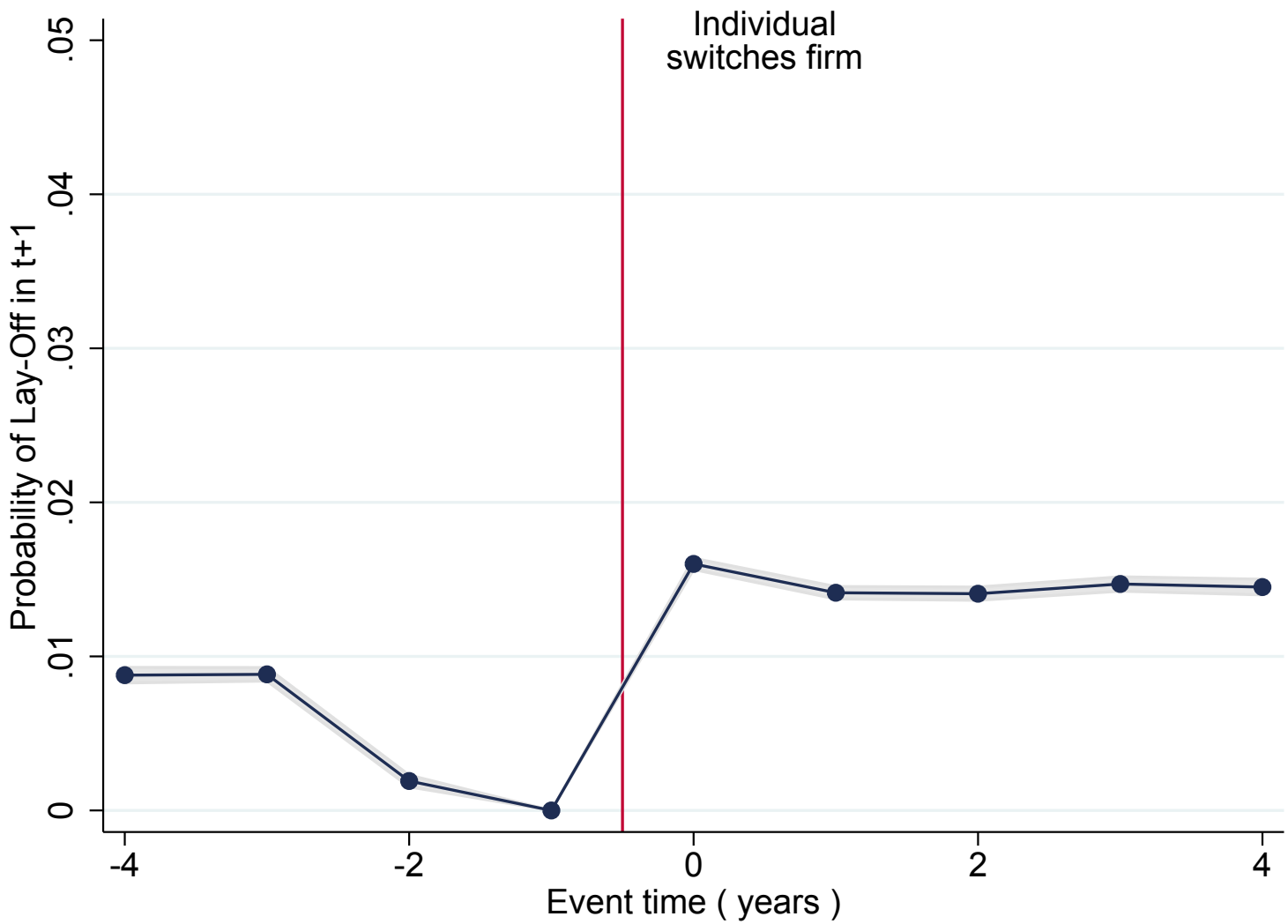
- Use the fact that $\pi_i = \pi(\theta_i, \bar{\pi}_{-i,j}, T_{ij})$
  - $\bar{\pi}_{-i,j}$: average layoff risk of other individuals in firm $j$
  - $T_{ij}$: tenure of individual $i$ in firm $j$
- Strategy:
  1. Firm-level risk and Tenure - Cross-section
     - Individuals in riskier firms $\bar{\pi}_{-i,j}$ more likely to buy UI
     - Individuals with low tenure $T_{i,j}$ more likely to buy UI
  2. Controlling for individual heterogeneity (panel) - Switchers
     - Individuals who switch firm lose tenure rank, are more likely to be laid-off and are more likely to buy UI
     - Effect is larger the larger is the change in firm riskiness $\bar{\pi}_j$
  3. Controlling for individual & firm-level heterogeneity (panel) - Firm level shocks
     - Individuals in firms experiencing shocks ($\Delta\bar{\pi}_j$, layoff notification) more likely to buy insurance

