# Avoiding layoffs: On-the-job search and partial insurance

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June 29, 2019

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North American Summer Meeting of the Econometric Society

# Motivation

- Consumption smoothing over time and states-of-nature has been a perennial theme in Economics.
- Continuum from Arrow and Debreu (1954); McKenzie (1954) markets to incomplete markets with usually one risk-free asset Hall and Mishkin (1982); Zeldes (1989); Aiyagari (1994)
- Smoothing possibilities always linked to assets, rarely other mechanisms are considered.
- In general, individuals can exert effort to prevent bad shocks in the future:
    - Nurture family relationships, to move back home if things go wrong Kaplan (2012).
    - Go to the doctor, exercise and diet to avoid or postpone diseases.
    - Search for a new job before being fired.

# Some scattered evidence (1)

**Fact 1: Workers search on the job to avoid painful unemployment.**

- Displaced workers suffer long unemployment spell and end up earning substantially less than did before.Jacobson et al. (1993); Farber (2017)
- Avoiding unemployment is key for stabilizing income and consumption. Is this real?
- Fallick and Fleischman (2004), using CPS data, show that people engaged in on-the-job search are more likely to change employer and, more likely to experience a job loss in the next month.
- Fujita (2012) reports survey evidence showing that 40% of on-the-job searchers justify their doing by fear of layoff or unsatisfactory current job in the UK.

# Some scattered evidence (2)

Fact 2: On-the-job seekers take wage cuts when moving to a new job.

- Connolly and Gottschalk (2008) and Tjaden and Wellschmied (2014) find that around 45% percent of all job to job transitions lead to lower real wages.
- Our theory predicts workers moving to new jobs and taking wage cuts to avoid their layoffs.

# Making sense of the evidence

- Agents uses the standard self-insurance mechanism and on-the-job search.
- Seekers exert effort given a perception of layoff risk and the distribution of opportunities in the labor market.
- The optimal search effort is again determined by the trade-off of marginal cost and benefits of effort.
- On the consumption/savings side, the optimal decisions are determined by the standard Euler equation.
- The job search behavior changes the probability of future outcomes (stay, switch jobs, unemployment) and the Euler equation is characterized by these probabilities.

# Literature Review

- We built on top of Burdett (1978) seminal paper.
- Lise (2012) studies an economy where on-the-job search impacts the savings behavior of agents, solely focusing on stochastic outside job offers (mainly risk of falling down the job ladder as individuals gain experience)
- Guvenen and Smith (2014) use joint dynamic of individual's labor earnings and consumption choices. They show that up to one half of persistence shocks are insured through informal channels.
- Chaumont and Shi (2017) study the relationship between on the job search with inequality and wealth accumulation.

# The Model

# The model

- A version of Burdett (1978) with search effort in discrete time.
- Workers save and borrow in a risk-free asset $a$ at an exogenous rate $r$ with a borrowing limit such that $a \geq \underline{a}$, and maximize

$$\max_{\{c_t, s_t\}} \sum_{t=0}^{\infty} \beta^t (u(c_t) - \lambda s_t)$$

- The layoff perception index (LPI), $x$, evolves as an AR(1) process.

$$x_{t+1} = (1-\rho)\bar{x} + \rho x_t + \varepsilon_{t+1} \quad x \in \mathbb{R}.$$

# Timing

- At the beginning of the period the worker exerts effort and consumes income.
- An offer arrives with probability $p(s)$, where $s$ is effort,and $p'(s) > 0$, $p''(s) < 0$.
- If a worker receives no offer or rejects it, the employed worker is fired with probability $\delta(x)$, such that $\delta'(x) > 0$, $\delta(x) : \mathbb{R} \to [0, 1]$.
- When a new job starts, $x = \bar{x}$.