# Firm Level Risk & Proba to buy UI - Cross-section



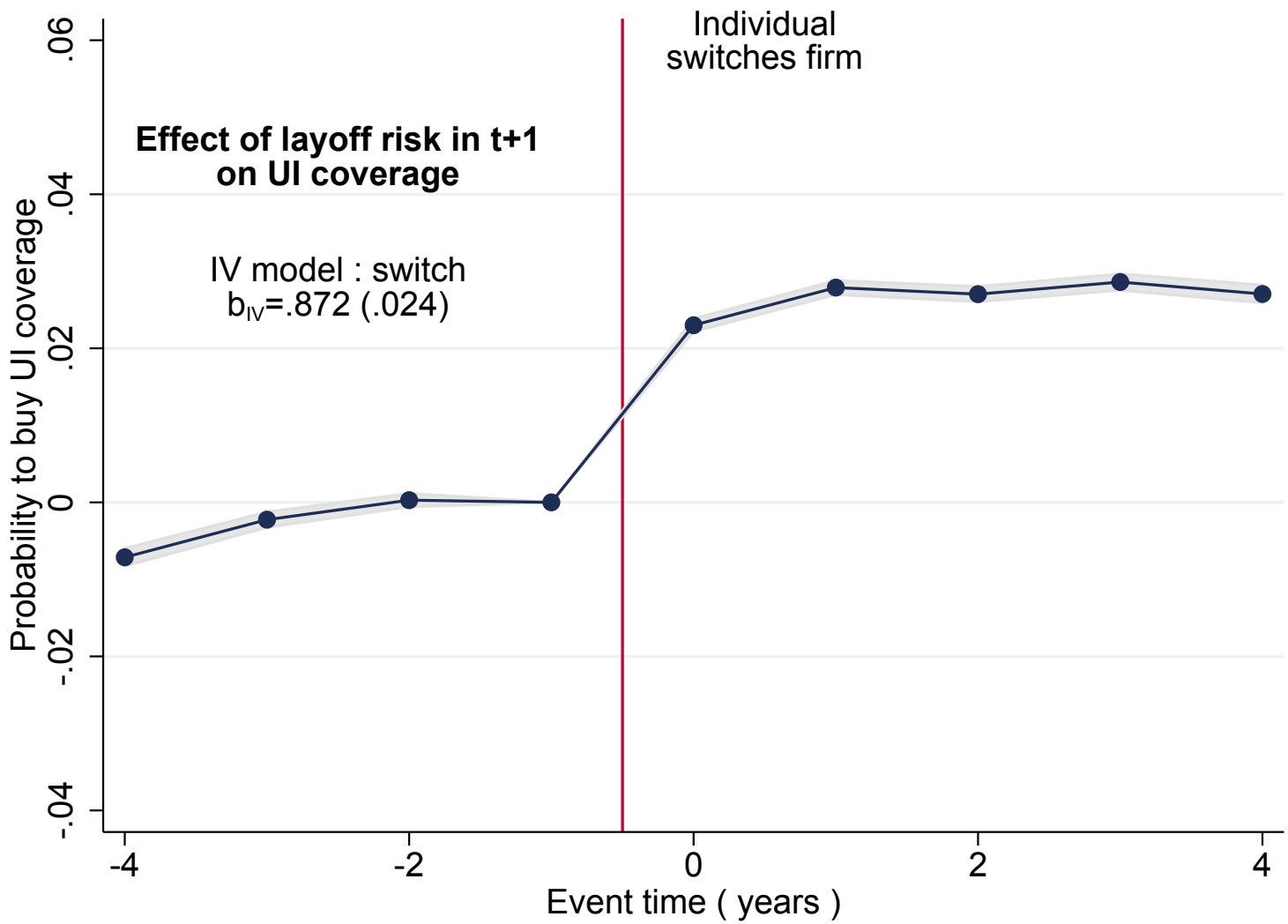

▸ Details ▸ Tenure Rank

# Controlling for individual heterogeneity (panel) - Switchers



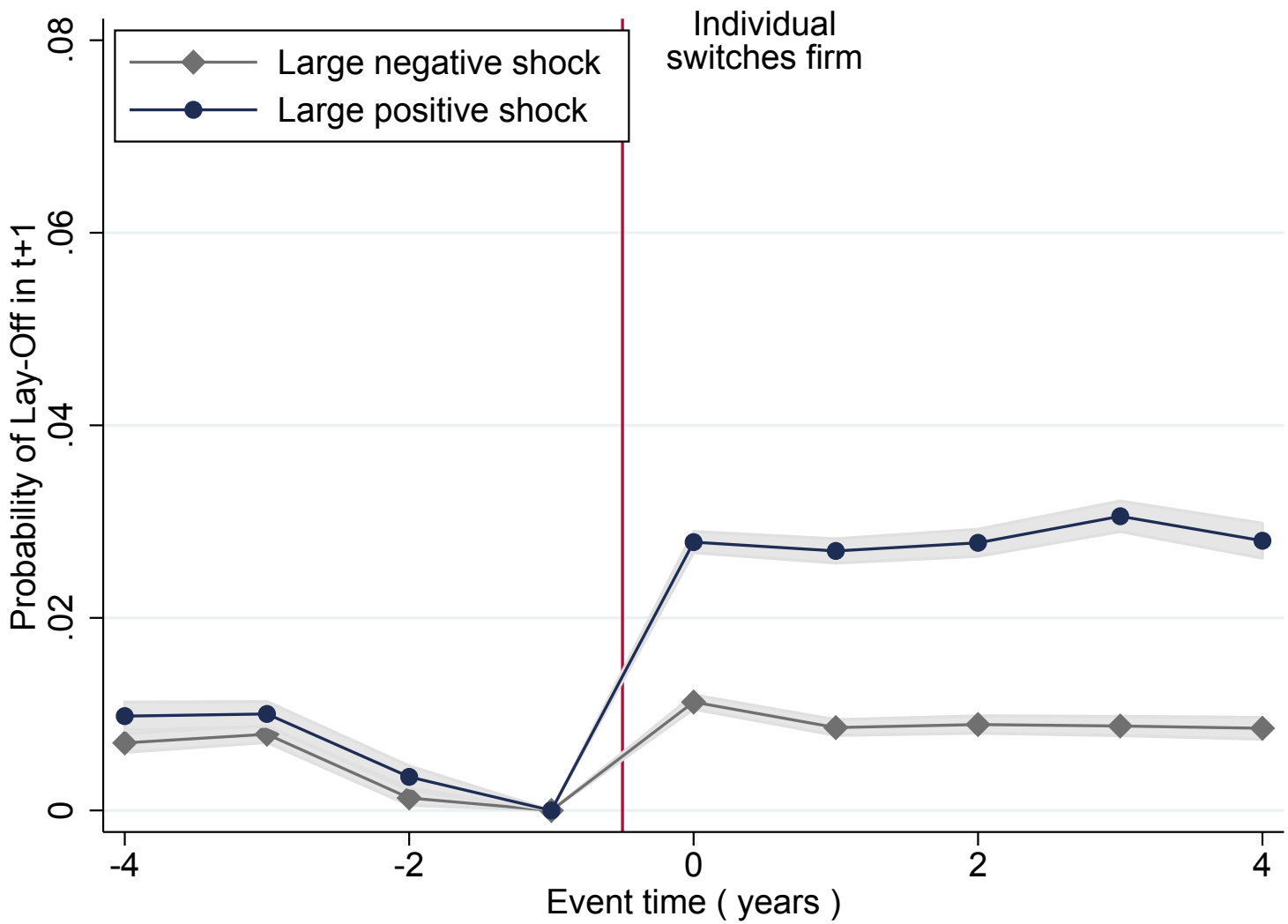

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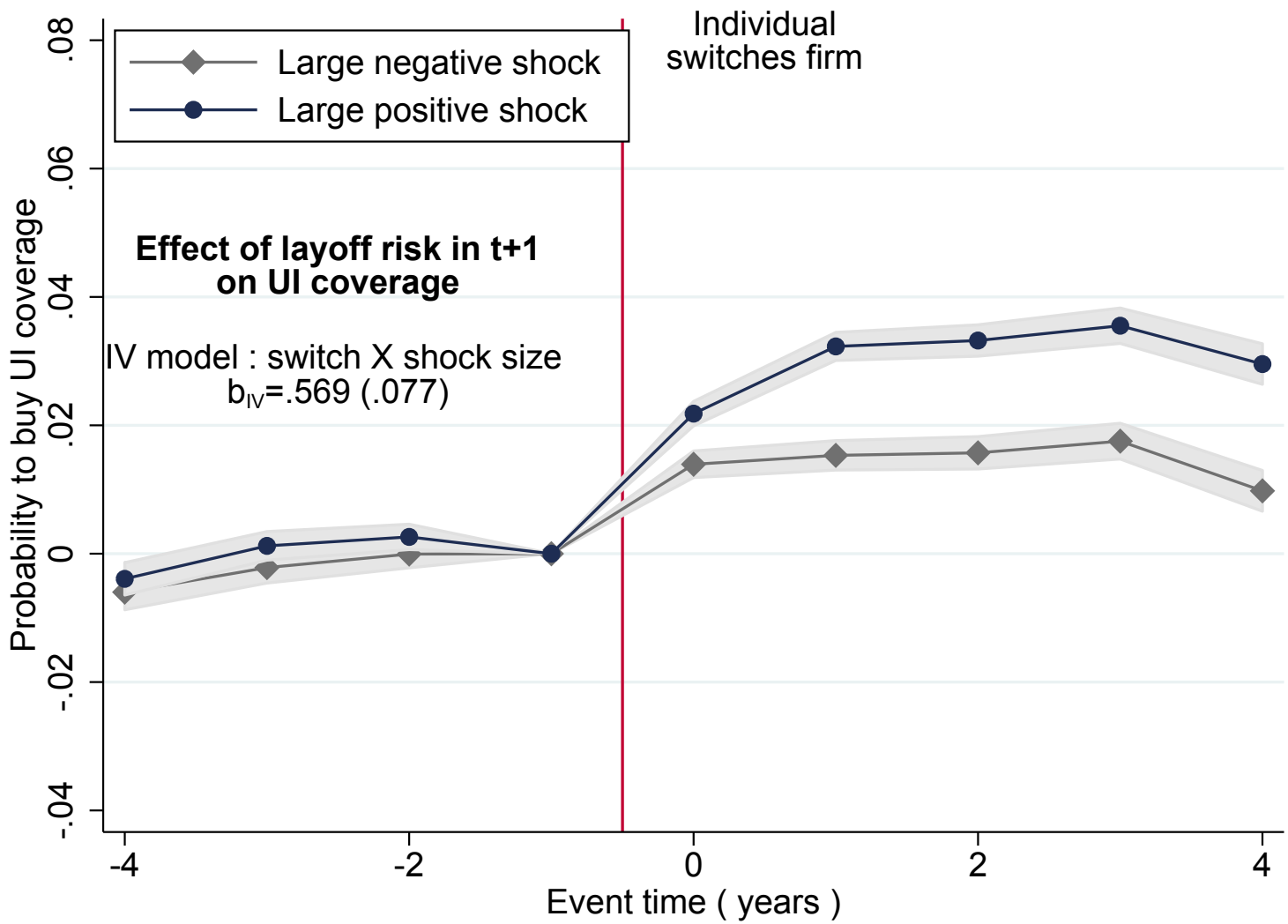

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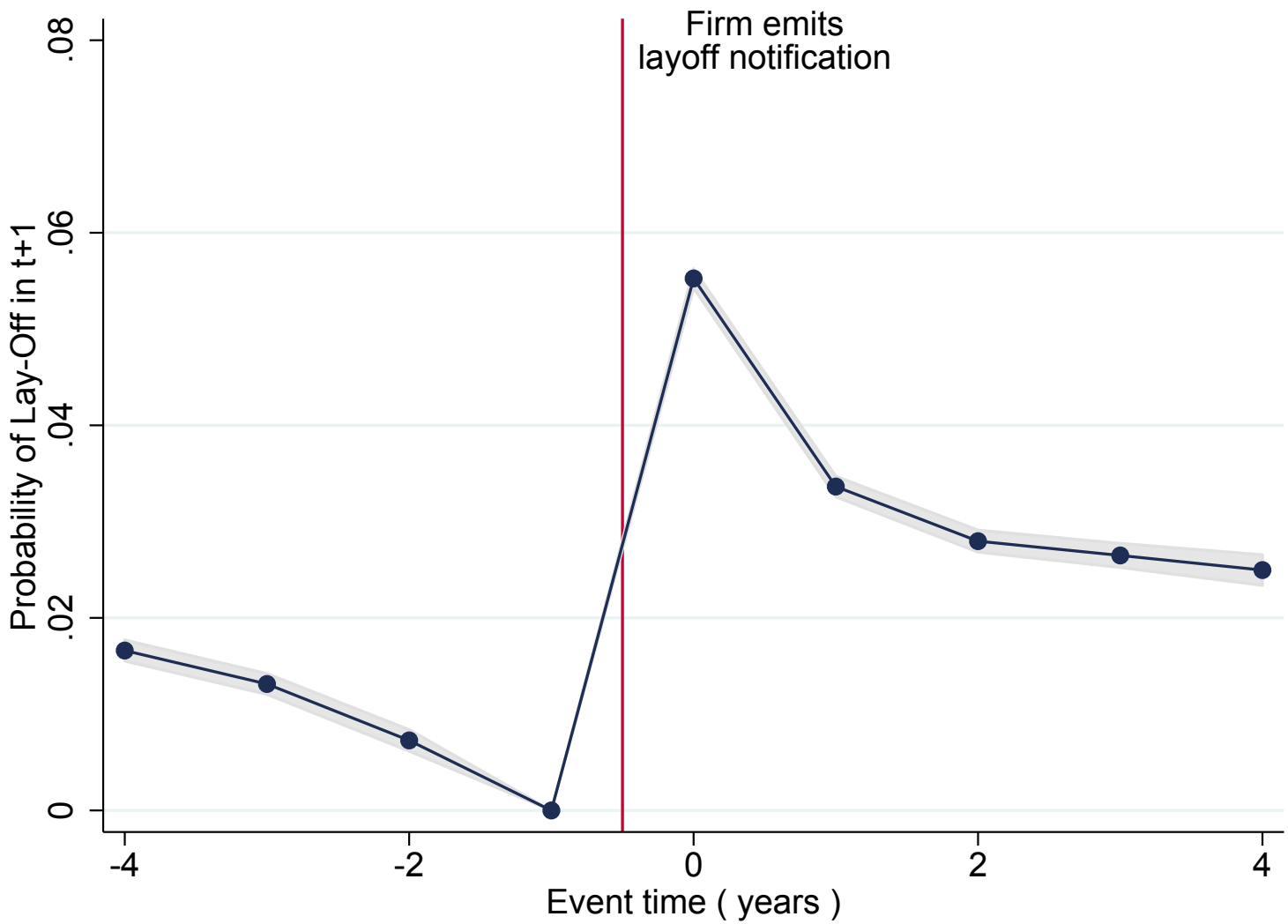

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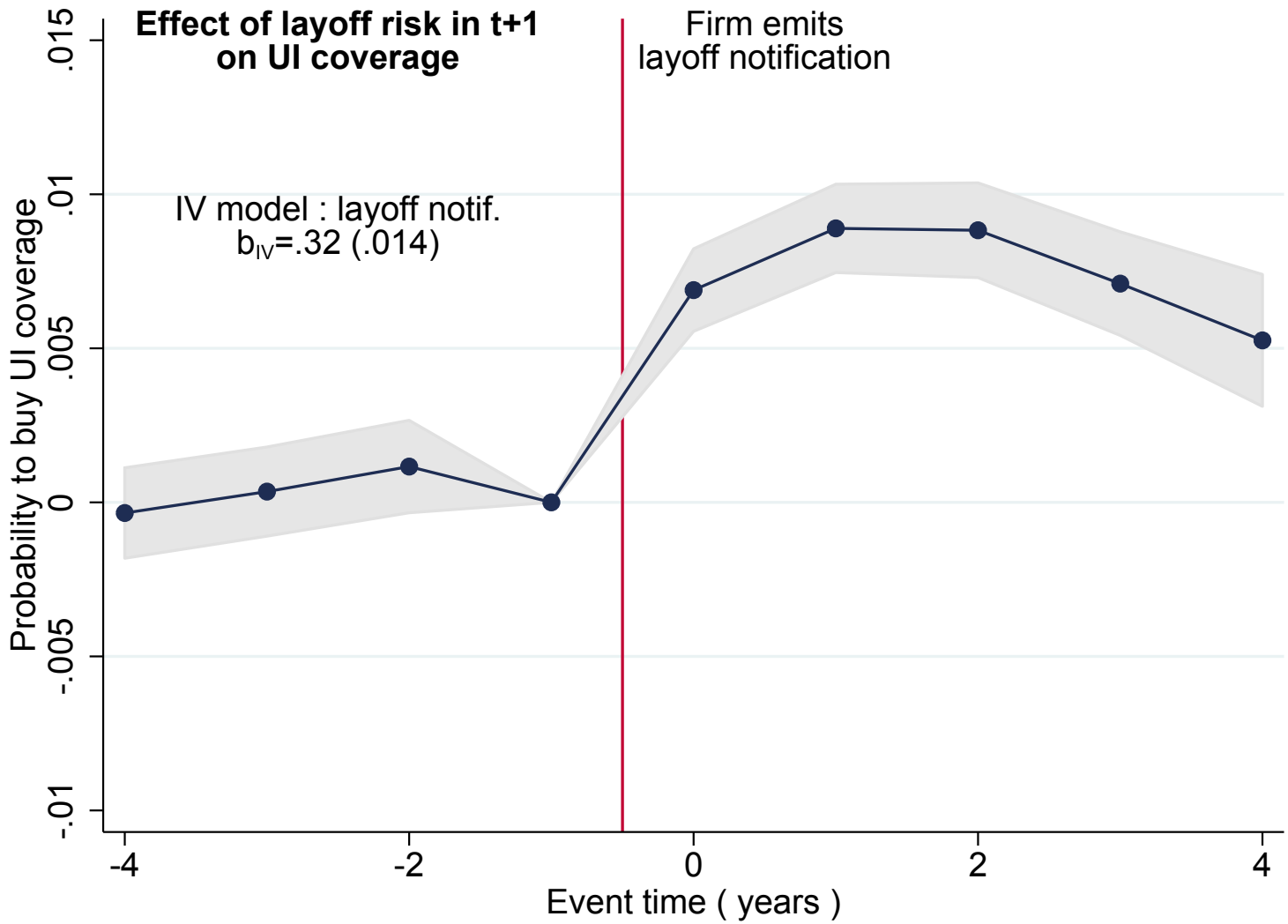

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# Controls for Individual & Firm Heterogeneity - Firm shocks




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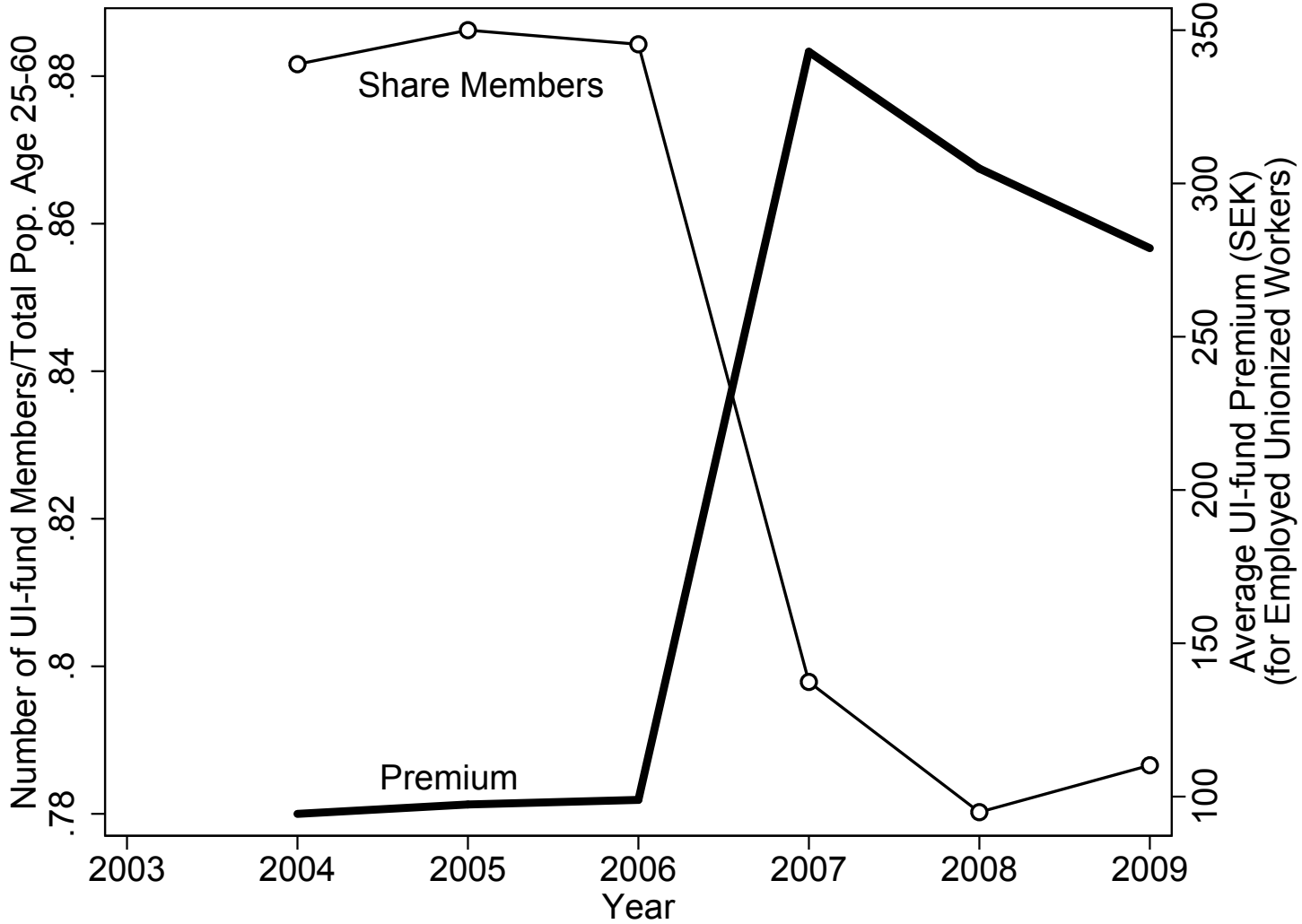

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# Beyond Correlation Test: Variation in Prices

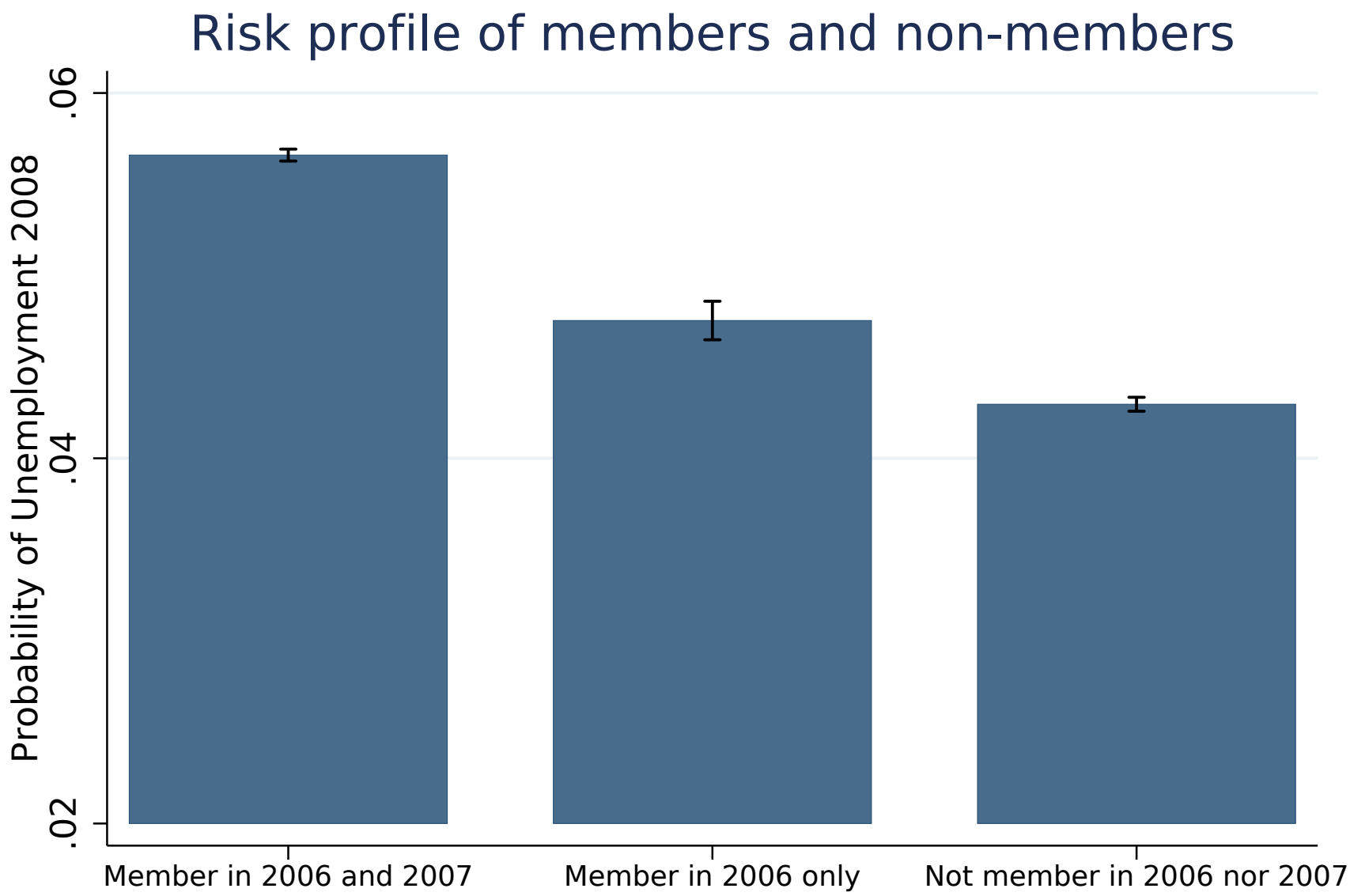
- Risk variation useful to identify that risk-based selection (and not MH) drives PCT
- But exogenous risk variation "kills" risk-related heterogeneity in preferences.
- Selection based on (unpriced) risk-related preferences is as relevant for cost of providing UI and thus welfare cost of adverse selection.
- Price variation allows identifying how risk varies with wtp for UI
  - use large "surprise" increase in UI premia in 2007
  - identify risk profile of marginals
  - compare to risk profile of inframarginals (conditional on same UI plan)

# Price Variation: the 2007 Reform




▸ Transition Rates

# Preliminary: Unemployment Risk by Willingness to Pay



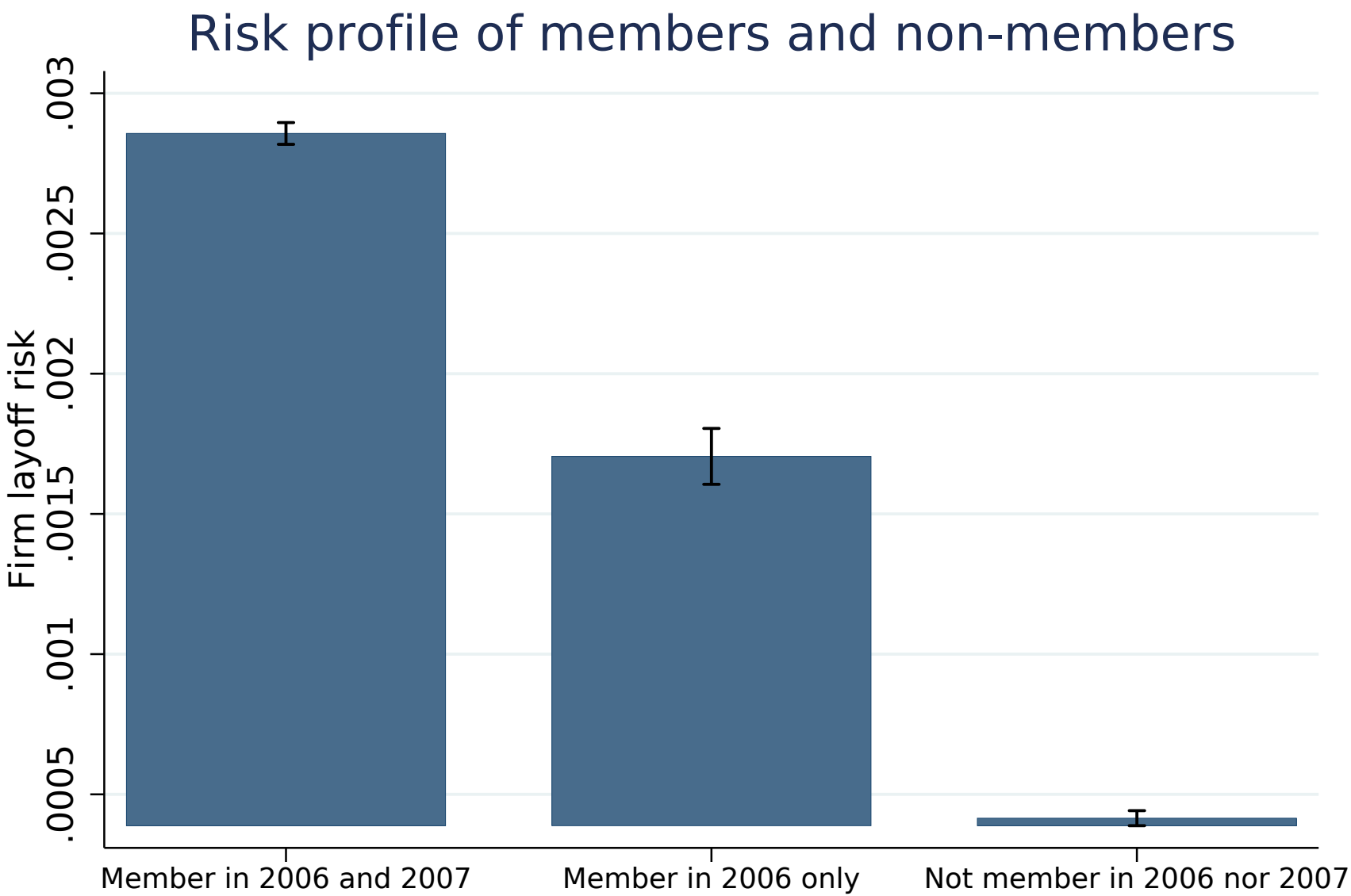

Group means of Unemployment Risk. The Unemployment risk is based on a dummy variable indicating whether or not an individual registred (ALL spells) as Unemployed at the PES in 2008.

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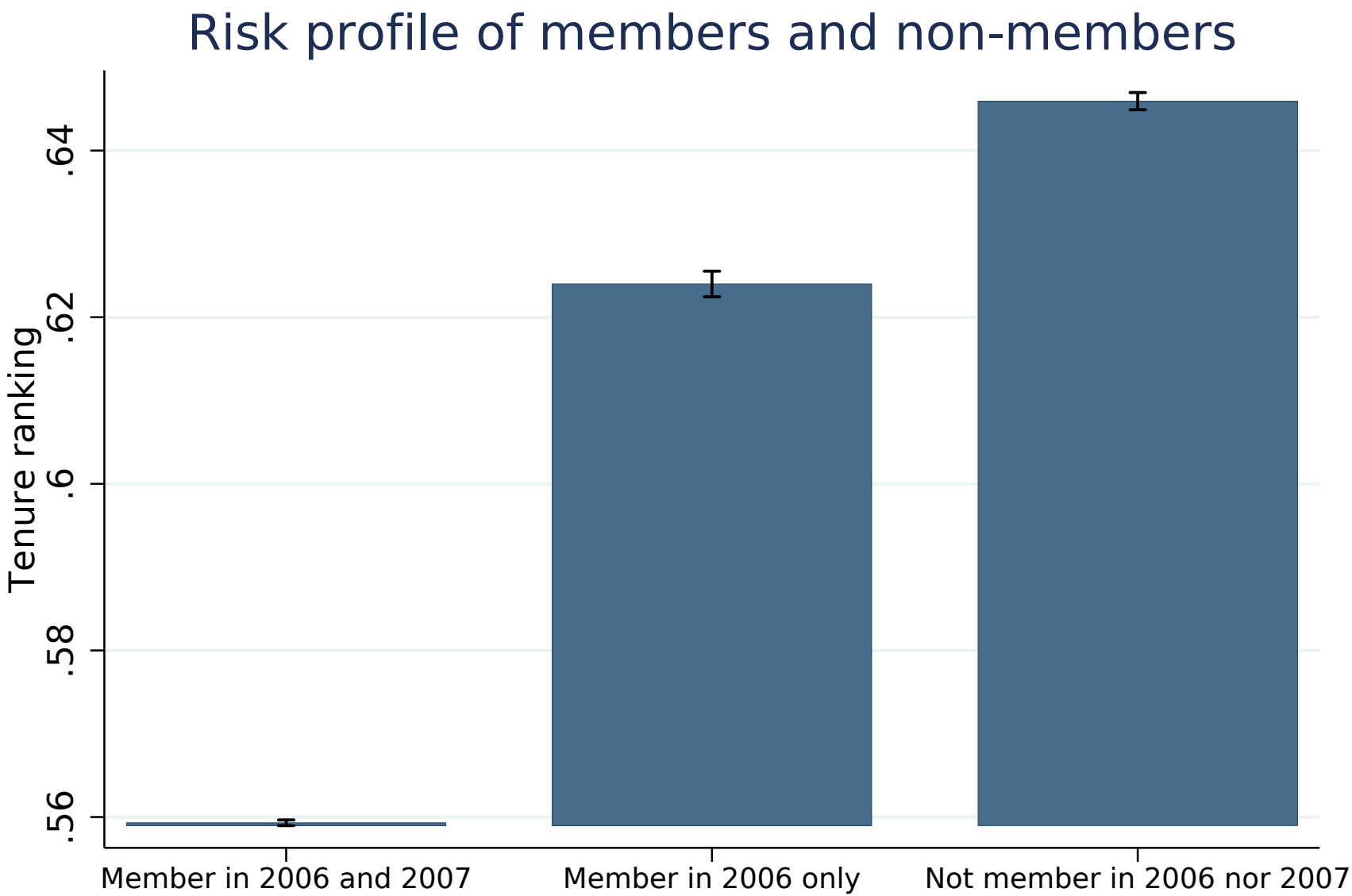

Group means of Supplementary Insurance Cost. The Unemployment Insurance Cost is based on the number of days an individual was registred (using All spell(s)) as Unemployed at the PES in 2008*Daily Benefits .