# Problem of the Unemployed

- The value function of being unemployed is

$$
\begin{aligned}
U(a) = \max_{s, a' \geq \underline{a}} \; & u(a(1+r) - a' + b) - \lambda s \\
& + \beta \Bigg\{ p(s) \int_{\underline{w}}^{\bar{w}} \max\{W(w, \bar{x}, a'), U(a')\} dF(w) \\
& + (1 - p(s)) U(a') \Bigg\}
\end{aligned}
$$

- The reservation wage is such that

$$
W(w^*, \bar{x}, a) = U(a)
$$

# Problem of the Employed

- The value function of being employed is

$$W(w,x,a) = \max_{a' \geq \underline{a}, s} u((1+r)a - a' + w) - \lambda s$$
$$+ \beta \Bigg\{ p(s) \int_{\underline{w}}^{\bar{w}} \max\{W(w', \bar{x}, a'), \int W(w, x', a') dG(x'|x)\} dF(w)$$
$$+ (1 - p(s)) \left( \delta(x) U(a') + (1 - \delta(x)) \int W(w, x', a') dG(x'|x) \right) \Bigg\}$$

- The reservation wage $w^*(w,x,a)$ is defined as

$$W(w^*(w,x,a), x, a) = \int W(w, x', a) dG(x'|x)$$

# Solution: Optimal effort

- For the unemployed worker, the optimal effort is determined by

$$\lambda = \beta p'(s) \int_{w^*(a)}^{\bar{w}} (W(w, \bar{x}, a') - U(a'))dF(w)$$

- For the employed worker, the optimal effort is determined by

$$\lambda = \beta p'(s) \Bigg\{ \underbrace{\int_{w^*(w,x,a')}^{\bar{w}} (W(w', \bar{x}, a') - \int W(w, x', a')dG(x'|x))dF(w')}_{\text{gains from job ladder}} + \underbrace{\delta(x)\Big( \int W(w, x', a')dG(x'|x) - U(a')\Big)}_{\text{gains from avoiding layoff}} \Bigg\}$$

- As $\delta(x)$ increases, the worker exerts more effort to improve chances of getting a new job to avoid a layoff.

# Solution: Consumption/Savings decision - Unemployed

- The first order condition with respect to $a'$

$$u_1((1+r)a-a'+b) = \beta p(s)\int_{w^*(a)}^{\bar{w}}(W_3(w,\bar{x},a')-U_1(a'))dF(w)+\beta U_1(a)+\mu$$

- Using envelope, and substituting $W_3(w,x,a) = (1+r)u_1((1+r)a-a'+w)$ and $U_1(a) = (1+r)u_1((1+r)a-a'+b)$ , we obtain

$$u_1((1+r)a-a'+b) = \beta(1+r)\Bigg(p(s)\int_{w^*(a)}^{\bar{w}} u_1((1+r)a-a'+w)dF(w)$$

$$+u'((1+r)a'-a''+b)-p(s)(1-F(w^*(a)))u_1((1+r)a'-a''+b)\Bigg)+\mu$$

- After some algebraic manipulations, we obtain an Euler equation

$$u_1((1+r)a-a'+b) = \beta(1+r)\mathbb{E}[u_1(c)|s^*,a'] + \mu$$

# The Euler Equation - Unemployed

- With probability $\pi_u(s, w^*(a')) \equiv 1 - p(s)(1 - F(w^*(a')))$ the jobseeker exerting optimal effort and saving remains unemployed because no offer or no good enough offer.
- The marginal utility associated is $u_1(a'(1+r) - a'' + b)$.
- With probability $\pi_e(s, w^*(a')) \equiv p(s)(1 - F(w^*(a')))$ the jobseeker finds a job due to a good enough draw.
- In this case, the marginal utility is

$$\mathbb{E}[u_1(a'(1+r)-a''+w)|w \geq w^*(a')] \equiv \int_{w^*(a)}^{\bar{w}} u_1(a'(1+r)-a''+w)\frac{dF(w)}{1-F(w^*(a'))}.$$

# The Euler Equation - Employed

- Similarly, the optimality condition for assets can be written as an Euler equation once again

$$u_1((1+r)a - a' + w) = \beta(1+r)\mathbb{E}[u_1((1+r)a - a' + y)|s^*, a'] + \mu$$

  where $y$ is the income receiving in each state, and $\mu > 0$ applies if the borrowing constraint is binding.
- With probability $\pi_{w'}(s, w^*(x, a')) \equiv p(s)(1 - F(w^*(x, a')))$ good enough wage and reset $x$ to $\bar{x}$. The marginal utility associated is

$$\mathbb{E}[u_1(a'(1+r) - a'' + w')|w' \geq w, x, a'] \equiv$$
$$\int_{w^*(w,\bar{x},a')}^{\bar{w}} u_1(a'(1+r) - a'' + w') \frac{dF(w')}{1 - F(w^*(w, \bar{x}, a'))} dG(x'|x).$$