# Robustness: Firm Risk by Willingness to Pay



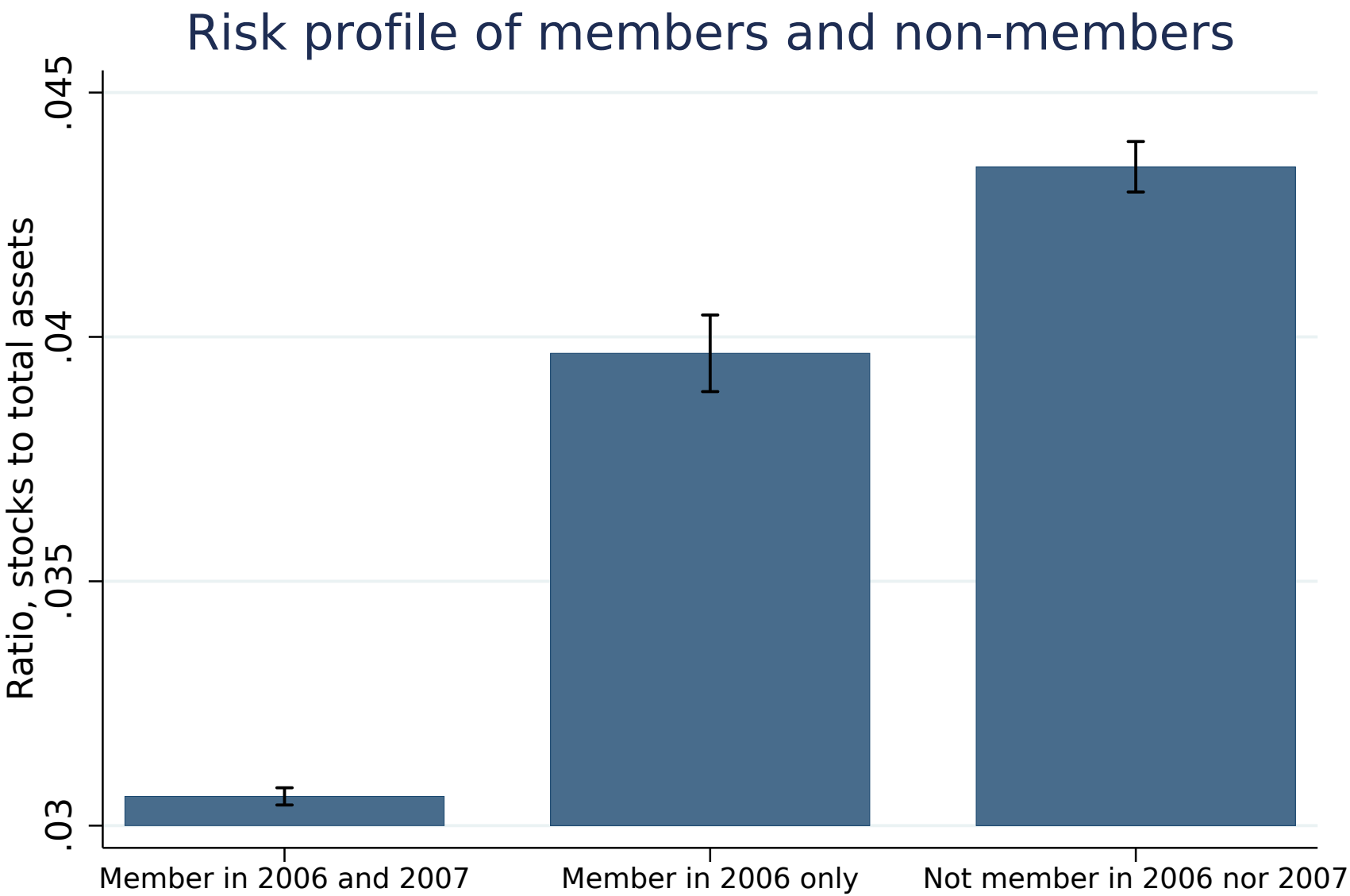

Group means of firm layoff risk. A firm's layoff risk is measured as the share of its employees receiving a layoff notification in 2008.
For each individual, the variable is set equal to the layoff risk of the firm he/she is working at in 2006.

# Robustness: Tenure by Willingness to Pay




Group means of tenure risk, based on relative tenure within the firm in 2006, controlling for age and actual tenure (in months).
A relative tenure of 0 indicates that the employee was the last one hired.

# Extra: Preference by Willingness to Pay




Group means of stock value to total asset value ratio, constructed as the total value of stocks as share of total assets in 2006.
Individuals having less than 20,000 SEK in total asset value has been removed.

# Implications for Unemployment Policy

- Risk-based selection causes UI markets to be inefficient
  $\Rightarrow$ gvt response = mandate generous UI coverages
- But no direct evidence that this is the optimal design of UI
- Swedish set-up with coverage choice allows for investigation of unexplored questions for design of UI
  1. should we mandate individuals to buy generous UI coverages?
  2. should UI policy allow for choice, and how?

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  2. **Should UI policy allow for choice, and how?**

# Stylized Framework

- UI system: basic plan $(b_0, p_0)$ & generous plan $(b_1, p_1)$
  - agent chooses plan providing highest utility $v_k - p_k$
  - expected cost of providing plan $c_k$ depends on agent's type and effort
  - government can cross-subsidize to satisfy budget constraint
- Example:
  - net value of plan $k$ to an agent equals

$$v_k(\theta) - p_k = \max_{a'} \pi(\theta, a')\, u(b_k - p_k | \theta, a') + (1 - \pi(\theta, a'))\, u(w - p_k | \theta, a')$$

  - cost of providing plan $k$ to this agent equals

$$c_k(\theta, a|k) = \pi(\theta, a|k)\, b_k \equiv c_k$$

  - cost of providing plan $k$ to agent observed under less generous plan $l$ is at least

$$c_k(\theta, a|l) = \pi(\theta, a|l)\, b_k \equiv c_{k|l}$$

# Q1: A Universal Mandate?

- Socially efficient to insure worker iff value exceeds cost, i.e.,

$$v_1 - v_0 \geq c_1 - c_0$$

- Use RP argument to bound valuation:
  - worker buys generous coverage iff

$$v_1 - v_0 \geq p_1 - p_0$$

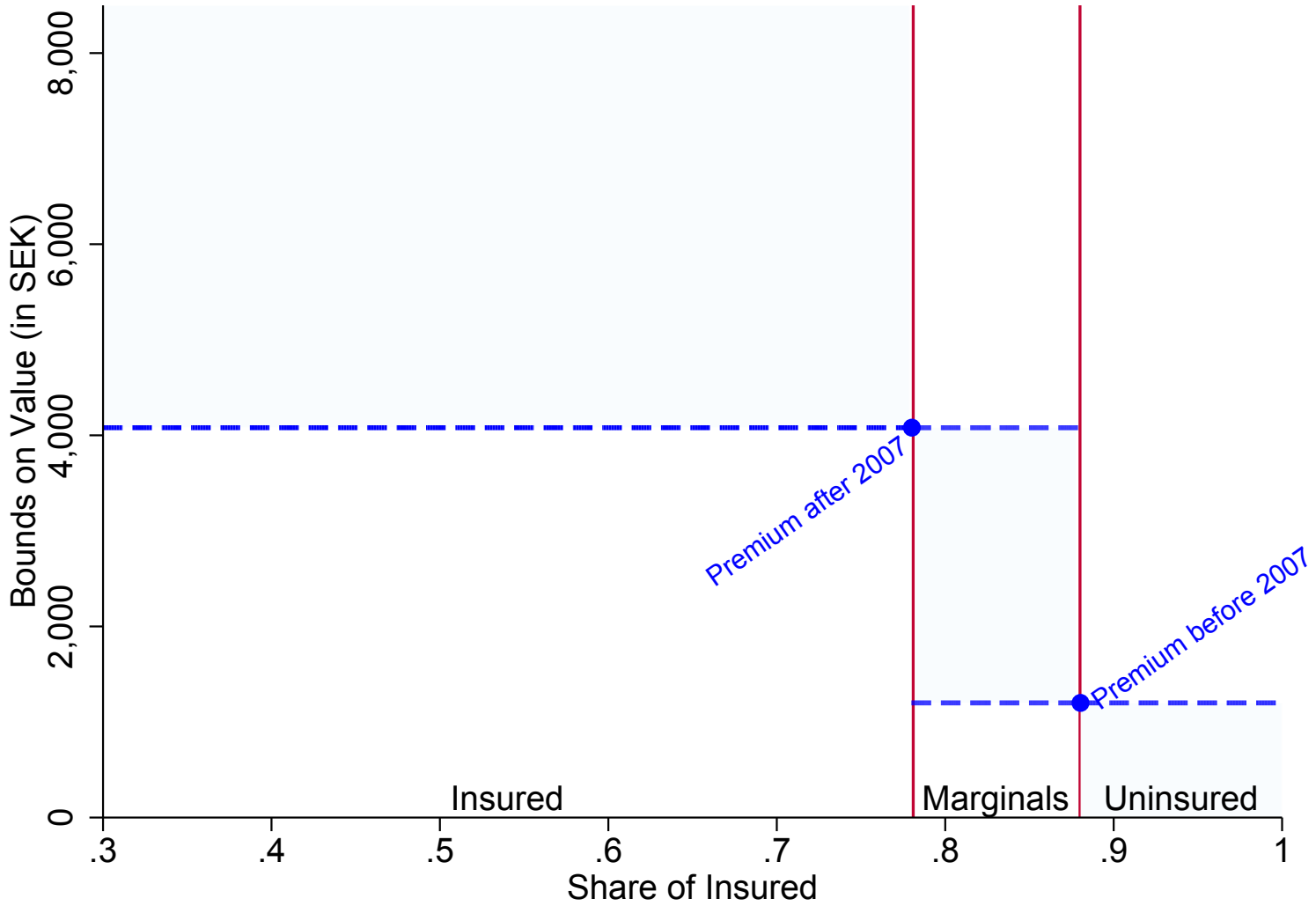
  - observed price differential reflects valuation of *Marginals* and provides an upperbound on valuation of *Uninsured*
- Impute cost differential $E_k(c_{1|k} - c_{0|k})$, which accounts for risk selection, but not for moral hazard