- With probability $\pi_u(s, w^*(a')) \equiv (1 - p(s))\delta(x)$ no good enough offer and fired. In this case, the marginal utility is

$$u_1(a'(1+r) - a'' + b).$$

# The Euler Equation - Employed

- With probability $\pi_w(s, w^*(a')) \equiv (1 - p(s))(1 - \delta(x)) + p(s)F(w^*(x, a'))$ stays. The marginal utility is

$$\mathbb{E}[u_1(a'(1+r) - a'' + w)|x, a'] \equiv \int_{w^*(w,\bar{x},a')}^{\bar{w}} u_1(a'(1+r) - a'' + w)dG(x'|x).$$

- Effort an asset decisions affect probabilities through
  - Chooses effort affecting the likelihood of finding a new job due to a good outside offer or a high layoff chance.
  - Chooses asset holdings $a'$ affects reservation wages in the future, i.e. the standard of a sufficiently good offer.
  - Joint dynamic effects: higher assets makes less attractive future wage draws, leading a lower incentive to search.

# Empirical Evidence

# Empirical Evidence

- On-the-job search behavior is rarely surveyed.
- Recently, the New York Fed introduced a small supplement of Job Search (JS) in each October (2013-17) of the Survey of Consumer Expectations (SCE). The data are described in Faberman et al. (2017).

# Empirical Evidence

The SCE database contains data on:

- Subjective probability of layoff within a year (A measure of $\delta(x)$).
- Distribution of received wage offers for employed and unemployed jobseekers (Measures for $F_e(w)$ and $F_u(w)$).
- Current and last wages.
- Measures of search effort: number of methods used Shimer (2004), number of hours devoted Aguiar et al. (2013); Mukoyama et al. (2018) and number of applications sent.
- Asset holdings (Financial wealth)
- Duration of search (indirect measure of $p(s)$).

Challenge: many sources of heterogeneity in the data, but only state variables in the model $(a, s, w, x)$.

# Dynamics of Inverse of Layoff probability

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8 |
|---|---|---|---|---|---|---|---|---|
| Inv Layoff pr ($x_{t-1}$) | 0.651*** | 0.615*** | 0.629*** | 0.704*** | 0.652*** | 0.624*** | 0.627*** | 0.69 |
| | (0.015) | (0.051) | (0.041) | (0.098) | (0.015) | (0.049) | (0.041) | (0.0 |
| Known lh wage | | -0.012 | | | | -0.035** | | |
| | | (0.014) | | | | (0.015) | | |
| Annual lwage (SCE-LAB) | | | -0.006 | -0.061** | | | -0.010 | -0.08 |
| | | | (0.007) | (0.027) | | | (0.008) | (0.0 |
| Log Assets | | | | 0.010 | | | | 0.0 |
| | | | | (0.010) | | | | (0.0 |
| Observations | 32,427 | 2,444 | 4,906 | 992 | 32,147 | 2,400 | 4,898 | 98 |
| R-squared | 0.402 | 0.351 | 0.395 | 0.423 | 0.406 | 0.381 | 0.396 | 0.4 |
| Year & Region FE | - | - | - | - | ✓ | ✓ | ✓ | ✓ |
| Demogr | - | - | - | - | ✓ | ✓ | ✓ | ✓ |
| Mean dv ($x$) | -2.419 | -2.416 | -2.442 | -2.418 | -2.420 | -2.422 | -2.442 | -2.4 |

Note: Robust standard errors in parentheses . *** $p < 0.01$, **$p < 0.05$, * $p < 0.1$

**Table 1:** Dynamics of Inverse of Layoff probability

# Empirical Evidence: Search Effort

| Variables | N$^o$ methods | Hours search | N$^o$ applications |
|---|---|---|---|
| Layoff prob | 2.656*** | 2.395 | 1.846** |
| | (0.718) | (1.612) | (0.823) |
| Observations | 1,988 | 1,988 | 2,491 |
| R-squared | 0.185 | 0.082 | 0.005 |