$$E_k(c_{1|k} - c_{0|k}) \leq E_k(c_1 - c_0)$$

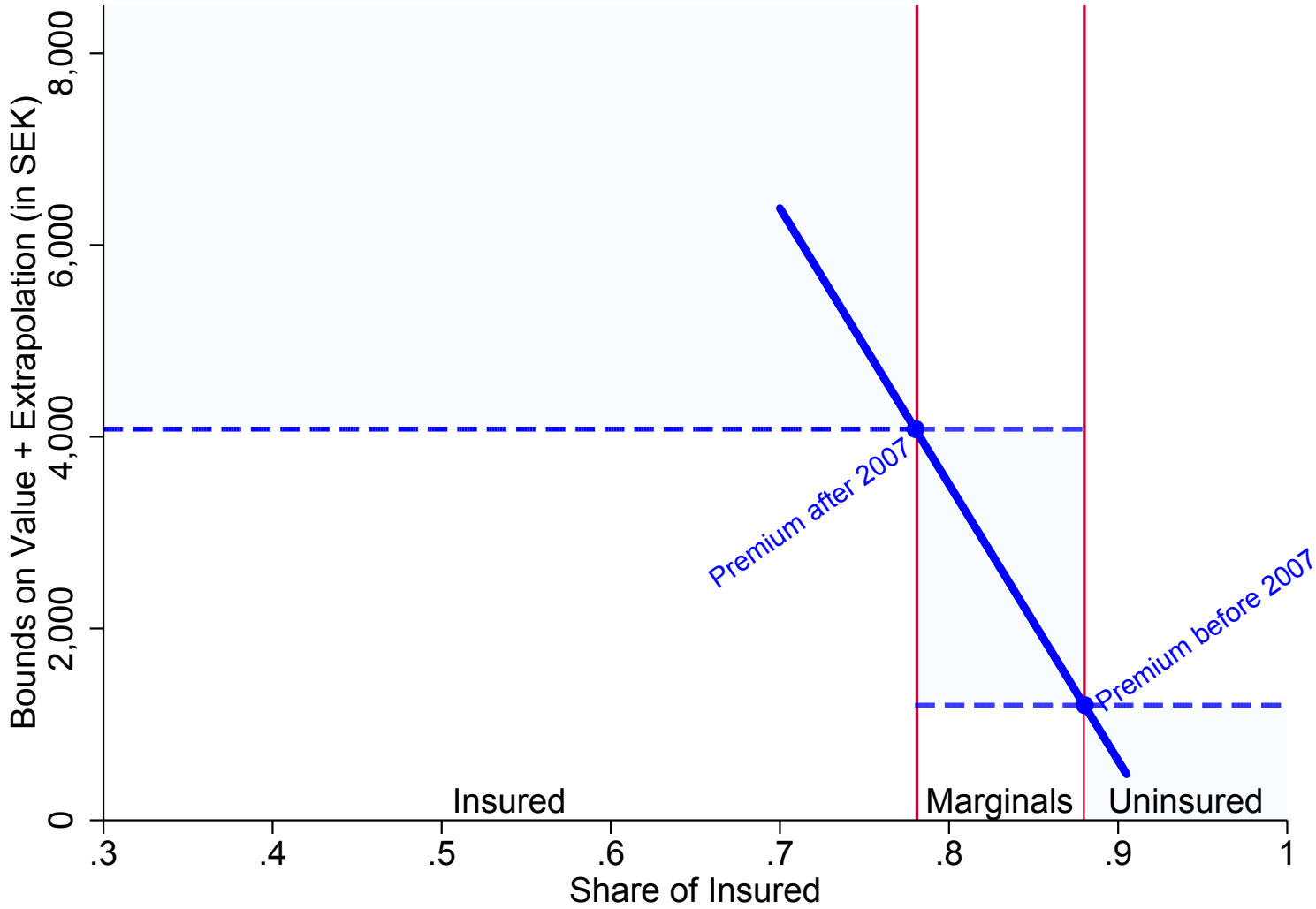
# Q1: A Universal Mandate?

- Exploit observed UI choices and the corresponding costs given price variation
  - Traces (locally) demand curve
  - Traces (locally) MC curve ( Einav et al. 2010)
- (Preliminary) implementation suggests:
  - not socially efficient to further reduce population of uninsured
  - insurance choices are approximately efficient for workers at the margin
- Mandates of generous UI coverage (cf. Europe) not necessarily optimal

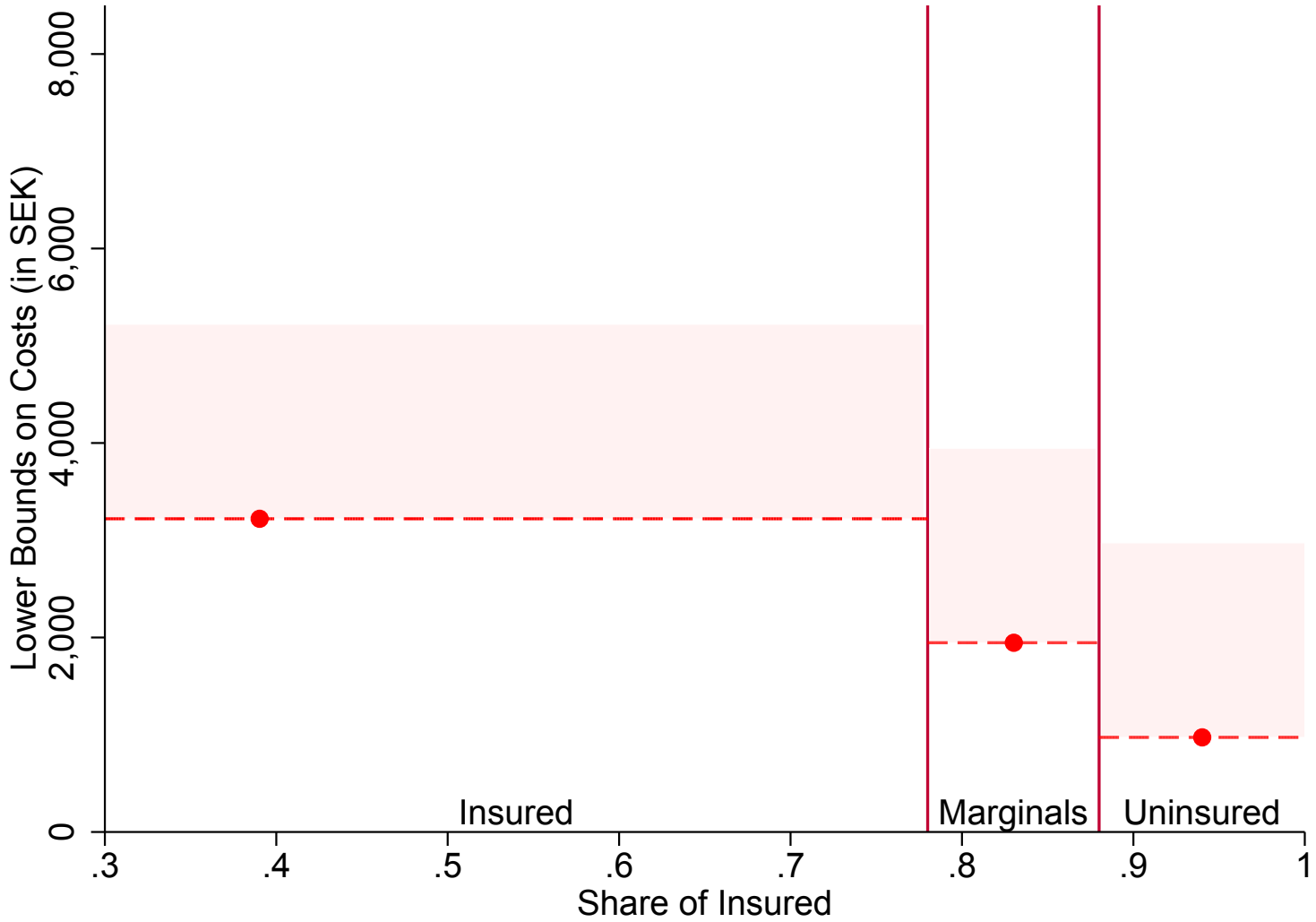
# Implementation: Graphical Representation



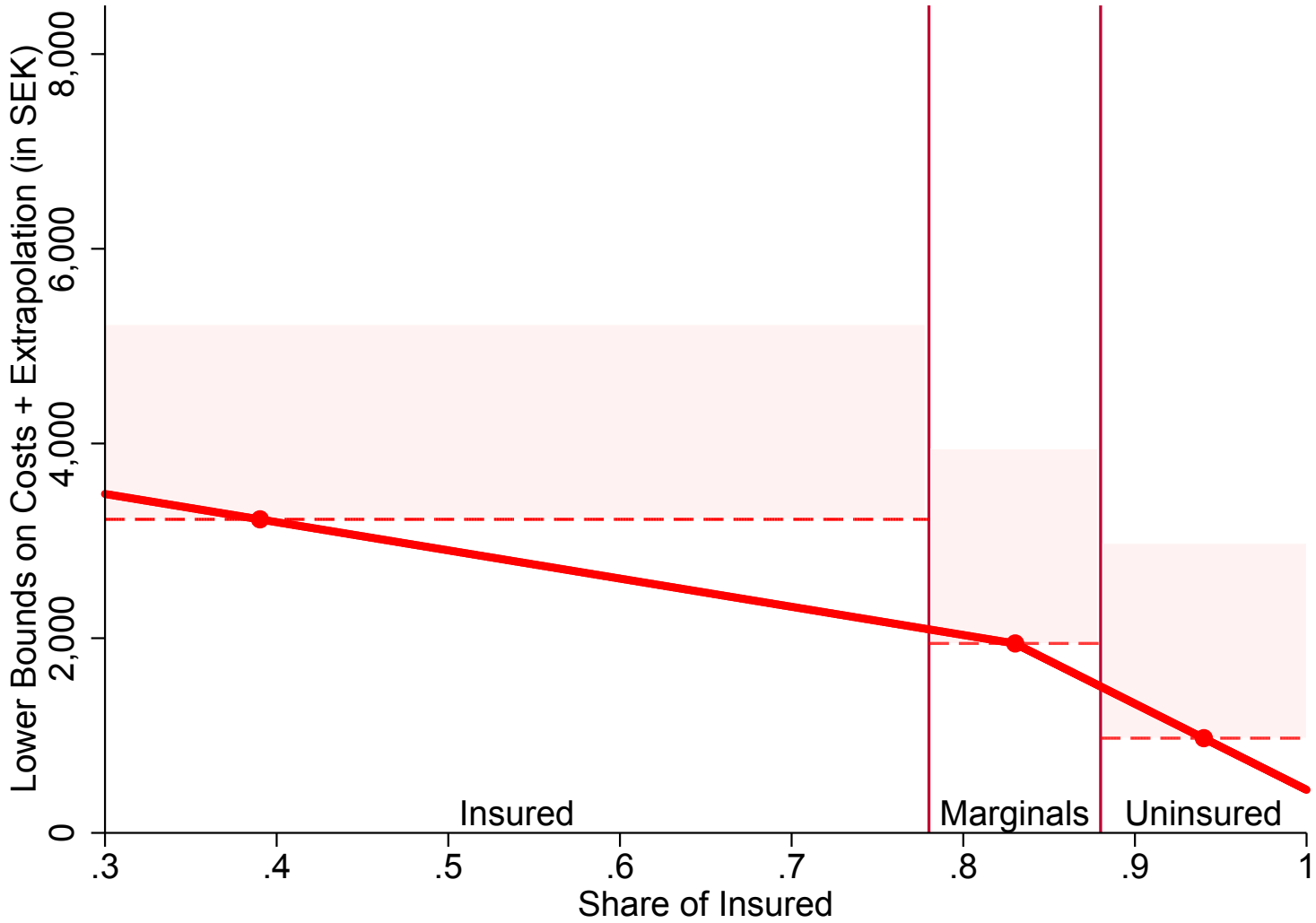
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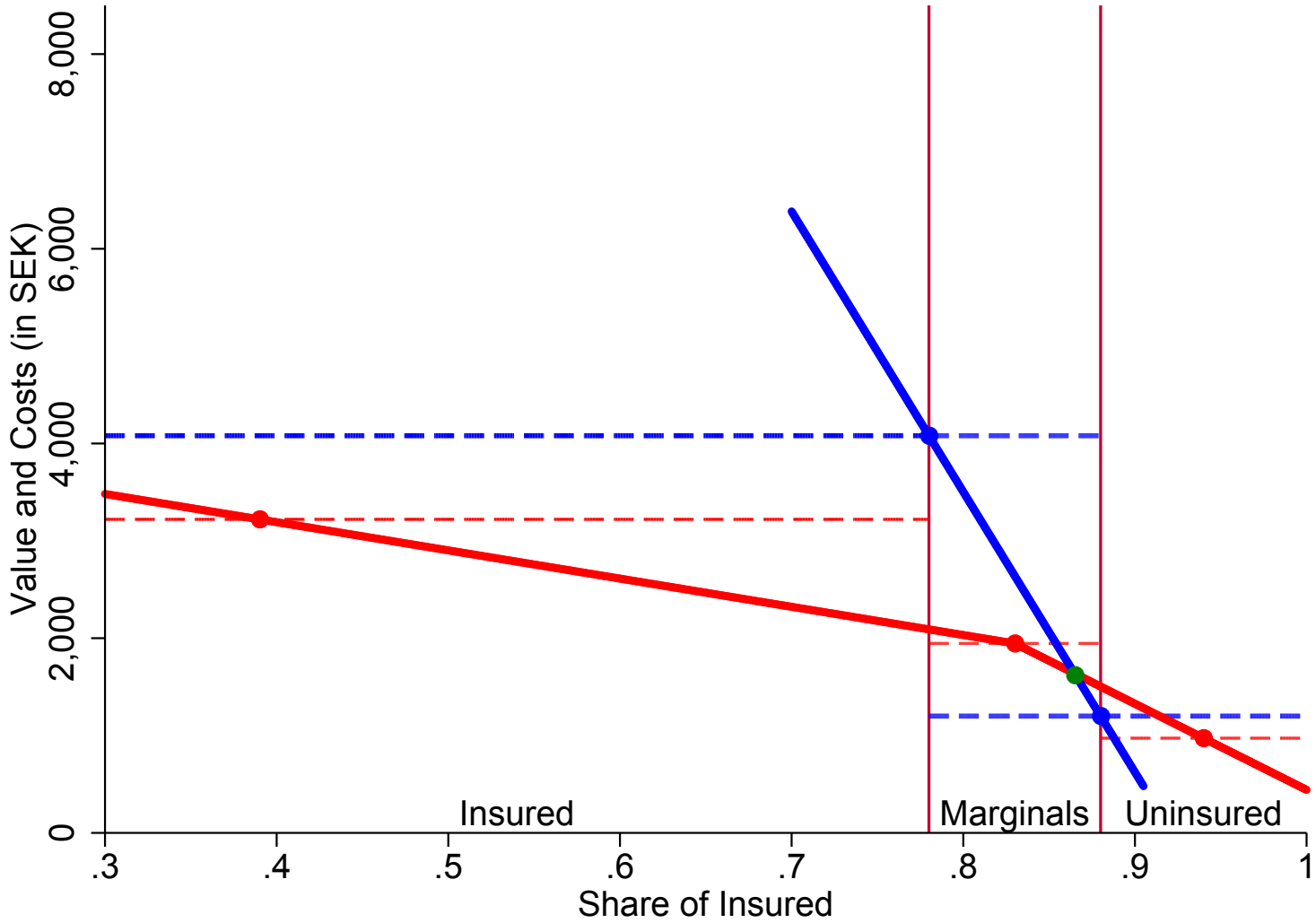
# Implementation: Graphical Representation