Note: Robust standard errors in parentheses . *** $p < 0.01$, **$p < 0.05$, * $p < 0.1$

**Table 2:** Expected search effort as a function of Layoff probability

# Empirical Evidence: Estimates for acceptance of job offer

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| log wage gap (offered - current) | 0.377*** | 0.388*** | 0.372*** | 0.385*** |
| | (0.111) | (0.110) | (0.115) | (0.114) |
| layoff prob | 2.312* | 2.424* | 2.587* | 2.673* |
| | (1.277) | (1.323) | (1.447) | (1.478) |
| log wage gap X layoff prob | -5.635 | -6.590* | -6.587 | -7.451* |
| | (3.774) | (3.906) | (4.138) | (4.243) |
| Observations | 570 | 570 | 561 | 561 |
| Year & Region FE | - | ✓ | - | ✓ |
| Demographics | - | - | ✓ | ✓ |

**Table 3:** Estimates for acceptance of job offer

# Wealth distribution

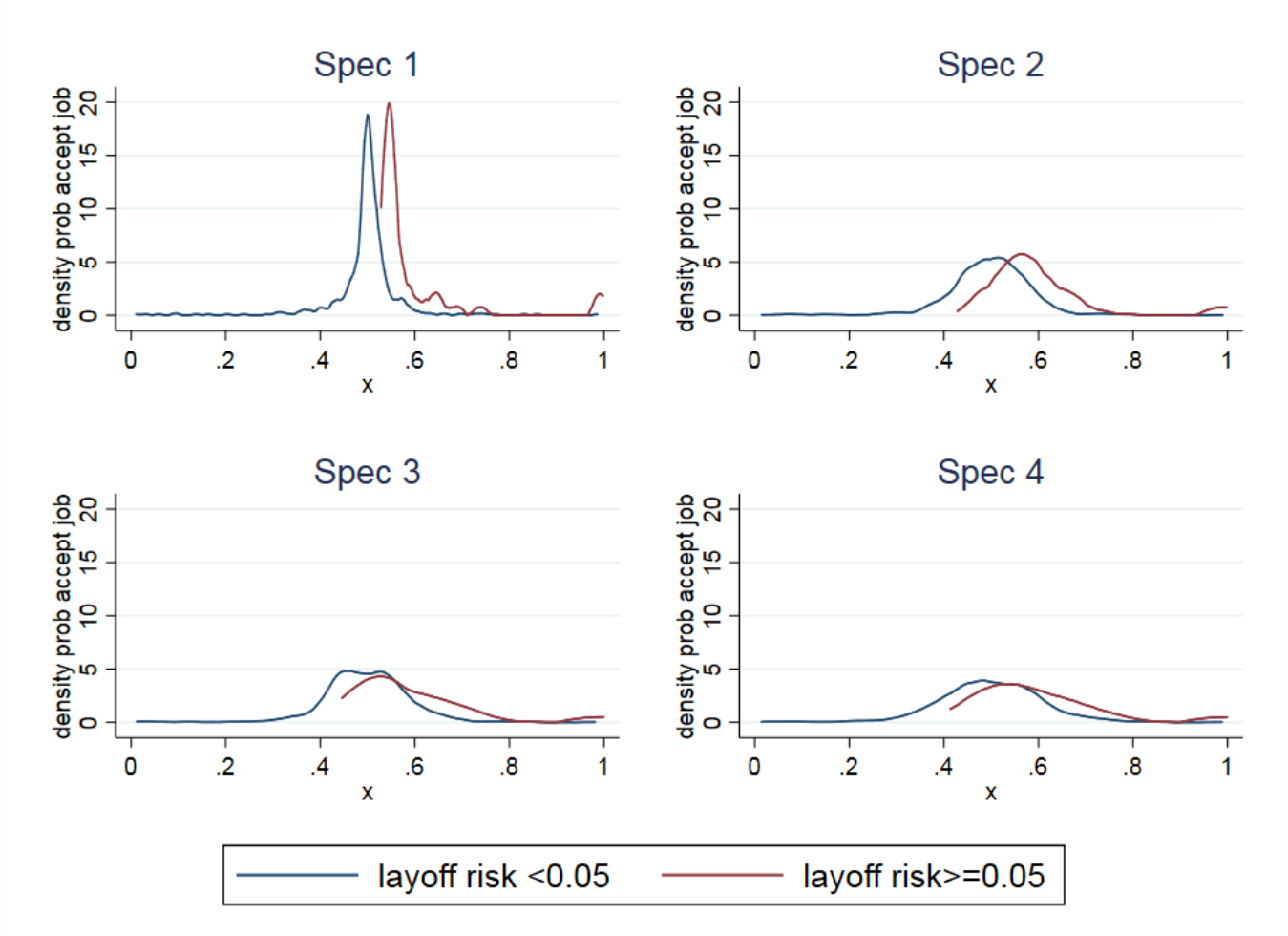


**Figure 1:** Density of acceptance, conditional on layoff risk

# Calibration

# Parameters

- Layoff perception index $\Rightarrow$ (1), $\rho_X = 0.65$ monthly, $\sigma_X = 0.5$ monthly.
- Cost of effort $\Rightarrow$ calibrated to replicate mean applications of unemployed and employed, $\bar{s}_u = 2.03, \bar{s}_e = 1.15$, $\lambda_u = \lambda_e = 8 \cdot 10^{-5}$
- Offer distributions $F_u$ and $F_w$ calibrated from Faberman et al. (2017)