# Implementation: Graphical Representation



# Implementation: Graphical Representation



# Q2: How to Provide Choice?

- How to allow for choice under adverse selection?
  1. subsidy $s$ to induce people to buy generous coverage
     $\rightarrow$ *reduce* adverse selection
  2. minimum mandate $b_0$ to increase coverage for the minimally insured
     $\rightarrow$ *mitigate* adverse selection
- In Sweden:
  1. large subsidy – premium covers only 22 percent of difference in average costs between generous and minimum coverage
  2. low minimum mandate – benefit level corresponds to 20 percent of median earnings
- How to evaluate whether this is optimal?

# Q2: How to Provide Choice? Subsidy

- Trade-off: adverse selection vs. redistributive losses/gains
- Using envelope conditions, welfare gain from reducing adverse selection simplifies to the corresponding fiscal externality:

$$\begin{aligned} AS \times dF_I &= \left[ (p_1 - p_0) - E_M \left( c_1 - c_0 \right) \right] \times dF_I \\ &= \left[ \left( E_I \left( c_1 \right) - E_U \left( c_0 \right) - s \right) - E_M \left( c_1 - c_0 \right) \right] \times dF_I \end{aligned}$$

- *AS*-term depends on the supplemental cost for the *Marginals* (which is substantially lower than difference in average costs!)

# Q2: How to Provide Choice? Subsidy

- **Optimal subsidy** $s$**:**

  *For given* $(b_0, b_1)$*, subsidy is optimal only if:*

$$\underbrace{\frac{AS}{p_1} \times \frac{\varepsilon_{1-F_I,p_1}}{F_I}}_{\text{Fiscal externality of selection}} = \underbrace{\frac{E_U \partial v_0/\partial y - E_I \partial v_1/\partial y}{\lambda}}_{\text{Redistribution btw I and U}}$$

- Fiscal externality can be estimated using price variation
- (Preliminary) implementation suggests that large Swedish subsidy $\approx$ optimal for redistributive value $\in [-.22, .42]$

# Q2: How to Provide Choice? Minimum Mandate

- Trade-off: insurance value vs. adverse selection
- Challenge: risky people value an increase in basic coverage the most
  - increasing minimum coverage makes residual market more adversely selected ($\sim$ Azevedo & Gottlieb '16)
- Minimum mandate is common in (social) insurance markets (e.g., Affordable Care Act)
  - due to the selection effect, generous mandate could explain absence of private UI market ($\sim$ Hendren '16)

# Q2: How to Provide Choice? Minimum Mandate

- **Optimal minimum mandate $b_0$:**

  *For given $b_1$, a minimum mandate $b_0$ is optimal only if*

$$\underbrace{\frac{E_U u'_u}{E_U u'_e} - 1 \cong \varepsilon_{E_U(\pi),b_0}}_{\text{Baily-Chetty for Uninsured}} + \underbrace{\frac{AS_{b_0}}{E_U(\pi)\, b_0} \times \varepsilon_{1-F_I,b_0}}_{\text{Fiscal externality of selection}}$$

- "Implementation" in Sweden:
  - due to large subsidy the fiscal externality of adverse selection is small (or even negative)
  - for the *Uninsured*, estimate of price per unit of expected coverage $\cong 1$:

$$(b_0, p_0) \gtrsim_U (b_1, p_1) \Leftrightarrow \frac{\pi}{1-\pi}\frac{\Delta u_u}{\Delta u_e} \leq 1 \Leftrightarrow \frac{u'_u}{u'_e} \leq \frac{1-\pi}{\pi}\frac{p_1 - p_0}{b_1 - b_0} (\cong 1)$$

  $\Rightarrow$ low minimum mandate in Sweden may be too high, but should be even lower in absence of the subsidy

# Discussion

- Our policy recommendations are local, but the relevant trade-offs are clearly identified and estimable.
- Structural model would allow us to assess non-marginal, joint reforms:
    - clearly valuable: e.g., formulae indicate that $s$ and $b_0$ are complementary policies ($\sim$ Rothschild & Stiglitz '76)
- Challenge: model selection with multi-dimensional heterogeneity and moral hazard!
- Direction: use sufficient statistics as moments for model estimation to preserve the local recommendations

# Next steps

- Use "consumption implementation" approach to assess marginal insurance value (*in progress*)
- Get direct estimates of moral hazard and selection responses.
  ▸ MH evidence
- Extend framework to allow for endogenous contracts offered in private market (e.g., Chetty & Saez '10, Azevedo & Gottlieb '16). ▸ Details for $b_1$
- Account for potential frictions underlying insurance demand. RP approach ignores their welfare-relevance (e.g., Handel, Kolstad Spinnewijn '16).

# Conclusion

- Paper provides first evidence of risk-based selection in UI
- We go beyond PCT using compelling variation in risk and prices
- We examine the implications for the design of UI. More work to be done here!

# The Swedish UI System: Details (I)

- Eligibility rules for displaced workers:
  - Work requirement to be eligible to any UI coverage (minimum or supplemental):
    - Within the past 12 months have worked more than 6 calendar months at least 80h per month
  - To be eligible to supplemental UI coverage:
    - Fulfill work requirement + have been contributing to a UI-fund for 12 mths prior to layoff
- Quits
  - Cannot receive UI benefits for first 10 weeks of U spell
  - In our data, we can identify quits to control for potential extra moral hazard from quits vs layoffs
- Basic coverage:
  - Fixed daily amount of 320 SEK ($\approx$ 20% of median daily wage)
- Supplemental coverage:
  - Identical for all UI funds
  - 80% of daily wage up to cap
  - Daily benefit = Max(320, min(.8*daily wage, 680))

# The Swedish UI System: Details (II)

- Premia determination:
  - Government controls formula for premia of supplemental coverage
  - No price discrimination (by gender, age, etc.)
  - No price differentiation across UI funds (until 2007, limited differentiation after 2007)
- Link between Kassas and Unions:
  - UI funds were historically linked to Unions
  - But not necessary to be member of Union to be member of Kassa
  - Being member of Kassa does not buy Union membership
  - We observe and always control for Union membership in regressions

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# Data: Details (I)

- UI fund membership info
  - From tax data (2002-2006): total premia paid each year
  - From Kassa data sent to Ministry (2005-2009): dummy for membership as of Dec. of each year
  - Covers universe of Swedish individuals above 18
- Public Employment Service (PES)
  - Individuals need to register with PES to get any transfer
  - Record entry - exit date for any unemployment spell from 1990 to 2015
  - Merged with IAF data on UI benefit payments + info on daily wage for benefit computation + info on quits vs layoffs + Kassa membership info for unemployed individuals

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# Data: Details (II)

- LISA
  - All income, taxes and transfers + all demographics info
  - Covers universe of Swedish individuals above 18
- Wealth Tax register (1999-2007)
  - Sweden levied Wealth Tax until 2007
  - Records all assets and debts for universe of Swedish taxpayers
  - Used to compute risk proxies, self-insurance / consumption smoothing opportunities, etc.
- RAMS (1985-2015)
  - Matched employer-employee data
  - Reports monthly earnings for each employed individual in any Swedish firm
  - Can compute tenure and tenure ranking for each employee within a firm
  - Can compute layoff risk for each employee within a firm

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# Data: Details (III)

- Layoff-notification register (2002-2012)
  - Under Sweden's employment-protection law, employer intending to displace 5 or more workers simultaneously, (or 20 or more workers within a 90-day period), must notify the PES in advance.
  - Two steps:
    1. Intended number of displaced workers must be reported to the PES with cause for displacement
    2. No later than 1 mth after 1st report, list must be submitted with names of displaced workers and displacement dates.
  - lists are determined in negotiations with labor unions
  - "last-in-first-out" principle

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## Table: Summary statistics

| | Mean | P10 | P50 | P90 |
|---|---|---|---|---|
| | **I. Unemployment** | | | |
| Layoff probability | 2.84% | - | - | - |
| Unemployment probability | 3.86% | - | - | - |
| Unemployment spell (days) | 8.86 | 0 | 0 | 0 |
| Duration of spell (days) | 218.06 | 28 | 121 | 518 |
| | **II. Union and UI Fund Membership** | | | |
| Union membership | 0.67 | - | - | - |
| UI fund membership | 0.77 | - | - | - |
| | **III. Demographics** | | | |
| Age | 40.08 | 28 | 40 | 52 |
| Fraction men | 0.51 | - | - | - |
| Fraction married | 0.43 | - | - | - |
| | **IV. Income and Wealth, SEK 2003(K)** | | | |
| Gross earnings | 195.9 | 0 | 202.5 | 363.8 |
| Net wealth | 337.7 | -190.1 | 47.5 | 991.9 |
| Bank holdings | 43.2 | 0 | 0 | 104.7 |

Table: Summary statistics: individuals with supplemental UI

| | Mean | P10 | P50 | P90 |
|---|---|---|---|---|
| | **I. Unemployment** | | | |
| Layoff probability | 3.33% | - | - | - |
| Unemployment probability | 4.56% | - | - | - |
| Unemployment spell (days) | 10.31 | 0 | 0 | 0 |
| Duration of spell (days) | 214 | 28 | 118 | 510 |
| | **II. Union and UI Fund Membership** | | | |
| Union membership | 0.83 | - | - | - |
| UI fund membership | 1.00 | - | - | - |
| | **III. Demographics** | | | |
| Age | 40.36 | 29 | 40 | 52 |
| Fraction men | 0.49 | - | - | - |
| Fraction married | 0.45 | - | - | - |
| | **IV. Income and Wealth, SEK 2003(K)** | | | |
| Gross earnings | 219.8 | 18.5 | 221.3 | 371.2 |
| Net wealth | 287.2 | -180.3 | 74.3 | 950.8 |
| Bank holdings | 40.2 | 0 | 0 | 105.1 |

Table: Summary statistics: individuals without supplemental UI

| | Mean | P10 | P50 | P90 |
|---|---|---|---|---|
| | **I. Unemployment** | | | |
| Layoff probability | 1.24% | - | - | - |
| Unemployment probability | 1.49% | - | - | - |
| Unemployment spell (days) | 3.8 | 0 | 0 | 0 |
| Duration of spell (days) | 269.16 | 49 | 175 | 601 |
| | **II. Union and UI Fund Membership** | | | |
| Union membership | 0.10 | - | - | - |
| UI fund membership | 0 | - | - | - |
| | **III. Demographics** | | | |
| Age | 39.12 | 26 | 39 | 52 |
| Fraction men | 0.58 | - | - | - |
| Fraction married | 0.38 | - | - | - |
| | **IV. Income and Wealth, SEK 2003(K)** | | | |
| Gross earnings | 110.7 | 0 | 3.9 | 321.8 |
| Net wealth | 517.4 | -225.2 | 0 | 1,216.7 |
| Bank holdings | 54.2 | 0 | 0 | 102.5 |

# CDF of Future Unemployment Duration - Details

- Graph plots the cdf of the total duration $D_i$ spent unemployed in $t+1$ and $t+2$, broken down by whether they bought the supplemental UI coverage in $t$
- Sample: years 2002 to 2006, UI coverage from tax data, individuals between 25 and 55
- Figure shows again clear first-order stochastic dominance:
  - Insured individuals are more likely to spend any amount of time unemployed than uninsured
- Key potential confounder = moral hazard
  - $D_i(\theta_i, a|k)$ is function of individuals' actions $a$, that may differ under supplemental vs basic coverage
  - i.e. vast literature on MH effect of higher UI mandated benefits $b$ on unemployment duration

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# Regression-based PCT: Approach

Baseline model:

$$\pi_i = \beta \cdot \mathbb{1}[i \in I_t] + \eta$$

- $\mathbb{1}[i \in I_t]$: indicator for being insured in year $t$
- Use various measures of ex-post (t+1 to t+2) realized risk for $\pi$
  1. Total future potential UI claims ($c_1$)
  2. Total unemployment duration ($D$)
  3. Probability of layoff ($L$)
- Report semi-elasticity of $\pi$ w.r.t insurance coverage $\hat{\alpha} = \frac{\hat{\beta}}{E(\pi)}$
- Add controls
  1. Socio-demographic covariates (non-parametric for age, industry, tenure, marital status, gender, education)
  2. Past U history (non-parametric for $D$ in $t$ to $t-8$)
- Dynamic version of PCT:

$$L_{t+k} = \beta_k \cdot \mathbb{1}[i \in I_t] + \eta$$

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# Note on PCT: wtp model vs inverse model

- PCT can be implemented in two ways:
  - by running latent variable model for insurance $v^*$:

$$v = b\pi + \epsilon, \text{ where } \epsilon = cX + \mu$$

$$v^* = 1 \quad \text{iff} \quad v > p$$

  - by running inverse model for risk $\pi$:

$$\pi = \beta v^* + \eta$$

$$v^* = 1 \quad \text{iff} \quad v > p$$

- Estimates from both models are closely related (assuming no measurement error)

$$\beta = \frac{cov(\pi, v)}{var(v)} = [b + c\frac{cov(\pi, X)}{var(\pi)}]\frac{var(\pi)}{var(v)} = \hat{b}_{OLS,bivar.}\frac{var(\pi)}{var(v)}$$

- $\beta$ matters for insurer's pricing, i.e., how average risk $E(\pi|v)$ varies with wtp (see Einav et al. '10). See later.