- For employment status $i \in \{E, U\}$, We assume that the number of offers follows a Poisson distribution with parameter $\mu_0^i + \mu_1^i s$. Hence, contact probability $p_i(s) = 1 - \exp(\mu_0^i + \mu_1^i s)$. Parameters $\mu_0^i$ and $\mu_1^i$ calibrated to match number of unsolicited contacts and solicited contacts at median effort.

# Parameters: Summary

| Parameter | Meaning | Value/choice | Comment |
|---|---|---|---|
| $\beta$ | Discount factor | $(0.95)^{1/52}$ | Standard |
| $\sigma$ | Risk aversion | 2 | Standard |
| $r$ | Interest rate | 4% | Mean 2013-16 |
| $b$ | Unemployment benefits | 10 percentile of $F_u(w)$ | |
| $\lambda$ | Cost of exerting effort (U) | $8 \cdot 10^{-5}$ | Calibrated |
| $\lambda$ | Cost of exerting effort (E) | $8 \cdot 10^{-5}$ | Calibrated |
| $\rho$ | Persistence of layoff index | $(0.65)^{1/4}$ | estimated AR(1) |
| $\sigma_\varepsilon$ | Std of dismissal shock | 0.5 | Sd residual AR(1) |
| $\bar{x}$ | long run layoff index | -1.81 | estimated AR(1) |
| $F_u, F_e$ | Wage distribution | Log normal | Standard |
| $(\mu_u, \sigma_u)$ | mean & std of u dist | $(2.639, 0.489)$ | SCE-JS control $w$ offers |
| $(\mu_e, \sigma_e)$ | mean & std of e dist | $(3.034, 0.525)$ | SCE-JS control $w$ offers |

**Table 4:** Calibration

# Moments

- Unemployment rate 5.25% (SCE 5.3%)
- Gross worker flows: EU: 0.0223, UE: 0.0223 (essentially the same), EE = 0.0727.
- Mean efforts: $s_u = 4.49$, $s_e = 1.05$