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# Decomposition of PCT: Details

Choice model

$$v = b\pi + cX + \mu$$

For $b_{OLS}$ we use

$$\tilde{\pi} = \pi + f(a) + m$$

$$\begin{aligned} b_{OLS,bivar.} &= \frac{cov(\tilde{\pi}, v)}{var(\tilde{\pi})} \\ &= \frac{cov(\tilde{\pi}, b\pi)}{V(\tilde{\pi})} + c\frac{cov(\tilde{\pi}, X)}{V(\tilde{\pi})} + \frac{cov(\tilde{\pi}, \mu)}{V(\tilde{\pi})} \\ &= b\left[\frac{V(\pi)}{V(\tilde{\pi})} + \frac{cov(f(a), \pi)}{V(\tilde{\pi})} + \frac{cov(m, \pi)}{V(\tilde{\pi})}\right] + c\frac{cov(\tilde{\pi}, X)}{V(\tilde{\pi})} + \frac{cov(\tilde{\pi}, \mu)}{V(\tilde{\pi})} \end{aligned}$$

So, assuming Classical Errors-in-Variables $cov(m, \pi) = 0$ and measurement-error and moral hazard problem, uncorrelated with other variables

$$b_{OLS,bivar.} = \left[b + c\frac{cov(\pi, X)}{V(\pi)}\right]\frac{V(\pi)}{V(\tilde{\pi})} + b\frac{cov(f(a), \pi)}{V(\tilde{\pi})} + \frac{cov(\tilde{\pi}, \mu)}{V(\tilde{\pi})}$$

So:

1. $b_{OLS,bivar.}$ without controls gives the above
2. $b_{OLS}$ with controls relative to (1) allows to back out $c\frac{cov(\pi,X)}{V(\tilde{\pi})}$
3. $b_{IV}$ relative to (2) allows to back out $\left[\frac{V(\pi)}{V(\tilde{\pi})} + \frac{cov(f(v),\pi)}{V(\tilde{\pi})}\right]$, assuming no selection on unobservables (exclusion restriction is valid)

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# Firm Level Risk & Proba to buy U - Details

- Graph description
- Take average proba of layoff within 2 yrs for all individuals in the firm
- Rank firms by percentiles in the yearly distribution of average proba of layoff
- 1 Bin = 1 percentile
- Plot average proba of layoff (x-axis) vs average residuals of regression of proba to buy UI on UNION, year, education, marital status, gender, age, occupation/industry (y-axis)
- OLS coeff for firm-level model is from regression of average residuals of UI on average proba of layoff at firm level:

$$\bar{v}_{i,t,j} = b\overline{\pi_{t,j}} + \mu$$

where individual indexed by $i$ ; firm indexed by $j$

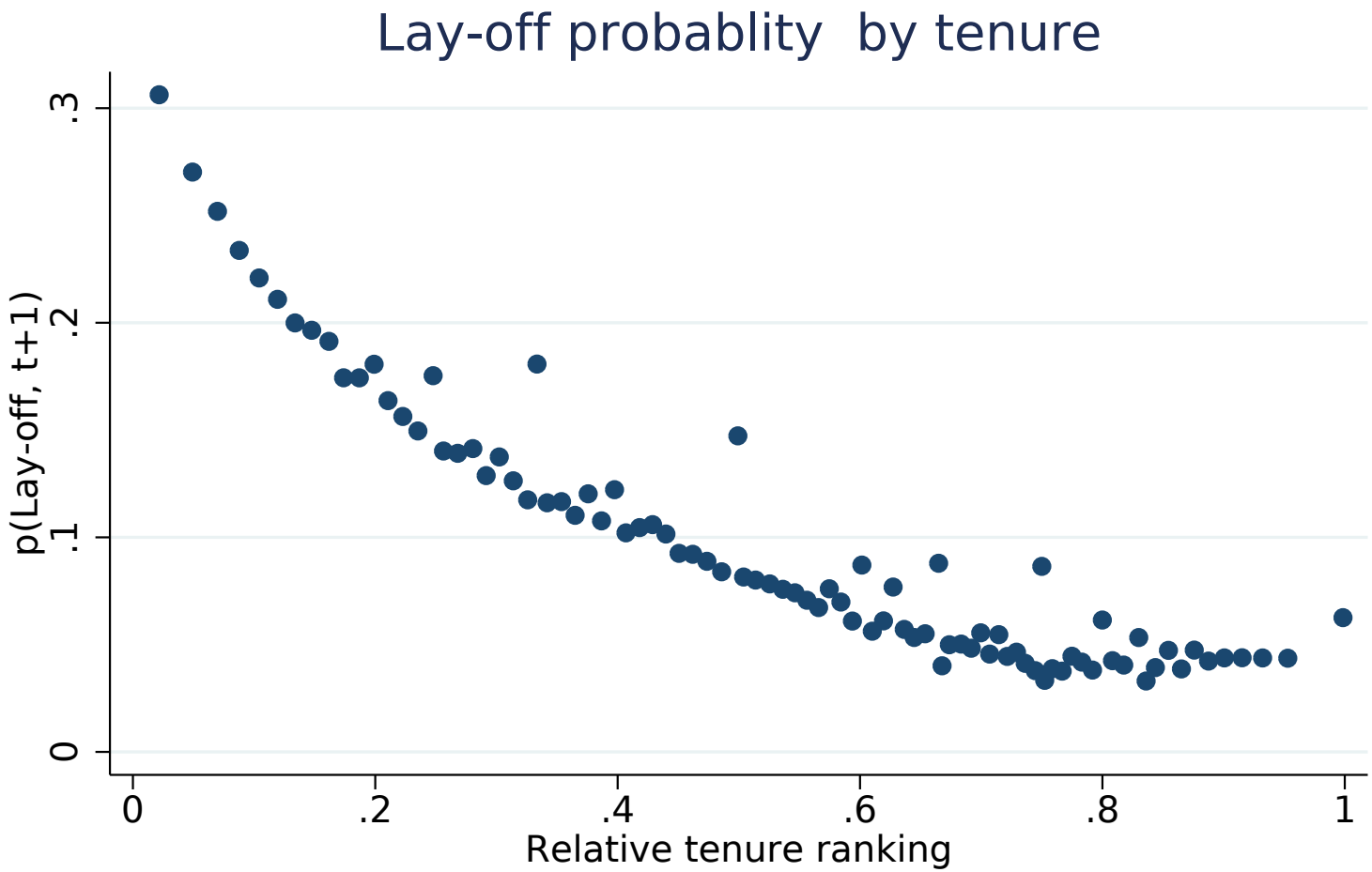
- Coefficient from model at the individual level

$$v_{i,t,j} = b\pi_{i,t,j} + cX_{i,t} + \mu$$

- $b_{OLS}$ at individual level is essentially equivalent to our baseline PCT with controls
- $b_{IV}$ is from a model where $\pi_{i,t,j}$ is instrumented by $\pi_{-i,t,j}$, the average layoff risk of all other individuals within the firm
- First stage shows that 1-pct increase in layoff risk of other individuals in the firm increases own $\pi_{i,t,j}$ by .65 pct.
- Exclusion-restriction: $cov(\pi_{-i,t,j}, \mu) = 0$, requires that no other unobservable correlated with average risk at firm level...
- Further check: if such unobservables are fixed within individual, or within firm, can be differenced out using variation over time

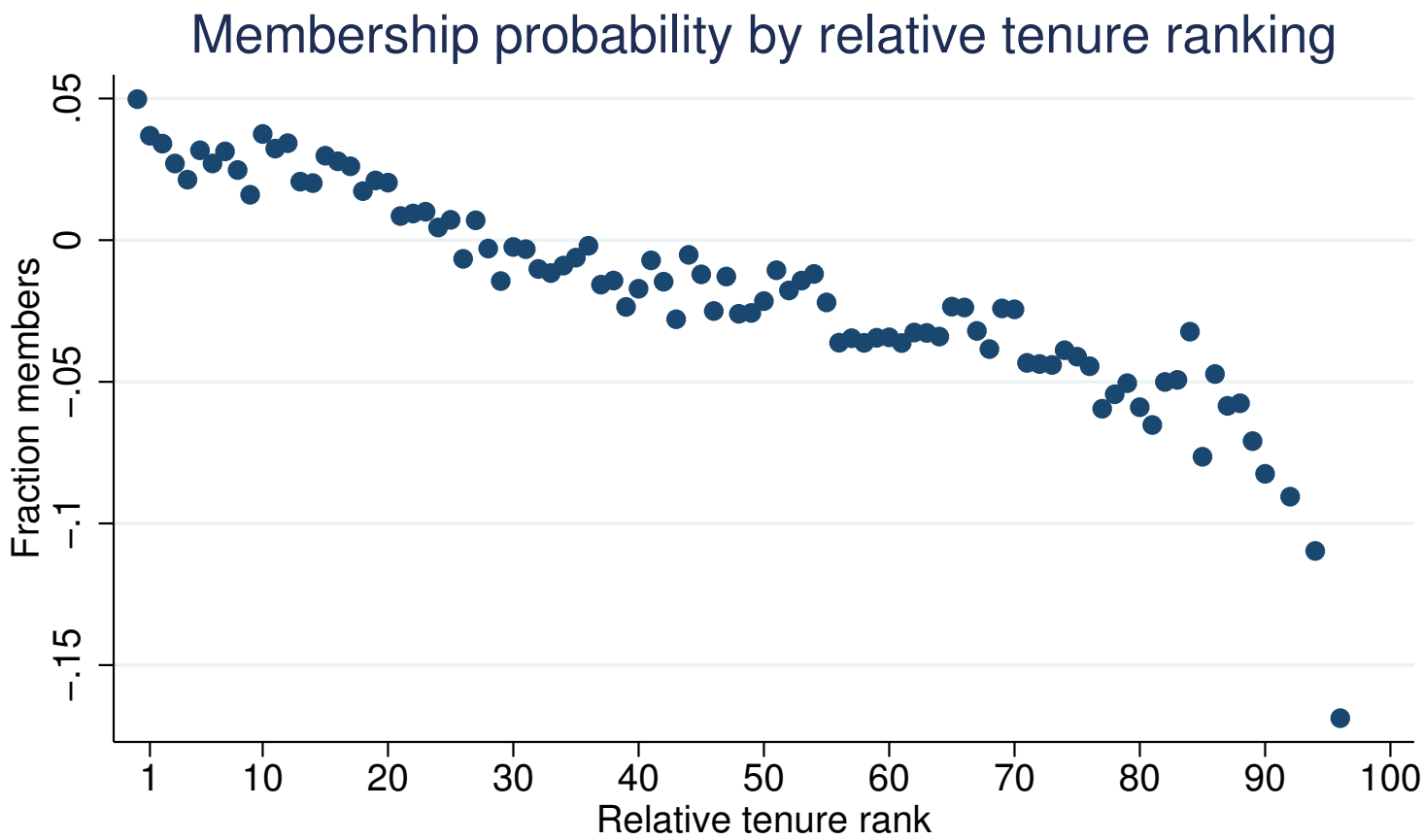
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# Tenure & Unemployment Risk - Cross-sectional




Notes: Relative tenure ranking for year t on x-axis, dummy taking the value 1 ifindividual received any unempl. benefits in t+1 on y-axis.