# Wealth distribution

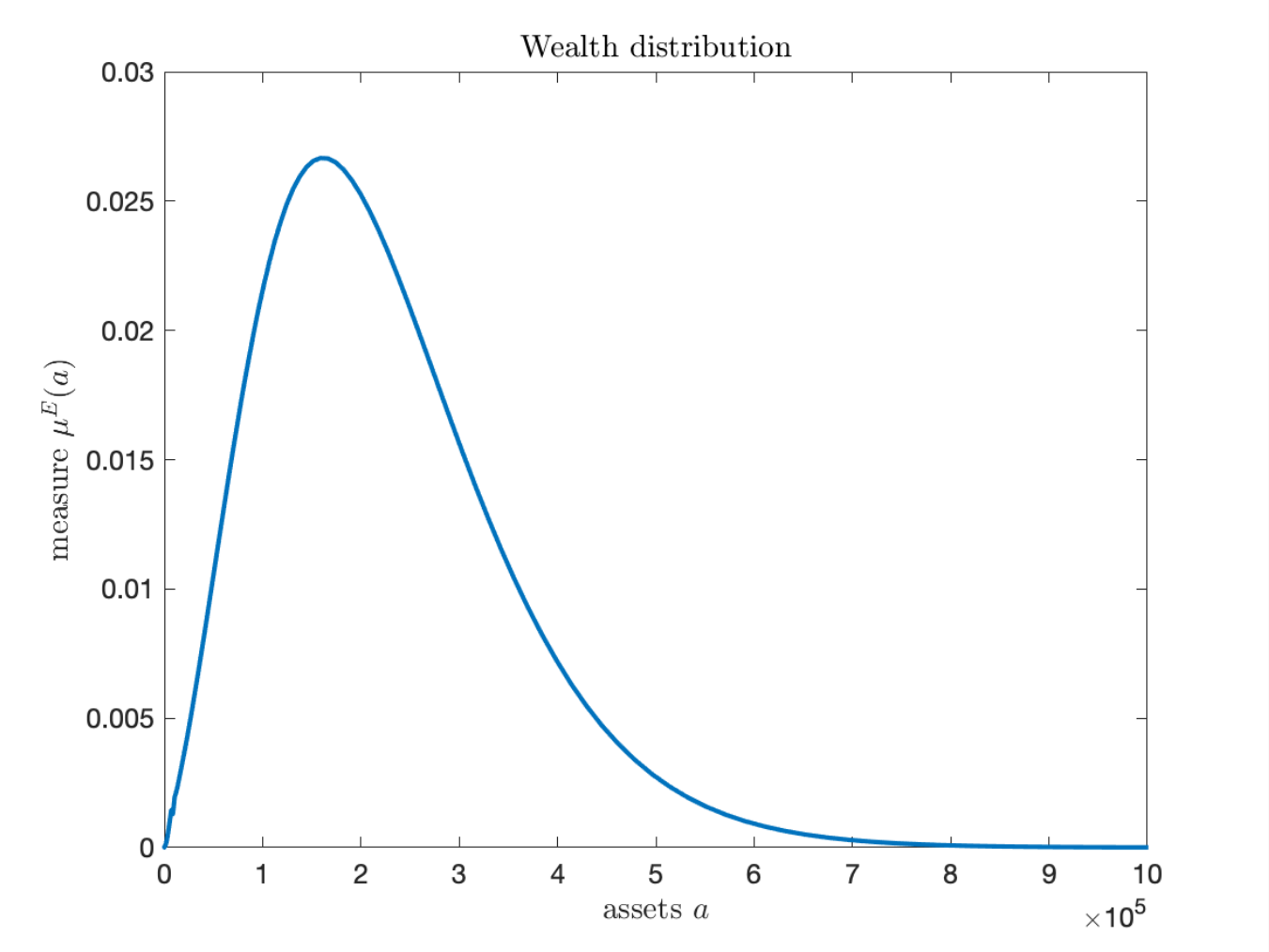


**Figure 2:** Wealth distribution

# Quantitative exercise

Simple quantitative exercise: shut down the idiosyncratic component.

| Moments | Baseline | No shock |
|---|---|---|
| Unemployment rate | 5.25% | 5.18% |
| EU flows | 2.23% | 2.35% |
| UE flows | 2.23% | 2.35% |
| EE flows | 7.27% | 5.12% |
| Mean effort U | 4.49 | 5 |
| Mean effort E | 1.05 | 0.7 |

**Table 5:** Comparative statics

# Conclusions and To do list

- Intuitive story about non-asset insurance using on-the-job search
- This may help understand: (i) why on-the-job searchers get dismissed; (ii) why job movers take wage cuts.
- Use SCE data to calibrate and provide some empirical evidence.
- Calibration is preliminary.
- Find out implications for: (i) precautionary savings / capital market participation; (ii) wage growth under layoff risk

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