# Tenure & UI Fund Coverage - Cross-sectional




Year: 2007–9
Graph considers all employees aged 18–60
in firms with 50 or more employees.
Relative ranking = 100*(ranking/#employees)
Controls: Age– and tenure–FE.

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# Tenure - Cross Section - Details

- Computation of relative tenure ranking:
- Each individual is ranked with a tenure rank (1 for last in) within the firm he is observed in year $t$
- Take for each individual percentile of this rank within the firm
- First-stage: plot average average probability of being laid-off in t+1 ($L_{t+1}$) (y-axis) vs percentile of tenure rank (x-axis)
- Strong correlation between tenure and layoff proba suggests that last-in first out is well-enforced
- Correlation holds when introducing comprehensive set of covariates
- Reduced-form: plot average residuals of regression of proba to buy UI on UNION, year, education, marital status, gender, age, occupation/industry (y-axis) vs percentile of tenure rank (x-axis)
- Reduced-form suggests strong correlation between risk and proba to buy UI $\Rightarrow$ risk-based selection drives PCT
- IV model assumptions: exclusion restriction requires $cov(\mu, T) = 0 \Rightarrow$ no unobservables correlated with tenure ranking
- Potential issues: individual heterogeneity ($\mu_i$) correlated with tenure
- Further check: if such unobservables are fixed within individual, can be differenced out using variation over time

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# Switchers' Design - Details

- Using panel data, one can control for (unobserved) individual fixed $\mu_i$ that may be confounding cross-sectional IV $\Rightarrow$ exploit within individual variation in tenure and/or firm risk
- Main source of variation in tenure and/or firm risk = switching firm ($S$)
- When individuals switch firm, tenure goes down and individual risk $\pi_i$ goes up, irrespective of $\bar{\pi}_{-i,j}$ $\Rightarrow$ Event study design around firm switches
- First-stage graphs shows that indeed, after switch, proba of future layoff significantly increases
- Reduced-form shows that proba to buy UI also significantly increases just after switch
- IV model: individual fixed-effect model where $\pi_{i,t}$ is instrumented by $S$
- Potential issue: IV estimate is very large. Individuals may re-optimize at specific times (switches)
- To control for this, exploit also differential variation in firm risk when switching and look at difference in change of proba to buy according to whether individuals move to much riskier ("positive shock") or less risky firm ("negative shock") than previous firm, conditional on previous firm's risk
- First-stage graphs shows that proba of future layoff significantly increases for individuals moving to more risky vs less risky firm
- Reduced-form shows that proba to buy UI significantly increases for individuals moving to more risky vs less risky firm
- IV model: individual fixed-effect model of buying insurance where $\pi_{i,t}$ is instrumented by $S \times \Delta\bar{\pi}_{-i,j}$
- Identification assumption with this IV design: requires no selection on switching to different firm types ($cov(\mu, S \times \Delta\bar{\pi}_{-i,j}) = 0$)

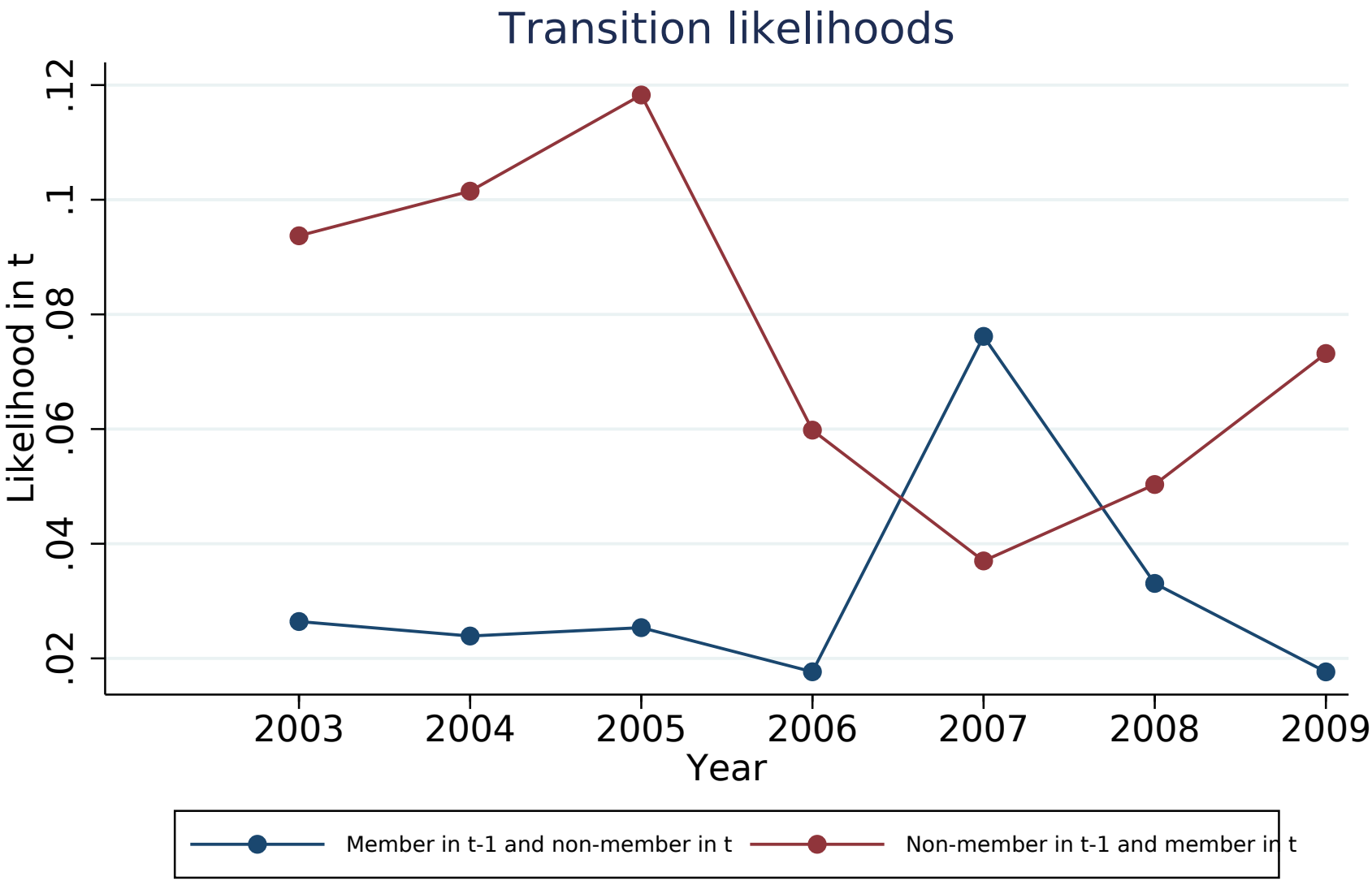
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# Firm Shocks Design - Details

- Potential concern with previous designs = firm-level heterogeneity may create that $cov(\mu, S \times \Delta\bar{\pi}_{-i,j}) \neq 0$ when looking at switchers
- In other words, more risky firms may have unobserved characteristics that also correlate with higher UI coverage
- If such characteristics are fixed over time, can use variation in a firms' riskiness for individuals who stay in the firm to difference out both individual and firm-level (fixed) heterogeneity
- Design: use layoff notification $N \Rightarrow$ sharp indication of a sudden increase in proba of layoff within the firm
- First-stage: individuals who are in firm who emit a layoff notification experience sharp increase in future individual layoff proba $\pi_i$
- Reduced-form: individuals who are in firm who emit a layoff notification experience sharp increase in proba to buy UI
- IV: model with both individual and firm f-e where instrument $\pi_{i,j,t}$ by $N_{j,t}$
- Identification assumption: requires no time-varying heterogeneity correlated with $N_{j,t}$ ($cov(\mu_t, N_{j,t}) = 0$)

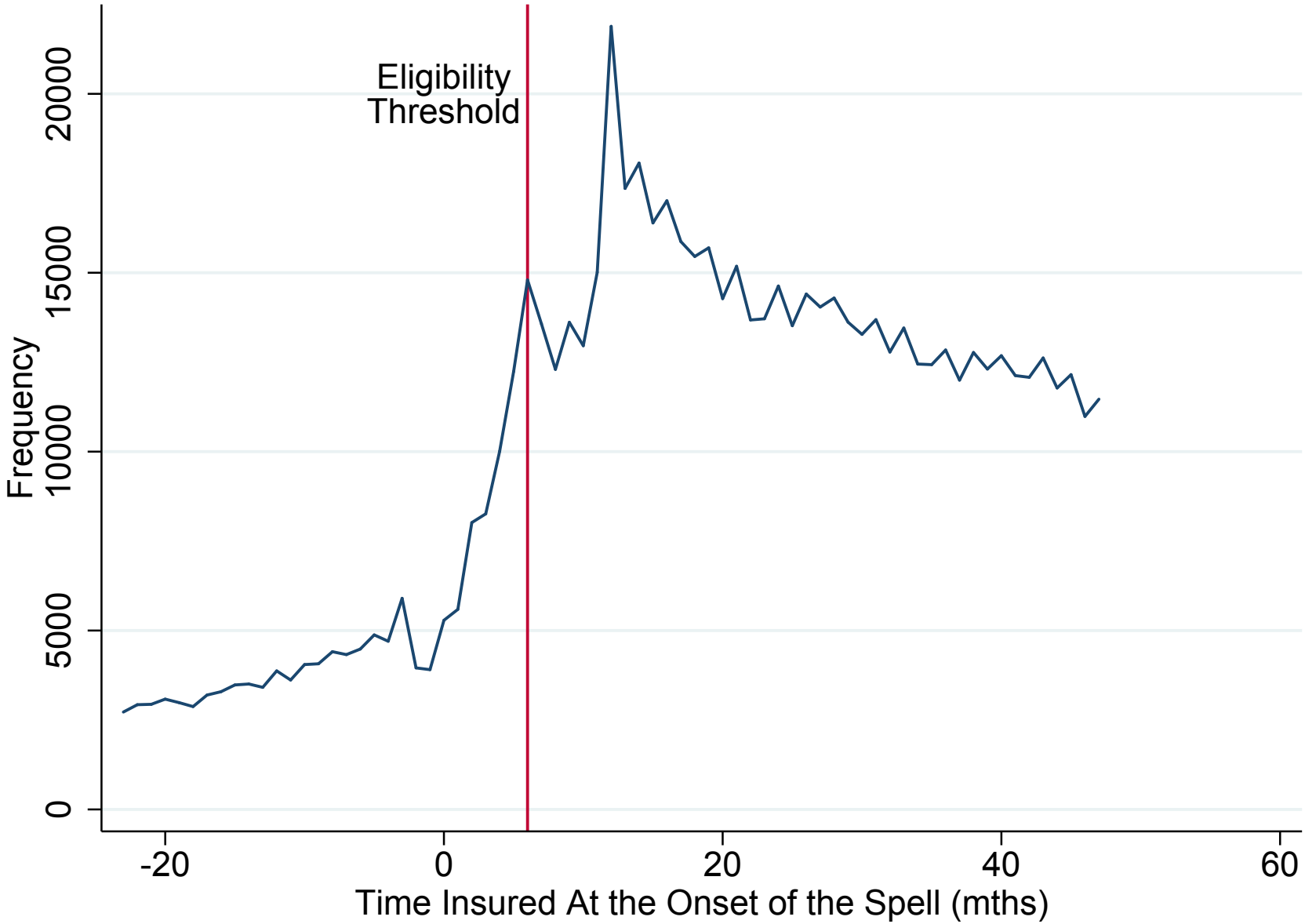
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# Price Variation: the 2007 Reform




The graphs shows that likelihood that individuals switch their UI membership status in t compared to t-1.
Ages 30-55, excl. duplicates in membership datasets.
Membership from 2002-2004 uses the tax data, membership from 2005-2009 uses the binary ui data.

# Proba density function of layoffs by membership duration



# Supplemental Coverage: How to set $b_1$

- In Sweden both coverage options are set by government:
- **Optimal unemployment policy** $b_1$ (with mandate $b_0$)

$$\frac{E_I u'(b_1 - p_1) - E_I u'(w - p_1)}{E_I u'(w - p_1)} - \varepsilon_{E_I(\pi), b_1} \cong -\frac{AS}{E_I(\pi)\, b_1} \times \varepsilon_{F_I, b_1}$$

- Compared to universal mandate, allowing for $b_1 (> b_0)$ increases welfare for those buying it, but introduces adverse selection:
  - less risky people value an (actuarially fair) increase in coverage the least, i.e., $\varepsilon_{F_I, b_1} < 0$
- Government accounts for fiscal externality of marginals for both plans
  - private insurers would only consider impact on their own plan
  - private equilibrium suffers from over-insurance at "intensive margin", but under-insurance at "extensive margin"

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